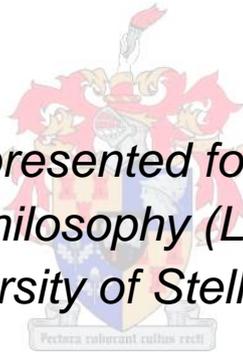


# THE DEVELOPMENT OF AN INTEGRATED SUPPLY CHAIN COMPETENCY MODEL

by

Willem Wouter Cilliers

*Dissertation presented for the Degree  
Doctor of Philosophy (Logistics) at  
the University of Stellenbosch*



Supervisor: Prof Johannes Jacobus Louw  
Co-supervisor: Prof Dirk Johannes Malan

December 2015

## **Declaration**

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

December 2015

## Acknowledgements

I wish to express my gratitude towards:

- God Almighty for granting me the grace and providing me with the capability to complete this study;
- Melani Prinsloo for her constant help, motivation, inspiration and allowing me the time to complete this work;
- Professor Johan Louw for his patience, guidance and contribution towards the research;
- Professor Johan Malan for his guidance and leadership towards completing the research.

## Abstract

Supply chain management is an important contributor to business performance, both financially and in terms of customer service. This is proven by various research reports, ranging from industry research, such as the Gartner Top 25 Supply Chains, an annual study of the world's top supply chains, to academic research which modelled the financial impact of superior supply chain capabilities.

The focus of supply chain management was traditionally on the infrastructure, processes and technology. The people side of supply chain management was overlooked and under researched. A global shortage of talent resulting in an increased focus on human capital and the development of talent contributed towards the focus.

A shift in human capital management towards a competency-based approach further contributed towards competency modelling as a key instrument for developing talent. This resulted in many organisations developing competency models. Previous research over 18 months across multiple organisations resulted in a best practice framework for competency modelling. This framework was also used to develop the competency model for the world's biggest human capital industry association.

The development of competency modelling in the supply chain is in its early stages of development. This is supported by limited research on the subject and various models being developed, but all from different perspectives and with different limitations if compared to the best practice framework for competency modelling.

The first objective of the research was to develop an integrated supply chain competency model by integrating various models into a single model using the principles of model development. This model was then tested through two phases of Delphi research using two different teams of experts. Once confirmed, the competency model was further enhanced by developing a competency measurement instrument.

The competency model was then applied in a multi-national supply chain company using the case-study research methodology. Testing the application of a competency model across multiple companies through survey research was not practical. A sample of job incumbents was selected, who completed an on-line competency assessment. The quality of questions was analysed through discriminative analysis and all poor quality questions were deleted. The balance of the questions was used to assess the level of competency of the job incumbents. A limited contribution towards existing knowledge on supply chain competency modelling was made. The conceptual model can

be further tested empirically and the first version of the on-line assessment can be improved through further testing.

## Opsomming

Voorsieningskettingbestuur is 'n belangrike bydraer tot die maatskappy se prestasie, beide finansiëel en in terme van kliëntediens. Dit is bewys deur verskeie navorsingsverslae, wat wissel van die industrie navorsing, soos die Gartner Top 25 voorsieningskettings, 'n jaarlikse studie van die wêreld se top voorsienings kettings, akademiese navorsing wat die finansiële impak van gevorderde voorsieningskettingbestuur illustreer. Die fokus van voorsienings-kettingbestuur was tradisioneel op infrastruktuur, prosesse en tegnologie. Die menslike hulpbron aspek is grootliks oor die hoof gesien en gevolglik ook nie baie nagevors nie. 'n Wêreldwye tekort aan talent en die ontwikkeling van talent, het nog 'n groter fokus geplaas op bydrae van menslike kapitaal tot suksesvolle voorsieningskettingbestuur.

'n Verskuiwing in die fokus van menslike kapitaalbestuur na 'n bevoegdheidsgebaseerde benadering het verder bygedra tot bevoegdheidsmodellering as 'n belangrike instrument vir die ontwikkeling van talent. Dit het gelei tot die ontwikkeling van baie organisasie bevoegdheidsmodelle. Vorige navorsing oor 'n periode van 18 maande met bydraes van verskeie organisasies het die basis geskep vir die ontwikkeling van 'n raamwerk vir die beste praktykte vir bevoegdheidsmodellering. Hierdie raamwerk is ook gebruik om die bevoegdheidsmodel vir die wêreld se grootste menslike kapitaal industrie assosiasie te ontwikkel.

Die ontwikkeling van bevoegdheidsmodellering in voorsieningskettingbestuur is in die vroeë stadiums van ontwikkeling. Dit word ondersteun deur beperkte navorsing oor die onderwerp. Die modelle wat wel ontwikkel is, het verskillende uitgangspunte as basis en het verskillende beperkings indien dit vergelyk word met die beste praktyk raamwerk vir bevoegdheidsmodellering.

Die eerste doelwit van die navorsing was om 'n geïntegreerde bevoegdheid model vir voorsieningskettingbestuur te ontwikkel deur die integrasie van verskeie modelle met behulp van die beginsels van modelontwikkeling. Hierdie model is getoets en bevestig deur twee fases van "Delphi" navorsing met behulp van verskillende spanne van kundiges. As 'n tweede doelwit is die bevoegdheidsmodel verder ontwikkel met die byvoeging van 'n instrument vir die meting van bevoegdheid.

As deel van die derde doelwit is die bevoegdheidsmodel in 'n volgende fase van die navorsing toegepas in 'n multi-nasionale maatskappy wat spesialiseer in voorsieningskettingbestuur met behulp van die gevallestudie-navorsingsmetodologie. Die toets van die toepassing van 'n bevoegdheidsmeetingsmodel oor verskeie maatskappye deur middel van opname navorsing was nie prakties nie. 'n Steekproef van toepaslike poste en die bekleërs daarvan is gekies om 'n aanlyn bevoegdheidsassessering te voltooi. Die diskriminerende waarde van items is ontleed en alle swak

gehalte vrae is verwyder. Die balans van die vrae is gebruik om die vlak van bevoegdheid van die posbekteërs te evalueer. Hoewel die struktuur van die model nie finaal bevestig kon word deur faktoranalise nie, is die betroubaarheid bevestig deur die analise van die individuele items. Hoewel die model nie 'n finale model is nie, en verdere navorsing nodig is om dit finaal te bevestig, het dit wel 'n bydrae gemaak tot bestaande kennis oor bevoegdheidsmodellering in voorsieningskettingbestuur.

## Table of contents

<b>Declaration</b>	<b>ii</b>
<b>Acknowledgements</b>	<b>iii</b>
<b>Abstract</b>	<b>iv</b>
<b>Opsomming</b>	<b>vi</b>
<b>List of figures</b>	<b>xvi</b>
<b>List of tables</b>	<b>xix</b>
<b>List of acronyms and abbreviations</b>	<b>xxi</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1. BACKGROUND	1
1.2. PROBLEM STATEMENT	2
1.3. RESEARCH QUESTIONS	3
1.4. OBJECTIVES OF THE RESEARCH	4
1.5. RESEARCH APPROACH AND METHODOLOGY	4
1.6. DEMARCATION OF THE STUDY	5
1.7. STRUCTURING OF THE THESIS	6
<b>CHAPTER 2 HUMAN CAPITAL MANAGEMENT: A MODERN APPROACH</b>	<b>10</b>
2.1. INTRODUCTION	11
2.2. TOWARDS A DEFINITION OF HUMAN CAPITAL MANAGEMENT	12
2.3. THE KEY TRENDS AFFECTING HUMAN CAPITAL MANAGEMENT	14
2.3.1. Globalisation	14
2.3.2. Skills shortage	15
2.3.3. Growth in social media	15
2.3.4. Hyper connectivity	16
2.3.5. Changes in the profile of human capital	16
2.3.6. Big data	17
2.3.7. Cloud computing	19
2.3.8. E-learning and mobile technology	19
2.4. THE MODERN APPROACH TOWARDS MANAGING HUMAN CAPITAL	19
2.4.1. A more strategic approach towards human capital	21

2.4.2.	A competency-based approach	25
2.4.3.	A focus on global talent management	27
2.4.4.	The impact of social media	28
2.4.5.	Collaboration: A new way of work	29
2.4.6.	The creation of a new learning ecosystem	31
2.4.7.	Advancement of analytics	33
2.5.	CONCLUDING COMMENTS	35
<b>CHAPTER 3</b>	<b>COMPETENCY DEVELOPMENT: A LITERATURE REVIEW</b>	<b>39</b>
3.1.	INTRODUCTION	40
3.2.	DEFINITION OF A COMPETENCY	40
3.3.	DEFINING COMPETENCY MODELS	42
3.4.	THE ROLE OF COMPETENCIES	44
3.4.1.	Types of competency modelling	44
3.4.2.	Strategic focus	45
3.4.3.	Other applications	46
3.5.	A REVIEW OF EXISTING COMPETENCY MODELS	47
3.5.1.	The Saville & Holdsworth Ltd (SHL) model	47
3.5.2.	The Competency Model Clearinghouse	49
3.5.3.	The Human Resource competency model	51
3.6.	DEVELOPING COMPETENCY MODELS	56
3.6.1.	Consider the organisational context	57
3.6.2.	Dynamic capabilities as the core driver	57
3.6.3.	Involvement of the executive team	58
3.6.4.	Linking competency models to organisational goals and objectives	59
3.6.5.	The link with the organisational structure	61
3.6.6.	Using rigorous job analysis methods to develop competencies	61
3.6.7.	Considering future-orientated job requirements	62
3.6.8.	Using additional unique methods	62
3.6.9.	Defining the anatomy of a competency	63
3.6.10.	Defining levels of proficiency	64
3.6.11.	Using organisational language	65
3.6.12.	Using both fundamental and technical competencies	66
3.6.13.	Using competency libraries	66
3.6.14.	Achieving the proper levels of granularity	67

3.6.15. Using diagrams, pictures and heuristics to communicate models to employees	67
3.6.16. Using organisational development techniques to ensure competency modelling acceptance and use	68
3.6.17. Using competencies to develop HR systems	69
3.6.18. Using competencies to develop a practical theory of effective job performance tailored to the organisation	70
3.6.19. Using information technology to enhance the usability of competency models	71
3.6.20. Maintaining the currency of competency over time	72
3.6.21. Using competency modelling for legal defensibility	73
<b>3.7. CONCLUDING COMMENTS</b>	<b>73</b>

## **CHAPTER 4 SUPPLY CHAIN COMPETENCY MANAGEMENT: A LITERATURE REVIEW**

**75**

4.1. INTRODUCTION	76
4.2. TRADITIONAL DEVELOPMENT	76
4.3. NEW SUPPLY CHAIN MODELS	78
4.3.1. The Lambert model	78
4.3.2. Supply Chain Consortium model	80
4.3.3. Supply Chain 2020	82
4.3.4. Strategic alignment model	83
4.3.5. Demand-driven supply networks	85
4.3.6. American Quality and Productivity Centre	87
4.3.7. The Supply Chain Council	89
4.3.7.1. Performance metrics	89
4.3.7.2. Process models	90
4.3.7.3. Best practices from the SCOR model	95
4.3.7.4. People	95
4.4. SUPPLY CHAIN COMPETENCIES: A REVIEW OF PREVIOUS RESEARCH	96
4.4.1. Supply Chain Capabilities	98
4.4.2. Dynamic Supply Chain Capabilities	104
4.4.3. The Supply Chain Talent Academic Initiative	107
4.4.4. The competency model of APICS	108
4.4.5. Developing a supply chain management program: A competency model	110

4.4.6.	Transportation, distribution, and logistics competency model of the Competency Clearinghouse	116
4.4.7.	Competence System from European Certification Board for Logistics	118
4.4.8.	Curriculum Model Accenture	120
4.4.9.	Supply chain talent: State of the discipline	121
4.5.	CONCLUSION	125
<b>CHAPTER 5</b>	<b>RESEARCH DESIGN AND METHODOLOGY</b>	<b>130</b>
5.1.	INTRODUCTION	131
5.2.	PROBLEM STATEMENT	131
5.3.	OBJECTIVES OF THE RESEARCH	132
5.4.	RESEARCH DESIGN & METHODOLOGY	133
5.4.1.	Phase 1: The development of a supply chain competency model	135
5.4.1.1.	Guidelines followed	135
5.4.1.2.	Process Followed	137
5.4.1.3.	Techniques applied	138
5.4.1.4.	Quality of results	140
5.4.2.	Phase 2: The development of a supply chain competency measurement instrument	141
5.4.2.1.	Research approach	141
5.4.2.2.	Data collection approach	142
5.4.2.2.1.	Different types of case studies	142
5.4.2.2.2.	Guidelines for designing case studies	144
5.4.2.2.3.	Quality tests for case studies	145
5.4.2.2.4.	Case-study design guidelines	147
5.4.2.2.5.	Developing a case-study protocol	147
5.4.2.2.6.	Principles for collecting evidence	149
5.4.2.2.7.	Analysis of evidence	152
5.4.2.2.8.	Analytic techniques	153
5.4.2.3.	Application of the research design: The case study design	154
5.4.2.4.	The development of a competency measurement instrument	156
5.4.2.4.1.	Assessment requirement	157
5.4.2.4.2.	Assessment approach:	157
5.4.2.4.3.	Item development	161

5.4.2.4.4.	Item screening	161
5.4.2.4.5.	Pre-test	161
5.4.2.4.6.	Quality of results:	162
5.4.3.	Phase 3: The application of the measurement instrument	162
5.4.3.1.	Methodology	162
5.4.3.2.	Sample	163
5.4.3.3.	Data collection	163
5.4.3.4.	Data analysis	164
5.4.3.5.	Quality of results:	164
5.5.	ANTICIPATED VALUE OF THE RESEARCH	165
5.6.	LIMITATIONS OF THE RESEARCH	165

## **CHAPTER 6 THE DEVELOPMENT OF A CONCEPTUAL SUPPLY CHAIN COMPETENCY MODEL**

		<b>167</b>
6.1.	INTRODUCTION	168
6.2.	THE PROCESS OF CREATING A CONSOLIDATED SUPPLY CHAIN COMPETENCY MODEL	168
6.3.	PHASE 1: INTEGRATING THE CORE ELEMENTS INTO A SINGLE SUPPLY CHAIN MODEL	170
6.4.	PHASE 3: INTEGRATING THE DIFFERENT COMPETENCY MODELS AND RESEARCH	177
6.5.	PHASE 4: DELPHI TESTING OF THE MODEL – ROUND 2	189
6.5.1.	The integrative processes	190
6.5.2.	The functional execution layer	190
6.5.3.	The support and enablement layer	191
6.5.4.	Delphi testing round two	191
6.6.	A MORE DETAILED OUTLINE OF THE COMPETENCY MODEL	195
6.6.1.	Meta-competency 1: Product and portfolio management	195
6.6.2.	Meta-competency 2: Supply chain strategy	196
6.6.3.	Meta-competency 3: Sales and operations planning	197
6.6.4.	Meta-competency 4: Demand execution management	198
6.6.5.	Meta-competency 5: Transport & Logistics	199
6.6.6.	Meta-competency 6: Make	201
6.6.7.	Meta-competency 7: Warehousing and facilities management	202
6.6.8.	Meta-competency 8: Procurement	203

6.6.9.	Meta-competency 9: Green supply chain management	204
6.6.10.	Meta-competency 10: Performance management	204
6.7.	CONCLUSION	207
<b>CHAPTER 7 THE DEVELOPMENT OF A SUPPLY CHAIN</b>		
<b>COMPETENCY MEASUREMENT INSTRUMENT</b>		<b>208</b>
7.1.	INTRODUCTION	209
7.2.	THE REQUIREMENT FOR LEVELS OF PROFICIENCY	209
7.3.	FOUNDATION	209
7.4.	AN OVERVIEW OF BLOOM'S TAXONOMY: THE ORIGINAL MODEL	210
7.5.	REVISED BLOOM'S TAXONOMY	211
7.5.1.	The knowledge dimension (vertical axis)	212
7.5.2.	The cognitive process dimension (horizontal axis)	214
7.6.	APPLICATION TO THE SUPPLY CHAIN COMPETENCY MODEL	216
7.6.1.	The knowledge domain	216
7.6.2.	The cognitive process dimension	217
7.7.	INTEGRATION AND CONSOLIDATION OF BEST PRACTICES	220
7.8.	LEVELS OF PROFICIENCY FOR THE SUPPLY CHAIN COMPETENCY MODEL	221
7.8.1.	Meta-competency 1: Product and portfolio management	221
7.8.2.	Meta-competency 2: Supply chain strategy	222
7.8.3.	Meta-competency 3: Sales and operations planning	226
7.8.4.	Meta-competency 4: Demand execution management	230
7.8.5.	Meta-competency 5: Transport & Distribution	232
7.8.6.	Meta-competency 6: Make	237
7.8.7.	Meta-competency 7: Warehousing and facilities management	241
7.8.8.	Meta-competency 8: Procurement execution	244
7.8.9.	Meta-competency 9: Green supply chain management	245
7.8.10.	Meta-competency 10: Performance management	246
7.9.	CONCLUDING COMMENTS	252
<b>CHAPTER 8 THE APPLICATION OF THE SUPPLY CHAIN COMPETENCY MODEL</b>		<b>254</b>
8.1.	INTRODUCTION	255
8.2.	THE COMPANY SELECTED FOR THE CASE STUDY	255

8.3.	DETERMINING THE STRATEGIC CONTEXT OF THE ASSESSMENT	256
8.3.1.	Targeted industry verticals	257
8.3.2.	Supply chain offerings	257
8.3.3.	Supply chain challenges	258
8.4.	THE ASSESSMENT REQUIREMENTS	258
8.5.	FURTHER DEVELOPMENT OF THE COMPETENCY ASSESSMENT	263
8.5.1.	Practical guidelines	264
8.5.2.	Research guidelines	265
8.5.3.	The assessment questions	266
8.5.3.1.	Scenario-based assessment	266
8.5.3.2.	Assessment questions	268
8.5.3.3.	An example of an assessment scenario	269
8.5.3.4.	Technology enablement	272
8.6.	RESULTS OF THE ASSESSMENT	272
8.6.1.	Perception-based assessment	272
8.6.1.1.	Results of the paper-based assessment	272
8.6.2.	The online assessment	277
8.6.2.1.	Testing	277
8.6.2.2.	Respondents	277
8.6.2.3.	Analyses: Quality of questions	279
8.6.2.4.	Calculating the competency scores	281
8.7.	CONCLUSIONS	284
8.7.1.	The research strategy selected	284
8.7.2.	Competency assessment requirements	284
8.7.3.	The competency assessment instruments	285
<b>CHAPTER 9</b>	<b>CONCLUSIONS AND RECOMMENDATIONS</b>	<b>287</b>
9.1.	INTRODUCTION	288
9.2.	RESEARCH PROBLEM	288
9.3.	RESEARCH OBJECTIVES:	289
9.4.	CONCLUSIONS, LIMITATIONS OF THE RESEARCH AND IMPLICATIONS FOR FUTURE RESEARCH	290
9.4.1.	A best practice framework for developing competency models	290

9.4.2.	Development of an integrated supply chain competency model	292
9.4.3.	The development of a measurement instrument for measuring supply chain competency	293
9.4.4.	The application of the competency measurement instrument	294
9.5.	IMPLICATIONS FOR FUTURE RESEARCH	295
9.6.	INTEGRATING THE SUPPLY CHAIN COMPETENCY MODEL INTO A BROADER COMPETENCY MODEL	298
	<b>REFERENCES</b>	<b>300</b>
	<b>APPENDIX A: DETAIL INFORMATION ON THE COMPETENCY MODEL OF THE COMPETENCY CLEARINGHOUSE</b>	<b>313</b>
	<b>APPENDIX B: BEST PRACTICES IDENTIFIED FROM THE SCOR MODEL AND THE PROCESS STANDARDS FROM THE COUNCIL FOR SUPPLY CHAIN MANAGEMENT</b>	<b>320</b>
	<b>APPENDIX C: EXAMPLE OF QUESTIONNAIRE USED FOR DELPHI STUDY IN SECOND ROUND</b>	<b>333</b>
	<b>APPENDIX D: DETAIL OF THE SIZE OF INCUMBENTS BY POSITION GAUTENG REGION ONLY</b>	<b>339</b>
	<b>APPENDIX E: EXAMPLE OF JOB PROFILE</b>	<b>340</b>
	<b>APPENDIX F: EXAMPLE OF COMPETENCY PROFILE</b>	<b>342</b>
	<b>APPENDIX G: RESULTS OF QUALITY ASSESSMENT OF QUESTIONS</b>	<b>345</b>

## List of figures

Figure 1.1: Conceptual positioning of subjects	5
Figure 1.2: Demarcation of the study	9
Figure 2.1: Traditional human resource management	13
Figure 2.2: Elements of the dynamic alignment business model	24
Figure 2.3: Dynamic capabilities, their interaction with knowledge and learning and how they affect operational capabilities	25
Figure 2.4: The potential impact of social media	29
Figure 2.5: The growth of the global networked organisation	31
Figure 2.6: A social learning ecosystem	32
Figure 2.7: Segmentation of human capital	34
Figure 2.8: Human capital segmentation based on scarcity	34
Figure 2.9: Evolution of analytics maturity	35
Figure 2.10: Overview of modern human capital management	38
Figure 3.1: Competencies defined	40
Figure 3.2: The proposed typology comprising eight different types of competencies	42
Figure 3.3: Types of competency modelling	45
Figure 3.4: The application of a competency model in competency development	47
Figure 3.5: The competency model from Competency Model Clearinghouse	50
Figure 3.6: Competency definition	54
Figure 3.7: Capability development process	57
Figure 3.8: Process of developing the competency framework	58
Figure 3.9: A Draft competency model that evolved into a tailored organisational model	60
Figure 3.10: Translating the competency framework into specific requirements	61
Figure 3.11: Levels of competencies	68
Figure 3.12: Using infographics with competency modelling	70
Figure 3.13: Competency management system	72
Figure 4.1: The traditional supply chain	77

Figure 4.2: Modern supply chain management	78
Figure 4.3: Integrating and managing business processes across the supply chain	79
Figure 4.4: Supply Chain Consortium best practices framework	81
Figure 4.5: Supply Chain 2020 framework for excellent supply chains	83
Figure 4.6: Gattorna elements for alignment	84
Figure 4.7: Gattorna supply chain alignment model	85
Figure 4.8: Elements that support demand driven supply networks	87
Figure 4.9: Process configuration framework	88
Figure 4.10: Supply Chain Council defined process categories	90
Figure 4.11: SCOR model – Core processes	91
Figure 4.12: Product and portfolio management processes	92
Figure 4.13: Design chain processes	93
Figure 4.14: Supply chain processes for sales and support	94
Figure 4.15: Multi-level processes model	94
Figure 4.16: Supply chain 2000 framework	98
Figure 4.17: A First Model of Dynamic Supply Chain Capabilities	105
Figure 4.18: A Further Model of Dynamic Supply Chain Capabilities	106
Figure 4.19: The Supply Chain Talent Academic Initiative	107
Figure 4.20: Supply chain talent initiative research	108
Figure 4.21: APICS competency model	109
Figure 4.22: Competency model of Clearinghouse	118
Figure 4.23: European Board for Logistics Competence System	119
Figure 4.24: Curriculum of the Accenture Supply Chain Academy	120
Figure 4.25: AMR supply chain talent attribute model	122
Figure 4.26: Sub-attributes within talent stations – Functional	123
Figure 4.27: Sub-attributes within talent stations - Enablement	124
Figure 4.28: Gartner dual supply chain focus model	125
Figure 5.1: Construct development methodology	134

Figure 5.2: The derivation of the guidelines for good theory	135
Figure 5.3: Different case-study designs	144
Figure 5.4: Convergence of evidence	151
Figure 5.5: Maintaining a chain of evidence	152
Figure 5.6: Construct development methodology stage II	157
Figure 5.7: The wheel of competency testing	158
Figure 5.8: Stage III of construct development	162
Figure 6.1: The process of integrating the different elements into an integrated model	169
Figure 6.2: First version supply chain competency model	185
Figure 6.3: The second version supply chain competency model	189
Figure 7.1: The cognitive domain of the Bloom taxonomy	211
Figure 7.2: The revised Bloom taxonomy	212
Figure 8.1: Creating context for supply chain competency assessments	256
Figure 8.2: Summary of statistical analysis for perception-based assessment: Importance	275
Figure 8.3: Summary of statistical analysis for perception-based assessment: Competency ratings	276
Figure 8.4: Overall competency scores	281
Figure 8.5: Competency scores by meta-competency	282
Figure 8.6: Competency scores based on the competency model	283
Figure 9.1: A different approach towards competency development	296
Figure 9.2: An integrated approach towards supply chain competency development	296
Figure 9.3: An integrated competency model – Detailed	299

## List of tables

Table 2.1: A comparison of personnel, human resource and human capital management	20
Table 2.2: A changing approach towards managing human capital	21
Table 2.3: A conceptualisation of dynamic capabilities	23
Table 2.4: Core competencies versus workplace competencies	27
Table 2.5: The impact of key driving forces on human capital management	36
Table 3.1: A summary of different perspectives on competencies	41
Table 3.2: Key differences between competency modelling and job analysis	43
Table 3.3: Competency modelling terminology	44
Table 3.4: The application of competency models	46
Table 3.5: The SHL “great eight” managerial competencies	48
Table 3.6: Elements of competency definition	52
Table 3.7: An example of proficiency standards	53
Table 3.8: Proficiency definitions for levels 1 and 2	55
Table 3.9: Proficiency definitions for levels 3 and 4	56
Table 3.10: The anatomy of a competency	64
Table 3.11: Example of definition of levels of proficiency	65
Table 3.12: Best practices in competency modelling	74
Table 4.1: Alignment of performance attributes with performance metrics	89
Table 4.2: Practice categories	95
Table 4.3: Core competencies versus workplace competencies	97
Table 4.4: Supply Chain Capabilities	99
Table 4.5: Further Research on additional Supply Chain Capabilities	100
Table 4.6: Categorisation of Supply Chain Capabilities	103
Table 4.7: Supply chain models: A comparison based on competency requirements	126
Table 4.8: Supply chain competency models: A comparison based on competency requirements	127
Table 5.1: A summary of the guidelines for evaluating empirical theory building	136

Table 5.2: Test for scientific research	146
Table 5.3: Typical case-study protocol	148
Table 5.4: Sources of evidence	149
Table 5.5: The application of the case-study protocol	154
Table 6.1: A consolidation of the different supply chain models	170
Table 6.2: A consolidation of supply chain competencies	177
Table 6.3: The supply chain competency model version 1	185
Table 6.4: Delphi results	192
Table 6.5: Alignment of performance attributes with performance metrics	205
Table 7.1: Bloom's revised taxonomy	212
Table 7.2: Application of the revised Bloom taxonomy to the supply chain proficiency levels	217
Table 7.3: Cognitive process dimension	218
Table 7.4: Translation of Bloom's taxonomy to the different competency levels	220
Table 8.1: Example of a job profile	259
Table 8.2: Rating of procedure for job analysis and competency profiling	261
Table 8.3: An example of a competency profile	262
Table 8.4: The application of competency assessment guidelines	265
Table 8.5: Allocation of question type to levels of proficiency	269
Table 8.6: Scenario example from the assessment	269
Table 8.7: The classification of each scenario	270
Table 8.8: Example of questions	270
Table 8.9: Results of paper-based assessment: Importance of competencies	273
Table 8.10: Competency rating scores	274
Table 8.11: Respondents by region	278
Table 8.12: Respondents by job title	278
Table 8.13: Summary of discrimination analyses	280
Table 9.1: Best practices for competency modelling	291

## List of acronyms and abbreviations

AMR	Advanced Manufacturing Research
APICS	American Production and Inventory Control Society
ATIS	Advanced Traveller Information Systems
ATP	Available to Promise
B2B	Business-to-business
B2C	Business to customer
BI	Business Intelligence
BOM	Bill of Material
CAD	Computer Aided Design
CCE	concurrent/collaborative engineering
CEOs	Chief Executive Officers
CPFR	Collaborative Planning, Forecasting, Replenishment
CRM	Customer Relationship Management
CTP	Capable to Promise
DCOR	Design-Chain Operations Reference model
DDSN	Demand-driven supply networks
DFMA	Design for manufacture and assembly
DRP	Distribution requirements planning
ECR	Efficient consumer response
EDI	Electronic data interchange
EFT	Electronic funds transfer
EHS	Environmental health and safety
ELA	European Logistics Association
ERP	Enterprise resource planning
FIFO	First-in-first-out
FMEA	Failure mode and effects analysis
FTSE	Financial Times Stock Exchange
GIS	Geographic Information Systems
GLS	Global Logistics Systems
HR	Human Resources
HRM	Human Resource Management
IP	Internet Protocol
ISO	International Organization for Standardization
IT	Information technology
ITS	Intelligent Transportation Systems

JIT	Just-in-time systems
JSA	Joint service agreements
KSAOs	Knowledge, Skills, Abilities, and Other characteristics
LMS	Learning management system
MBTI	Myers–Briggs Type Indicator
MDS	Master Demand scheduling
MPS	Master Production scheduling
MRP	Material requirements planning
PPE	Personal protective equipment
QFD	Quality function deployment
R&D	Research and development
RFX	Request for Information, Proposal or Quotation
RFID	Radio Frequency Identification
RFQ	Request for quotation
S&OP	Sales and operations planning
SCM	Supply chain management
SCOR	Supply-Chain Operations Reference model
SHL	Saville & Holdsworth Ltd
SHRM	Society for Human Resource Management
SIOP	Society for Industrial Organizational Psychology
SKU	Stock keeping unit
SM	Strategic Management
SME	Small and medium enterprises
SPC	Statistical process control
TCO	Total cost of ownership
TMS	Transportation Management Systems
TQM	Total Quality Management
UCF	Universal Competency Framework
UCFD	Universal Competency Framework Database
UK	United Kingdom
US	United States
VMS	Vehicle Monitoring Systems
WIP	Work in progress
WMS	Warehouse Management Systems

# CHAPTER 1

## INTRODUCTION

### 1.1. BACKGROUND

Supply chain management is a key contributor towards the improvement of business performance. The direct relationship between supply chain competence and company performance was confirmed by a number of research articles (Bowersox, Closs & Stank, 1999). An analysis of the Top 25 Supply Chains, a study conducted annually by Gartner, showed that an investment in these companies yielded an average return of 17.89 percent in 2007 compared with returns of 6.43 percent for the Dow Jones Industrial Average and 3.53 percent for the Standard and Poor 500 (Frischia, O'Marah, Hofman & Souza, 2009). This was reconfirmed in the most recent study of the Top 25 Supply Chains in the research of Gartner (Hofman, Aronow & Nilles, 2013). The positive contribution of supply chain management capability to improved customer satisfaction, another key business performance indicator, was confirmed by the work of Ellinger, Shin, Northington, Adams, Hofman and O'Mahra (2012).

Supply chain management has grown and evolved significantly over the last number of years and has become a strategic priority for most businesses. In defining supply chains, one aspect that is often overlooked and underestimated is the human element. Definitions mostly focus on elements such as infrastructure, processes, technology and collaboration between supply chain partners.

This was confirmed by John Gattorna (2006: 6), who stated, "*It is best to stop thinking of supply chains as a 50:50 mix of infrastructure and information systems technology. Start thinking of the ideal mix as more like 45/45/10 – human behaviour, systems technology and asset infrastructure*".

In a study conducted by Apics on "Mapping the Future of the Strategic Supply Chain", talent management and leadership were identified as one of the five most important issues facing supply chain managers in 2010 and beyond (Melnyk, Lummus, Vokurka & Sandor, 2006). Hofman *et al.* (2013) identify supply chain talent management as one of the key strategies of the supply chain leaders. In a more recent study of top supply chain pains, a lack of talent was identified as the second most important cause of pain in supply chains.

The strategic importance of talent management is not only a key supply chain issue. A global shortage of talent is identified by multiple sources. Global shortages of talent are reported across various continents. Global talent management is increasingly becoming a source of competitive advantage. Human capital management is focusing more on competency-based management as an approach towards developing global talent pools. A competency-based approach towards human capital management places more emphasis on the development of competency models

and assessment as mechanisms to improve talent development. This is supported by the recent development of a competency model by the Human Resource Society, a leading industry association for human capital management.

Getting the maximum return from human capital requires the measurement and improvement of competency. Without measurement, the existing levels of competency are unknown and creating a match between competency requirements and competency levels remains a difficult challenge. This principle is supported by the extent of research for the development of human characteristics through psychological and psychometrics assessments. It was estimated that companies in the UK spent more than £20 million on psychometric assessments in 2003, and more than 70 percent of companies on the Financial Times Stock Exchange (FTSE) make use of these tests (McHenry, 2003). According to Howard (2008), this figure now stands at 85 percent of the FTSE 100. In the United States, it is suggested that the value of sales of psychometric tests and inventories for recruitment, team and personal development is in excess of 100 million US dollars per year (Harper, 2008). More than 3.5 million people around the world annually complete the Myers-Briggs Type Indicator personality inventory (MBTI) (Briggs Myers, 2000: 5). It is further estimated that more than 5 000 psychometric tests exist in English (Simms, 2007).

In assessing human capital within a supply chain context, the focus needs to be placed on functional competency rather than aptitude or personal traits. A comprehensive literature study of the supply chain theory and research identified only two publications on supply chain competency. The first study was conducted in 1990 and focused on the supply chain competence of companies. Only one further publication since then was identified, which focused more on the development of a supply chain curriculum.

The increased importance of supply chain competency is further supported by the development of competency models by Apics and the Supply Chain Council, both leading supply chain industry associations. These models, however, are based on different fundamental approaches towards supply chain, and have major limitations when evaluated using a best practice guide for competency modelling.

## **1.2. PROBLEM STATEMENT**

Although significant progress has been made in various areas of supply chain management, the human element has not been the focus and has only recently become a strategic focus. Assessing the human element in the supply chain has a functional focus, focusing on the assessment of functional competency rather than personal competency, which is well covered by the wide variety of psychometric assessments. Measuring people's functional supply chain competency is a core problem in the process of developing the human capital part of the supply chain.

In order to measure supply chain competency, a competency model is required on which to base the measurement. The current status concerning a supply chain model is that although various supply chain models are being used, no complete competency model for supply chain is published and available in the public domain.

The implications of not being able to measure supply chain competency are as follows:

- Skills development by training and academic institutions is based on various internally developed models contributing towards different approaches and potential fragmentation of the field.
- Skills development programmes are based on perception-based skills assessments, which has limitations from a validity and reliability perspective.
- Supply chain models such as SCOR provide guidelines for process implementation and best practice, but do not provide the tools for conversion of process requirements into competency and skills requirements.
- People competency as a critical element of supply chain capability and performance is underdeveloped due to the lack of tools such as competency models.
- The supply chain competency research to date is either positioned at the core competence or strategic level, or at a very detailed level for course development.
- The implication is that there is no generally accepted competency model which can be used as a basis for skills development and talent management.

The Apics study (Melnyk *et al.*, 2006) referred to in the previous section supports the fact that skills development or talent management was one of five key priorities identified for supply chain management in 2010 and beyond. With this context to the study, the research objectives will be discussed in section 1.6.

### **1.3. RESEARCH QUESTIONS**

The following research questions were formulated based on the overview of relevant research and literature:

- What would constitute an integrated supply chain competency model?
- What are the guidelines that should be followed in the development of a supply chain competency model?
- Which competency management best practices could be utilized to develop an integrated competency management model?

- How can the level of supply chain competency be measured?
- What are the implications of the findings of the current study for future research and the management of supply chain competencies?

The research questions provided the basis for the formulation of the research objectives in section 1.4.

#### **1.4. OBJECTIVES OF THE RESEARCH**

The purpose of this research was to develop a supply chain competency model that would include the definition of individual supply chain competencies providing the basis for developing an instrument for measuring supply chain competency. The focus of the competency model is on supply chain competencies, thus functional competencies, and not personal traits or characteristics that also form part of a competency model.

More specifically, the objectives of the research were to:

- Develop a supply chain competency model which integrates various supply chain models into a single model, and complies with the best practices for competency modelling. The focus of the competency model is on functional supply chain competencies and not personal traits or characteristics.
- Develop a measurement instrument for measuring functional supply chain competency in line with the competency model.
- Implement the competency model and complete an exploratory assessment to better understand the challenges, complexities and possible solutions during the implementation of a competency model.

These research objectives provided the basis for the formulation of a research approach which is explained in the next section.

#### **1.5. RESEARCH APPROACH AND METHODOLOGY**

A construct development methodology was followed to develop the measurement instrument. This was based on the research of Lewis, Templeton and Byrd (2005) and Siddhartha (2009). In terms of these guidelines, a phased approach was followed.

The first phase in developing a construct is to establish the domain of the idea. This endeavour should produce three items of information: (1) the premise, which specifies the purpose and/or importance of the construct, (2) the conceptual definition, which describes the construct in general or theoretical terms, and (3) a list of dimensions, which represent the elements of the construct. This was done through a literature review followed by two phases of Delphi studies to confirm the

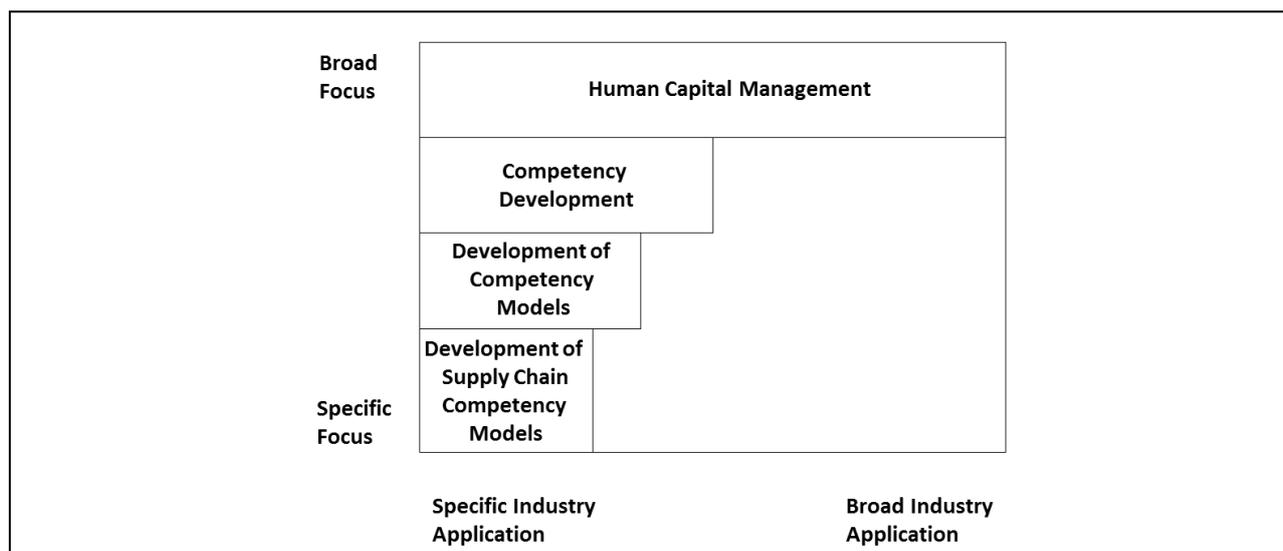
definition of the construct and the dimensions identified. Guidelines for achieving construct validity were applied.

In the second phase of the methodology, a measurement instrument is produced and improved through multiple iterations. To begin, each item statement in the domain should be converted into an item on the instrument. The form of these statements will depend on the nature of the measurement approach and the unit of analysis that will be the target of the instrument. In the third phase of the methodology, data is collected through application of the instrument and the measurement properties of the instrument are assessed and optimised. The case-study research approach was followed in the third phase, where a multinational supply chain company was selected to apply and test the measurement instrument.

The anticipated value of the research is firstly an evaluation of existing supply chain models using a best practice competency modelling framework. A second possible contribution is the development of an integrated supply chain competency model, although only a conceptual model, it is providing the basis for further research. The learning from the application of the measurement model is a third contribution to research on supply chain competency measurement. Although only exploratory research, it provides a set of learnings which can be further researched.

## 1.6. DEMARCATION OF THE STUDY

The first key aspect of structuring the study was to create a conceptual understanding for the different subject areas involved in the theoretical context of the study and to establish how the subject areas relate to each other. This was to provide the basis for the demarcation in terms of the different chapters. This conceptual positioning of the different subject areas is depicted in Figure 1.1.



**Figure 1.1: Conceptual positioning of subjects**

Human capital management is the broad overarching discipline which provides the framework and principles serving as the broad contextual framework for the study. Competency development is a subject area within the field of human capital management. The development of competency models is a sub-area of competency management. The specific application for this study was the development of a competency model for application within the area of supply chain management.

The approach towards the demarcation of the study was based on the same principal design: it started with the contextual positioning of human capital management as a process. With this as a basis, the theory of competency management was reviewed, with more emphasis on the development of competency models. A strong theoretical basis was developed by reviewing various competency models and the principles followed for their development. A review of the current research and development of theory on supply chain competencies provided the basis for developing a supply chain competency model.

## **1.7. STRUCTURING OF THE THESIS**

The structuring of the thesis is based on flow required to support the research approach. The thesis consists of nine chapters that follow a logical sequence.

### **PART 1: INTRODUCTION**

#### **Chapter 1: Introduction**

The introduction creates the context for the study by providing a high-level summary of the existing theory and the potential requirements for further research. The research problem with questions provides the basis for formulating the research objectives. The research approach provides the logical sequence for the structuring of the different chapters.

### **PART 2: REVIEW OF THE THEORY**

#### **Chapter 2: Human capital management – a modern approach**

An overview of the latest developments in managing human capital as a strategic asset is provided in Chapter 2. The traditional approach towards human capital management is contrasted with the more modern approach of human capital management. The key drivers contributing towards these changes are also outlined.

#### **Chapter 3: Competency development: a literature review**

The development of a set of guidelines for competency modelling is the objective of Chapter 3. These guidelines will provide the basis for the evaluation of the existing supply chain competency models which will confirm the research requirement.

**Chapter 4: Supply chain competency management: a literature review**

Different supply chain models are discussed as a basis for understanding the evolution of the theory. Existing research on supply chain competency is reviewed. Supply chain competency models developed by different industry associations are analysed against the competency modelling guidelines developed in Chapter 3. The conclusion of this chapter will confirm the research problem and the need for further research.

**Chapter 5: Research design and methodology**

The research design and methodology address two different research objectives that require different designs and the application of different methodologies. The development of a conceptual competency model is the first research objective. Deductive research guided by the principles for model development is used to develop the conceptual model. The model is then tested through two phases of Delphi research. The second objective is addressed through a case-study research approach to apply the competency model to a case study.

**Chapter 6: The development of a conceptual supply chain competency model**

The different models of supply chain management combined with the existing competency models are integrated through a phased approach into a single conceptual model. The principles of model development are applied in this process. The conceptual model is then tested through two phases of Delphi research. The tested model is further enhanced through adding definitions from the theory to the different competencies in the model.

**Chapter 7: The development of a supply chain competency measurement instrument**

The value of a competency model is limited without the capability to perform competency assessments. Bloom's revised taxonomy is used as a basis for developing proficiency levels that will be used for competency assessment. The research guidelines for developing measurement instruments are applied to the development of an assessment instrument. The measurement is enabled through software that provides an on-line competency assessment.

**Chapter 8: The application of the competency model**

A multinational supply chain company was selected as a case study for the application of the competency model. Strategic context was provided in terms of the industry verticals in which the company competes and the service offerings provided to its clients. A selection of 42 supply chain positions was chosen as the sample for applying the competency model. The job incumbents in the sample all completed on-line assessments which provided the data for further analysis. After data analysis, a number of questions were deleted from the assessment and the balance of the items was used to analyse the level of competence of the job incumbents.

## **Chapter 9: Conclusions and recommendations**

A limited contribution towards the theory of supply chain competency modelling is made through the development of an integrated supply chain competency model. The application of the competency model to a case study provided some valuable learnings. The implications for future research are explained.

This demarcation of the study is outlined in Figure 1.2.

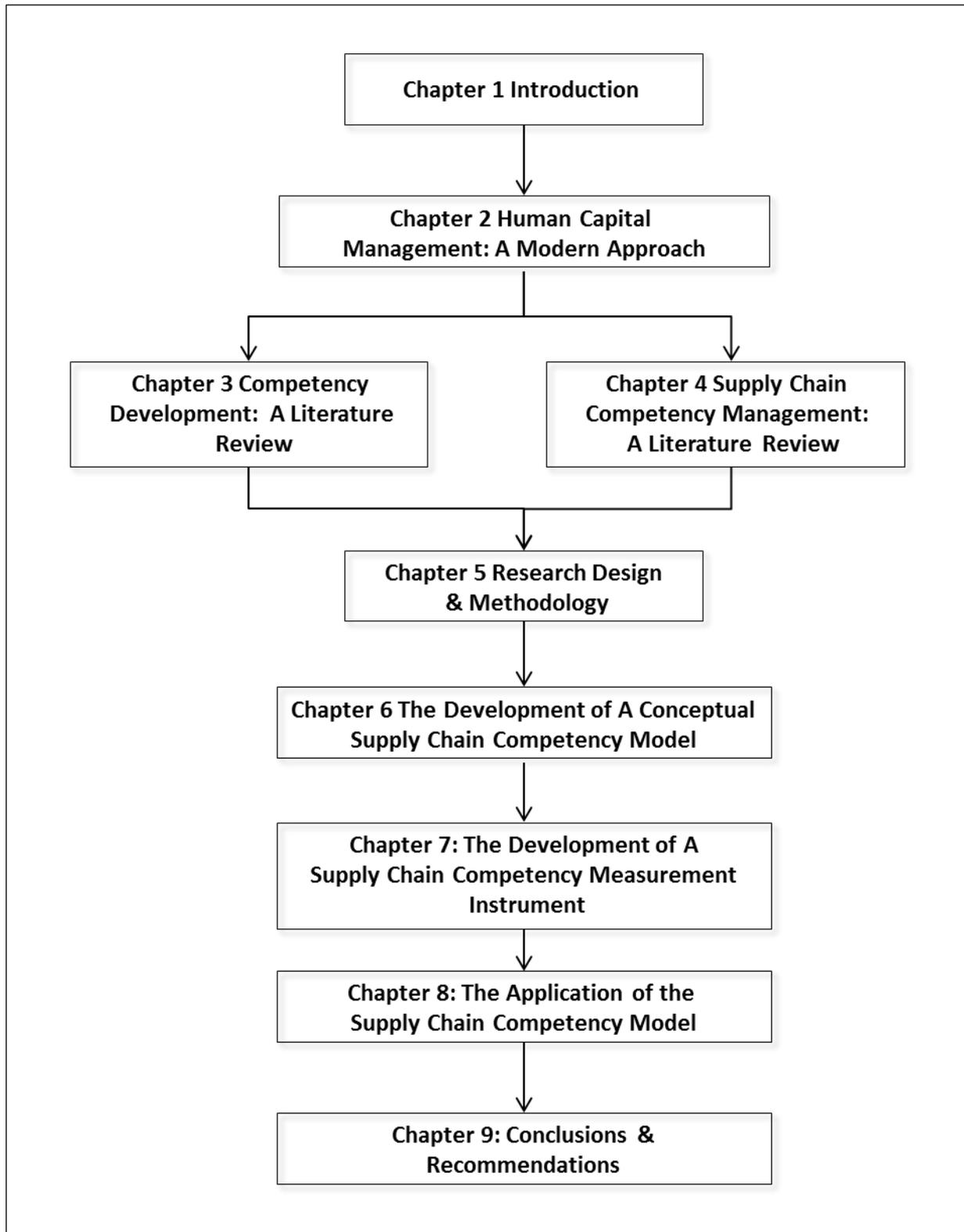
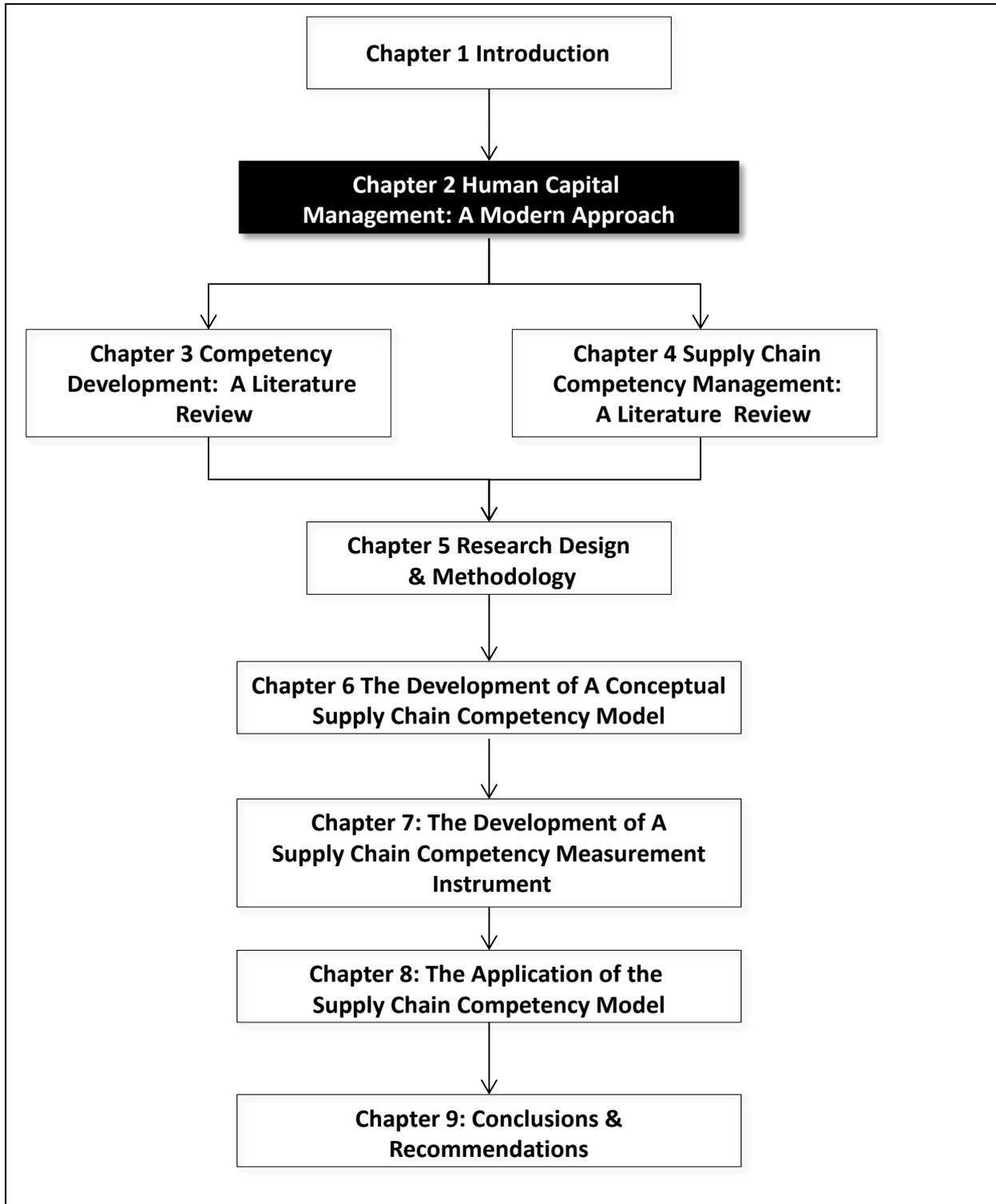


Figure 1.2: Demarcation of the study

## CHAPTER 2

### HUMAN CAPITAL MANAGEMENT: A MODERN APPROACH



## 2.1. INTRODUCTION

Senior executives universally agree that human capital and their capability is nowadays a key differentiator and as such is in the top agenda for implementing interventions. The differentiation potential of processes, infrastructure and technology as a source of competitive advantage was marginalised over the last number years. Today people are a key source of sustainable competitive advantage (Bingham, 2008).

The war for talent is continuing, even in markets experiencing modest growth. According to global research only 15 percent of companies in North America and Asia indicated that the requirement to fill key positions with qualified successors could be met. The scenario in Europe was slightly better with but still less than 30 percent of companies expressed confidence about the quality and amount of talent available. In emerging markets where many companies are focusing their growth strategies, the supply of experienced managers is the most limited, and the shortage is expected to continue for another two decades” (Fernandez-Araoz, Groysberg & Nohria, 2011).

Traditionally organisations have developed employee capabilities through traditional practices such as succession planning, mentoring, coaching and training. The increased pressure for improved performance and reduced cycle times raise new questions about the effectiveness of traditional practices. Organisations increasingly experience that it is more challenging to attract and retain the talent required to realise performance expectations (Bingham, 2008).

The aim of this chapter is to provide an overview of human capital management as a high-level context to this study. The objectives more specifically are to:

- Provide a definition of human capital management.
- Relate human capital management to the traditional human resource management approach.
- Outline the key trends and forces of change that drive a shift towards modern human capital management.
- Provide an overview of modern human capital management.
- Identify competency-based management as a key element of the modern approach towards human capital management.

The purpose of this chapter is not to provide a detailed review of human capital management as a discipline, but rather to provide an overview that should serve as a context to the study.

## 2.2. TOWARDS A DEFINITION OF HUMAN CAPITAL MANAGEMENT

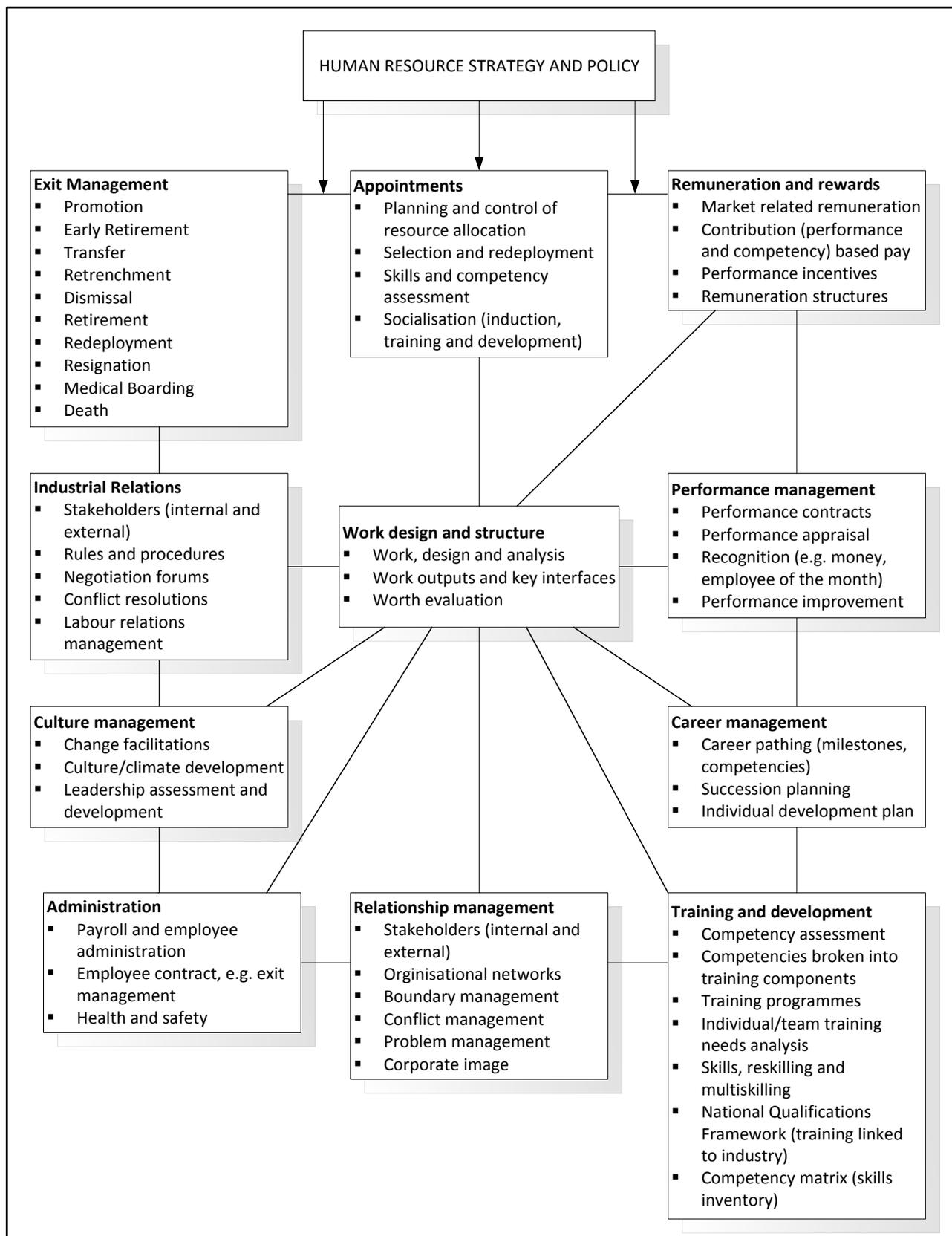
Managing people at work has evolved through different phases. The following labels provide testimony to that (Ogunyomi, Shadare & Chidi, 2011):

- Labour administration
- Labour and staff administration
- Personnel administration
- Personnel management
- Human resource management
- Strategic human resource management
- Human capital management.

Human resource management today is a radical departure from the personnel management of decades ago. Both the scientific management approach and human relations approach have appeared and declined and the focus has changed to what is known as the human resource approach. (Grobler, Wörnich, Carrell, Elbert & Hatfield, 2006). The key elements of traditional human resource management are the following (Grobler *et al.*, 2006):

- Work design and structure
- Recruitment and appointments
- Remuneration and rewards
- Performance management
- Career management
- Training and development
- Relationship management
- Administration
- Culture management
- Industrial relationships
- Exit management.

The interaction between these elements is outlined in Figure 2.1. It is evident that less of a strategic approach was followed with strong emphasis on aspects such as work design and career management, with internal compliance as a goal.



**Figure 2.1: Traditional human resource management**

Source: Grobler *et al.*, 2006.

The traditional elements of human resource management is evident from figure 2.1 with no reference to the business or organisational strategy and more of a strategic focus. The role of human resource management as explained in the traditional sense is thus clear from the diagram. The traditional approach towards human resource management was challenged by a number of trends and developments.

### **2.3. THE KEY TRENDS AFFECTING HUMAN CAPITAL MANAGEMENT**

Managing human capital in a changed business environment is influenced by a number of key driving forces. The purpose of this section is to provide an overview of these forces.

#### **2.3.1. Globalisation**

The speed of economic growth and recovery varies in different economies around the world. While developed markets such as North America and Europe are experiencing stagnant growth, emerging and developing markets such as China, India, Latin America, Southeast Asia, and the Middle East are showing economic growth and are generally acknowledged as the key drivers of future economic growth. Brazil's economic growth rests on a strong export economy and rising domestic demand. Deloitte estimates that "35 million people joined the middle class between 2003 and 2009, and 20 million more are expected to be included by 2014. China's middle class already exceeds the total population of the United States" (Deloitte, 2012: 6). This has resulted in the development of a global consumer market.

The global consumer market has given rise to the development of global talent pools, for instance offshore manufacturing and call centre operations that have become increasingly global in the last ten years. According to the same research "*many companies are now using offshore resources for high-value activities, such as research and development, knowledge processing and advanced analytics. Whereas the United States (US) used to boast the highest number of 25 to 34-year-olds with college degrees, it now ranks 12th among 36 developed nations, whereas China generates ten times more natural sciences graduates than the United States*" (Deloitte, 2012: 7).

In 2012, it was estimated that emerging markets would buy more than half of the world's imports, with established markets facing "uneven recoveries, flat growth, and declining talent pools". Emerging economies are now widely acknowledged as the primary drivers of future growth, profits and talent. Instead of focusing on the home market only, many leading companies are therefore generating global business and operating models. Consequently, global talent pools have become the focus for high value skills, rather than simply cheap labour costs. New levels of globalisation will represent one of the major changes facing organisations this decade. The move to new global operating models highlights "human capital management's particular ability to lead and shape the

agenda around change, talent, and global human capital management operations” (Deloitte, 2012: 9).

### **2.3.2. Skills shortage**

In recent research it was found that only 30 percent of chief executive officers indicated that the talent supply will be adequate to support their growth objectives. In the same study 31 percent indicated that talent constraints already had a negative impact of innovation and growth. It is estimated that the United States will require an additional 26 million workers by 2030 to be able to sustain the average economic growth of the past two decades. In the case of Western Europe, this figure is estimated to be 46 million people (World Economic Forum, 2010 cited in Kapoor, 1996). This would force multinationals to search for talent in emerging markets such as Brazil, Russia, India and China. It is estimated that around 33 million potential professionals are available for this purpose.

“The total number of university-educated workers in low-wage countries far exceeds the number for higher wage countries. Currently, India produces as many young engineers as the United States, and China produces more than twice as many. Russia produces ten times as many finance and accounting professionals as Germany. According to the International Organisation for Migration, there were an estimated 214 million international migrants in the world in 2010, and 57 percent of all migrants live in high-income countries” (World Migration Report, 2010 cited in Kapoor, 1996: 2).

### **2.3.3. Growth in social media**

The world has experienced explosive growth in social media, today, “more than 1.5 billion people around the globe have an account on a social networking site, and almost one in five online hours is increasingly spent on social networks via mobile devices. By 2011, 72 percent of companies surveyed reported using social technologies in their businesses and 90 percent of those users reported that they were seeing benefits. Social technologies have been adopted at a faster rate than any other media technology. While it took commercial television 13 years to reach 50 million households and internet service providers three years to sign 50 million subscribers, it took Facebook just a year to hit 50 million users and Twitter took nine months” (Chui, Manyika, Bughin, Dobbs, Roxburgh, Sarrazin, Sands & Westergren, 2012).

“In an attempt to quantify the value of the potential impact of social media on a transformative scale, more than \$1 trillion annually can be realised across the value chain, not just in the consumer-facing applications that have been at the forefront of adoption. Most importantly, research has indicated that social technologies, when used within and across enterprises, have the

potential to raise the productivity of the high-skill knowledge workers that are critical to performance and growth in the 21<sup>st</sup> century by 20 to 25 percent” (Chui *et al.*, 2012: 1).

Chui *et al.* mention that businesses are also employing social technology users “to ‘crowdsource’ product ideas and even to co-create new features”, adding that “social platforms have become a means of managing procurement and logistics, allowing direct communication between different parties on business-to-business (B2B) supply chains. It is becoming evident that social technologies can increase the efficiency of knowledge workers. Such technologies have the potential for improving the competences of such high-skill, increasingly sought-after workers by restructuring communication and collaboration, reducing barriers between functional silos, and even “redrawing the boundaries of the enterprise to bring in additional knowledge and expertise in extended networked enterprises” (Chui *et al.*, 2012: 2). The use of social media will bring about fundamental changes across all business processes, especially in managing human capital in future.

#### **2.3.4. Hyper connectivity**

Two billion people globally have access to the internet, while e-commerce amounts to almost \$8 trillion annually. In some mature markets, about two-thirds of all businesses have some web presence while one-third of small and medium-sized businesses use web technologies extensively. Chui *et al.* remark that the internet “has transformed the way we live, the way we work, the way we socialise and meet, and the way our countries develop and grow adding that in twenty years “the internet has changed from a network for researchers and geeks to a day-to-day reality for billions of people” (Chui *et al.*, 2012: 3).

Technology facilitates communication and collaboration, thus speeding up the rise of the global customer and talent markets, “*whether they are in adjacent cubicles or halfway around the world*”. *Deloitte adds that “in a business environment where everything is connected to everything else, geographic distances and national boundaries are almost irrelevant”* (Deloitte, 2012: 18).

Connectivity in combination with the advances in search capability and availability of content provides access to information at a scale never seen before. The access to information will have a major impact on learning and development in future.

#### **2.3.5. Changes in the profile of human capital**

The number of US workers over the age of 40 has increased significantly, 51 percent of the workforce in the United States was estimated to be over 40 years of age which is an increase of 30 percent from 1980. The number of workers over 55 years of age will grow from 13 percent in 2000 to 20 percent in 2020. During this same period, Millennials (individuals born between 1977 and

1997) will be entering the workforce in record numbers, with a current 22 percent of all workers, by 2014 they will make up almost 47 percent of the workforce (Meister & Willyerd, 2010).

In Europe, the current aging of the population combined with reduced fertility rates, will translate in a reduction of the population by around 1 percent by 2010. This decline is expected to accelerate to declining population of between 15 to 25 percent. These demographic trends are producing a workforce that is both aging and shrinking. It is estimated that in 2020 Germany will have a workforce that is reduced by 20 percent compared to 2000 and a retired population that increased by 50 percent (Meister & Willyerd, 2010).

“In future, most workplaces will have five generations working side by side, Traditionalists born before 1946, Baby Boomers born between 1946 and 1964, Generation X born between 1965 and 1976, Millennials born between 1977 and 1997, and Generation 2020 born after 1997. While human resource executives are trained to address many forms of diversity, they must now be prepared to manage extreme age diversity as well” (Meister & Willyerd, 2010. p308).

The change in demographics is also related to a broader trend, a different requirement in the skills and knowledge levels to be able to attract and retain employment in the global economy. Over the next decade, increasingly employment will demand a significantly more complex set of interdisciplinary skills. McKinsey Research calls this the “rise of the tacit workforce”, referring to employees in jobs that require a complex set of skills such as problem solving, judgment, listening, data analysis, relationship building, collaborating and communicating with co-workers. “These tacit jobs are opposed to transactional ones, which involve fewer conceptual duties. The tacit segment of the workforce is growing two and half times faster than the transactional segment. Today, 48 million of the more than 137 million US workers are knowledge workers, making knowledge workers the fastest-growing talent pool in most organisations. Put another way, 70 percent of all US jobs created since 1998, 4.5 million jobs, or roughly the combined workforce of the 56 largest public companies by market capitalisation, require a set of conceptual tacit skills” (Meister & Willyerd, 2010: 334).

### **2.3.6. Big data**

In a rapidly developing trend called the Internet of Things, “sensors and actuators embedded in physical objects from roadways to pacemakers are becoming linked through wired and wireless networks, often using the same Internet Protocol (IP) that connects the internet. These networks churn out huge volumes of data that flow to computers for analysis. As of 2012, about 2.5 exabytes of data are created each day, and that number is doubling every 40 months. More data crosses the internet every second than was stored in the entire internet 20 years ago” (McAfee & Brynjolfsson, 2012: 19).

New ways of capturing value emerge from this integration of the physical and virtual worlds. Customer buying preferences can in future be associated in real time with a specific location, enabling more timely and relevant offers. With sensors on objects, companies can turn product sales into services sales, encompassing, for example, proactive maintenance, and selling usage instead of a capital good (e.g. car-sharing services in urban areas). Instrumented complex systems such as electrical grids can be operated more efficiently and reliably, and could lead to dynamic pricing to manage peak demand. The costs of treating patients can be reduced by remote health monitoring while simultaneously improving their health outcomes. All the benefits of this development lead to an estimated growth rate of connected nodes on the Internet of Things of 35 percent annually for at least the next five years (Chui *et al.*, 2012).

Consequently, the knowledge gained by companies and governments using the Internet of Things will enable competitive advantage. Advances in big data might affect various industries. For instance, the annual productivity of the US health care industry could improve by about one percent over the next ten years, creating potential value of more than \$300 billion, while the public sector in industrialised European countries could see annual productivity gains of about 0.5 percent with a potential value of €255 billion (Chui *et al.*, 2012).

In a recent Accenture survey of executives at large companies in the US and United Kingdom (UK), nearly three-quarters of participants said they were working to increase their company's use of analytics (Harris, Craig & Egan, 2010). The volume of data available to organisations has become a major source of competitive advantage. It will also place significant emphasis on converting data into business intelligence and improved decision-making. Recent research conducted in the US indicated that companies in the top third of their industry in the use of data-driven decision-making were on average five percent more productive and six percent more profitable than their competitors (McAfee & Brynjolfsson, 2012).

This will drive the growth in knowledge workers referred to in the previous section to a new level, a new role is fast emerging in organisations, that of the data scientist. "Data scientists are specialised people who focus on finding answers to research questions by analysing big volumes of unstructured data. As the volumes of data is constantly growing, finding enough of these people will be a constant (Davenport & Patil, 2012). This is supported by the same Accenture research which found that companies neglected this resource, as "analytical talent" was not seen as a separate valuable segment of human capital. A further observation was that participants struggled to organise these resources, and lastly that analysts were motivated by other aspects compared to other segments of human capital (Deloitte, 2012).

### **2.3.7. Cloud computing**

Cloud computing is a major technology trend that has emerged over the last number of years. It will create a completely new technology platform to operate globally, it will set the stage for a new approach to information technology that enables individuals and businesses new options on how to acquire or deliver information technology services. It will reduce, the traditional constraints of I software licensing models and remove barriers to entry created by hardware investment requirements. Cloud computing will have a significant impact on every aspect of information technology, and how users access applications, information and business services (Cearley & Smith, 2012). It is estimated that cloud computing would generate 2.3 million new jobs in the Europe over the next five years and that an average of 2.1 percent improvement in productivity can be expected (World Economic Forum & Accenture, 2012). Cloud computing will facilitate the development and roll-out of global human capital management platforms as processing power and computing capacity will be more scalable and provide access to less developed regions of the world.

### **2.3.8. E-learning and mobile technology**

Learning and development have gone through major changes during the last decade. The advancement of e-learning technology in combination with growth in connectivity, the advancement of search engines and the growth in mobile devices is providing human resources (HR) with access to information and knowledge on a scale never available before. E-learning technology is also enabling the growth of self-paced learning, a more flexible and cost-effective model than instructor-led development.

The growth in e-learning technology is supported by the growth forecasts: a compounded annual growth rate of 23 percent is expected over the next 5 years, while the market is expected to grow from \$155 billion in 2012 to \$255 billion in 2017 (Pranjalee, 2013). This should be seen in combination with the growth in mobile devices: it is estimated that 2.4 billion people are internet users connecting through computers. The expected growth is 8 percent per annum. In comparison, the total number of smart phone users is estimated at 1.5 billion, with 15 percent of internet traffic already coming from mobile devices. This is expected to grow by 1.5 times per annum (Jacquez, 2013).

These forces are driving the emergence of a modern approach towards the management of human capital. More context on the implications of these forces is provided in the next section.

## **2.4. THE MODERN APPROACH TOWARDS MANAGING HUMAN CAPITAL**

To better understand the modern approach towards managing human capital, Ulrich's (cited in Friedman, 2007) human capital management model is used:

- **The first role of strategic partner:** A strategic partner focusing on the alignment of human capital with organisational goals and strategy. The output of this role is alignment of strategy and execution to the benefit of investors, managers, employees and all other stakeholders.
- **A change agent** who delivers a renewed organisation that is more competitive. To achieve and maintain competitive advantage, organisations have to monitor constant changes in the competitive landscape, government regulations and global economy. Human capital have to develop interventions that will allow the organisation to respond to these changes. Change management must focus on communication of the vision and overcoming employee resistance to achieving this vision.
- **An administrative expert** who delivers efficient human capital management processes that utilises leading technology and new thinking to deliver the best possible results.
- **An employee champion** who maximises employee contribution and commitment in two ways. First, human capital management monitor and respond to employee needs pro-actively with available resources. Second, human capital management practices increase employees' knowledge, skill and ability to contribute to organisation effectiveness (Ulrich, Brockbank, Yeung & Lake, 1995).

This model distinguishes between four different roles that of a strategic partner, a change agent, an administrative expert and an employee champion. The different levels of focus on strategic alignment with the business strategy is evident. Further explanation of the modern approach towards human capital management is provided by Table 2.1, which compares traditional personnel management, human resource management and human capital management.

**Table 2.1: A comparison of personnel, human resource and human capital management**

Personnel management	Human resource management	Human capital management
HR can be managed, aimed at and controlled: people can be managed		You can lead a horse to the water but you can't make it drink
Authoritarian, command	Temptation	Alignment
Controlled information	Open communication	Dialogue
Standardised tasks and job descriptions	Individual tasks and job descriptions, global indication of responsibilities	Individualised descriptions of roles, tasks and responsibilities
Training aimed at function	Training aimed at multi-availability	Training aimed at personal development and fulfilment of personal development plans
Employees cost money	Employees cost money, optimal output needs to be generated	Employees are partners, with whom a professional discussion about costs and output can be held

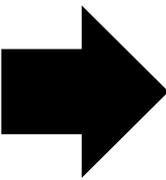
Personnel management	Human resource management	Human capital management
Selection based on job description	Selection based on personal competencies	Selection based on personal competencies and values
Interventions on the basis of operational problems	Interventions on the basis of tactical problems	Interventions on the basis of strategic problems
Instrumental orientation	Functional orientation	Strategic orientation

Source: Van Marrewijk & Timmers, 2003.

The changed emphasis on a more strategic approach with strategic alignment between business strategy and individual competencies where human capital is approached as partners is evident. The human capital approach is more strategically focused with employees seen as partners, selected based on personal competencies and values, and interventions being based on what strategic problems are faced.

The potential impact of the factors outlined in the previous section is shown in Table 2.2, where these implications are outlined in more detail. The remainder of the chapter will discuss these trends in more detail.

**Table 2.2: A changing approach towards managing human capital**

Key forces changing the workplace		A changing approach towards managing human capital
<ul style="list-style-type: none"> <li>• Multiple generations in the workplace</li> <li>• Globalisation of business</li> <li>• People always connected</li> <li>• Social media</li> <li>• Advancement of the virtual workplace</li> <li>• Advancement of e-learning technology</li> </ul>		<ul style="list-style-type: none"> <li>• A more strategic approach</li> <li>• A competency-based approach</li> <li>• Focus on talent management</li> <li>• The creation of a new learning ecosystem</li> <li>• The advancement of analytics</li> </ul>

#### 2.4.1. A more strategic approach towards human capital

In a fast-paced global economy, change is the norm. Environmental, social and technological change, increased globalisation of business, the cost of, and increased competition for, scarce human capital require a more strategic approach towards human capital management. Strategic human capital management thus includes a variety of people issues relevant to the business strategy. Human capital management embraces all the functional areas and is fully integrated with all the significant parts of the organisation (Grobler *et al.*, 2006). Today, the alignment of human capital management strategies and processes with the objective of creating alignment between individual competencies and organisational capabilities plays a key role in creating sustainable

competitive advantage (Ulrich & Smallwood cited in Soderquist, Papalexandris, Loannou & Prastacos, 2010).

Distinguishing strategic and non-strategic human capital management, Bratton and Gold (1999: 2) suggested that “*non-strategic human capital management can be identified by a number of characteristics separate from the business: reactive and short term, of no interest to the board of directors, constrained by a legalistic and institutional definition that focuses on lower-level employees*”. Various research however identified human capital management as a source of potential competitive advantage and the ‘matching model’ is based on the view that human capital practices should match and support business strategy (Ogunyomi *et al.*, 2011). Wright and McMahan (2011: 298) defined strategic human capital management as “the pattern of planned human resource deployments and activities intended to enable the firm to achieve its goals”. They stated that the domain of strategic human capital management consisted of “the determinants of decisions about human capital management practices, the composition of the human capital resource pool, the specification of the required human resource behaviours, and the effectiveness of these decisions given various business strategies and/or competitive situations”. To better understand the integration between human capital management and business strategy, the process of business strategy formulation needs to be further unpacked.

The concept of business strategy consisting of a set of dynamic capabilities being developed was first introduced by the research of Teece, Pisano and Shuen (1997: 8), where dynamic capabilities are defined as “*the firms’ ability to integrate, develop and reconfigure internal and external competencies to address rapidly changing environments. Dynamic capabilities thus reflect an organisation’s ability to achieve new and innovative forms of competitive advantage given path dependencies and market conditions*”. Stalk, Evans and Shulman (1989) further developed the concept of corporate strategy called “capabilities based competition”.

The building blocks of corporate strategy are not products and markets but business processes; competitive success depends on transforming a company's key processes into strategic capabilities that consistently provide superior value to the customer. The concept of strategic capabilities was further developed by Teece (cited in Pavlou & El Sawy, 2011) to dynamic capabilities, where competitive advantage in turbulent environments is seen as a function of dynamic capabilities rather than competitive positioning or industry conflict. The term “dynamic” is used to reflect the capacity to renew capabilities to achieve congruence with the changing environment. Although various research have been done to further develop the concept of dynamic capabilities, a good conceptualisation is provided by Ali, Peters and Lettice (2012), who summarised dynamic capabilities as listed in Table 2.3:

**Table 2.3: A conceptualisation of dynamic capabilities**

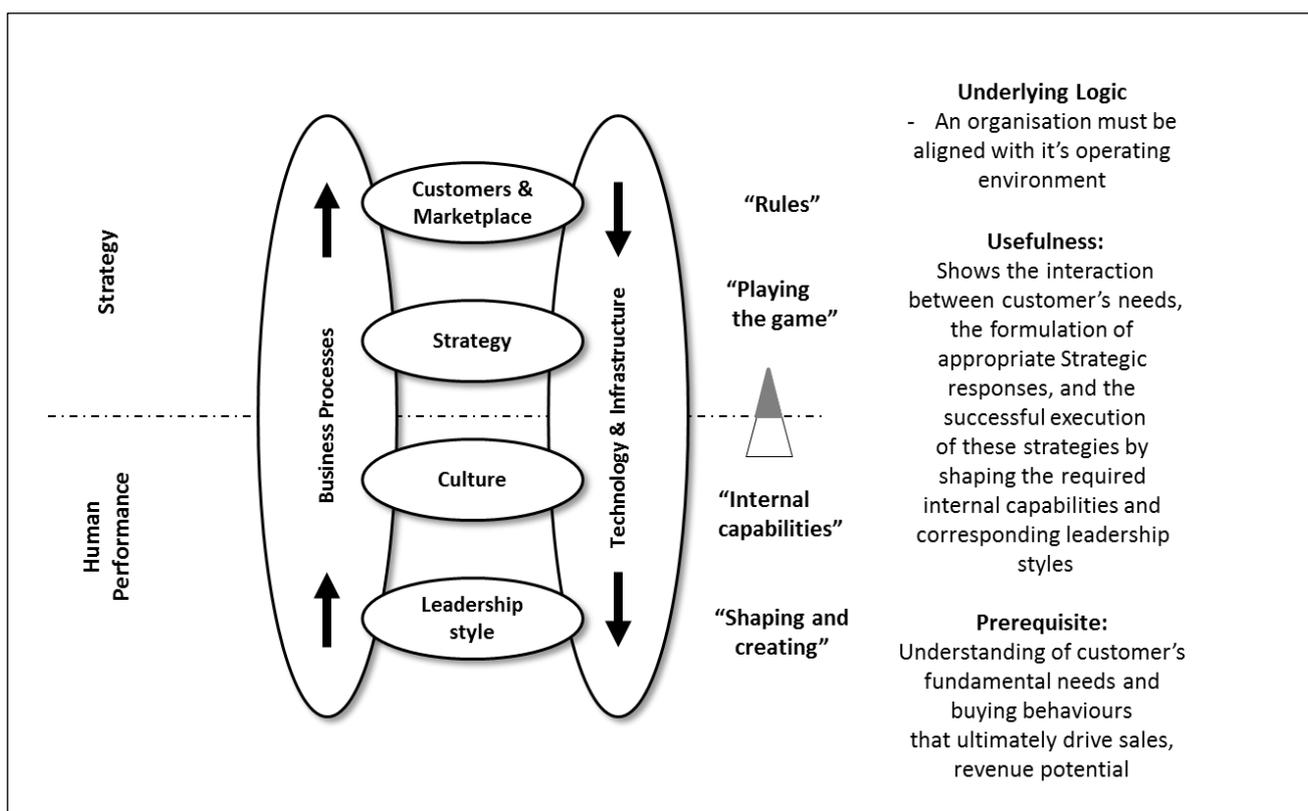
<p><b>Integration capabilities:</b></p> <ul style="list-style-type: none"> <li>• Interconnecting work tasks/outputs (i.e. linking, communicating and synchronising human capital management activities, designs, reports, etc. among a firm's departments and group members)</li> <li>• Structuring resources (i.e. acquiring, accumulating and divesting resources)</li> <li>• Bundling resources (i.e. stabilising, enriching and pioneering firm resources)</li> <li>• Organising resources (i.e. arranging and allocating human and material resources within and among a firm's departments)</li> </ul>
<p><b>Reconfiguration capabilities:</b></p> <ul style="list-style-type: none"> <li>• Patching resources (i.e. realigning of business processes to match-up the changing market conditions and opportunities)</li> <li>• Effective benchmarking (i.e. identifying the best practices from industry and government, and comparing and adapting them to the organisation's operations)</li> <li>• Transforming competencies (i.e. relinquishing/cannibalising existing competencies into novel combinations)</li> <li>• Transforming markets (i.e. forgoing existing markets and targeting future markets)</li> <li>• Consolidating resources (i.e. rationalising and centralising resources in a firm)</li> <li>• Leveraging resources (i.e. mobilising, replicating and deploying resources needed to capitalise on opportunities in the market, e.g. extending the scope of the resource into other business units or market domains)</li> </ul>
<p><b>Renewal/recreation</b></p> <ul style="list-style-type: none"> <li>• Adaptation (i.e. adapt and recreate resources/capabilities in search of enhancing business processes)</li> <li>• Exploitation and exploration (i.e. exploit/explore resources/capabilities in search of enhancing business processes)</li> </ul>
<p><b>Market management capabilities</b> (i.e. effective market segmentation and targeting capabilities)</p> <p><b>Marketing mix capabilities</b></p> <ul style="list-style-type: none"> <li>• Logistics capabilities (i.e. creating efficient distribution system for marketing programme success)</li> <li>• Promotional/selling capabilities (i.e. developing and executing advertising programmes, using effective sales promotion and managing brand image)</li> <li>• Price setting capabilities (i.e. using pricing skills and evaluating competitors' pricing strategies)</li> </ul>
<p><b>Table 2.3: A conceptualisation of dynamic capabilities (continued)</b></p> <p><b>Relationship-building capabilities</b></p> <ul style="list-style-type: none"> <li>• Customer-linking capabilities (i.e. creating and maintaining relationships with customers)</li> </ul> <p>Channel-bonding (networking) capabilities (i.e. keeping suppliers informed, co-operating with them, pooling expertise and sharing trust and goals with them)</p>
<p><b>Technology related capabilities:</b></p> <ul style="list-style-type: none"> <li>• Technical capabilities (proficiency) (i.e. building product/services to designated or revised specification, executing prototypes and determining the final product design)</li> <li>• Quality control/regulatory capabilities (i.e. monitoring organisation's technical processes and their outcomes)</li> <li>• Information technology (IT) infrastructure capabilities (i.e. using IT in the organisation and supporting and maintaining systems with the latest IT applications)</li> </ul>

Source: Ali, Peters and Lettice, 2012.

With these company capabilities as the key driving force of business strategy, two key issues that need further exploration is firstly the concept of dynamic alignment and secondly how these capabilities are developed and constantly renewed.

The concept of dynamic alignment has been researched and developed for a number of years by Gattorna and can be defined as alignment based on the concept of dynamism of life in the organisation or the supply chain, seeking dynamic alignment means treating organisations as living organisms, rather than an inanimate mechanical structures. Dynamic alignment uses customer behaviour as its direction aligning energy, human capability and execution through processes dynamically (Gattorna, 2015).

The model for dynamic supply chain alignment depicted in Figure 2.2 takes the concept of dynamic alignment further by identifying the elements that need to be aligned as customers and market place, company strategy, culture and leadership style. Business processes, technology and infrastructure are the mechanisms being used to enable the alignment.

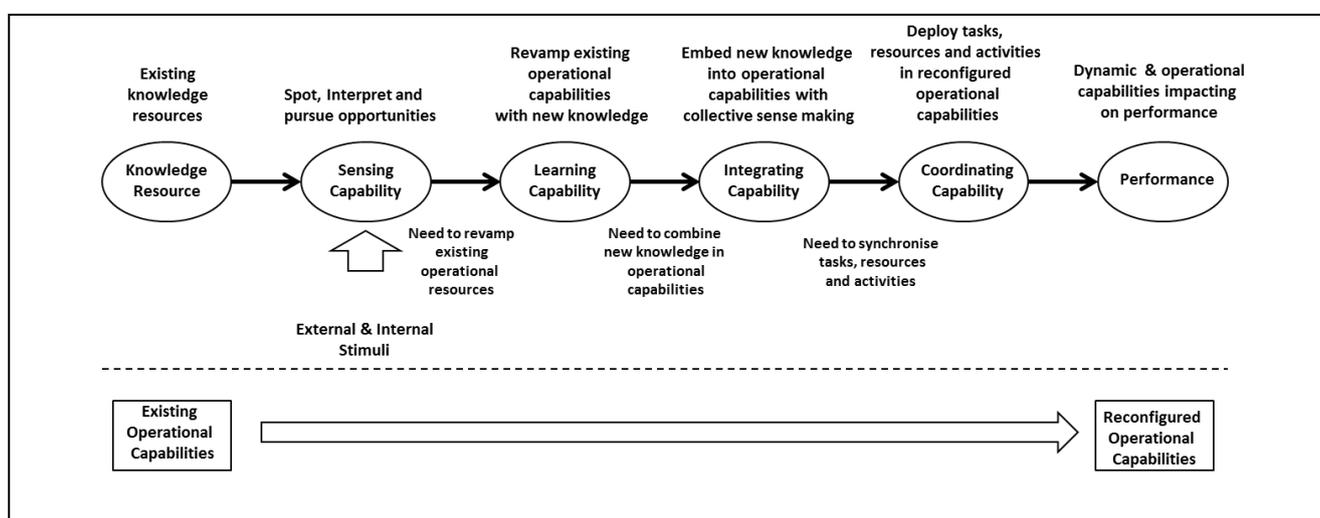


**Figure 2.2: Elements of the dynamic alignment business model**

Source: Gattorna, 2015.

Linking this model to the role of human capital, it emphasises the importance of human capital to implement mechanisms and interventions to develop the culture or sub-cultures required to achieve dynamic alignment.

The second aspect is the process of developing dynamic capabilities. The existing research on dynamic capability recognise the key roles of both knowledge resources and learning mechanisms. The knowledge resource is a key strategic resource that has a high potential for contributing towards competitive advantage (Grant, 1996 cited in Chien & Tsai, 2012). The link between dynamic capabilities and knowledge resources has been widely discussed (Prieto & Easterby-Smith cited in Chien & Tsai, 2012). Dynamic capabilities are focused on creating, obtaining, integrating, and redeploying knowledge resources (Ali *et al.*, 2012). *“Knowledge-based dynamic capabilities include knowledge absorption, knowledge creation, knowledge storage, and knowledge application. Without a learning mechanism, knowledge resources might not be effectively translated into dynamic capabilities. The influence of the learning mechanisms provides insight into how dynamic capabilities work from a process perspective”*(Chien & Tsai, 2012: 3). This process can best be depicted as in Figure 2.2 below.



**Figure 2.3: Dynamic capabilities, their interaction with knowledge and learning and how they affect operational capabilities**

Source: Adapted from Chien and Tsai, 2012; Pavlou & El Sawy, 2011.

Learning capability thus plays a vital role in developing dynamic capabilities. It becomes a key mechanism for delivering the capabilities required to achieve performance objectives.

#### 2.4.2. A competency-based approach

Organisations are increasingly focusing on people, with more emphasis on planning human capital through what is now often referred to as "talent management". The emphasis is not only on examining the demographics of the employee population, but also on an analysis of employees' required knowledge, skills and personal attributes to enable organisations to successfully achieve their goals. Organisations recognise that their workforce is crucial to their success in the modern workplace, hence their emphasis on the identification and assessment of competencies, and the

development of competency-based management frameworks to support activities such as "gap analysis", recruitment, learning and other strategic human capital processes. Competencies are the range of unique skills that will provide an organisation with core capabilities and competitive advantage. With competencies, organisations can emphasise the requisite knowledge, abilities and personal qualities for success in key jobs and classify the qualities needed for the success of all jobs in the organisation (Bonder, Bouchard & Bellemare, 2011).

The traditional approach towards human capital management focused on designing organisations around job structures, with the emphasis on identifying and providing operational knowledge, skills and other characteristics that are required from employees for successful performance in specific job positions. In this approach, the human capital management function focused its efforts on tasks and interventions about the knowledge and skills required in order to perform the related tasks by employing techniques such as job analysis. However, a number of evolutions in today's business environment drive a change to this practice. Now more than ever, competitive advantage stems from knowledge intensity, flexibility and innovation. This new landscape has slowly but surely become a dominant paradigm in business, influencing also human capital management practices. In response, human capital managers have significantly increased their use of competency frameworks and competency-based human capital management globally (Soderquist *et al.*, 2010).

The key differences between a task-based and a competency-based approach to human capital management can be summarised as follows. Competency-based human capital management

- Is human-centred and concentrates on how objectives are met or how work is accomplished successfully, rather than on what is accomplished (Shippmann, Ash, Battista, Carr, Eyde, Hesketh, Kehoe, Pearlman, Prien & Sanchez, 2000).
- Seeks to identify those competencies that will enable long-term organisational fit with evolving business conditions, rather than achieving a short-term task match (Campion, Fink, Ruggeberg, Carr, Phillips & Odman, 2011).
- Provides a specification of the "*individual level competencies that are core and common for an occupational group executing a range of jobs, rather than describing what is required for executing the specific tasks that make up a specific job*" (Shippmann *et al.*, 2000: 12).
- Allows behavioural traits to be integrated in human capital management models, rather than focusing merely on technical skills (Soderquist *et al.*, 2010).
- enables assessing individuals ex-ante against requirements and responsibilities other than those currently held, and activating potential skills and behavioural traits, rather than evaluating the performance in executing specific tasks ex-post (Campion *et al.*, 2011).

It is important to contextualise the concept of competencies within an organisational context. There is a parallel body of literature in strategic management (SM) that views competencies as characteristics of an organisation as a whole, with particular emphasis on core competencies and dynamic capabilities (Prahalad & Hamel, 1990; Ali *et al.*, 2012). Whilst the notions of competency and capability have, at times, been used interchangeably, capability typically refers to distinctive strengths at the collective or organisational level, and as such is distinguished from competency, which usually applies at the individual level. In human capital management literature, competency refers to how the individual excels in specific job positions and responsibilities. It is distinguished from the term competence, which relates to a particular skill that an employee possesses (Soderquist *et al.*, 2010). This is summarised in Table 2.4 below.

**Table 2.4: Core competencies versus workplace competencies**

	<b>Core</b>	<b>Workplace</b>
Scope	Organisation	Individual
Purpose	Strategic	Tactical
Participants	Business unit	Worker
Task	Processes	Activities
Competencies	Global	Position

Source: Sanghi, 2008.

According to Prahalad and Hamel (1990), core competencies of the organisation are developed from intangible assets that are difficult to imitate by competitors and can provide the basis for the company to deliver unique value to its customers thereby creating a competitive advantage. Core competence is thus positioned at an organisational level and is more strategic in nature, while competencies are operating at individual, workplace or position level. Essentially, core competence at strategic company level will dictate the development of competencies at work or position level.

### **2.4.3. A focus on global talent management**

Human capital will be increasingly managed from a global perspective in line with business strategies being more and more globally focused as opposed regionally focused. In line with this some work activities are likely to be centralised in low-cost labour markets in the future to reduce costs and capitalise on economies of scale. Other activities will increasingly be retained in local markets in line with market demands and emerging sources of income which require product localisation and improved customer responsiveness. Human capital management will most probably have to provide direction and support to advance global talent strategies that provide new skills and talent in new places. Human capital management will also be required to help create a source of leadership that can be quickly redeployed to capitalise on global opportunities as they

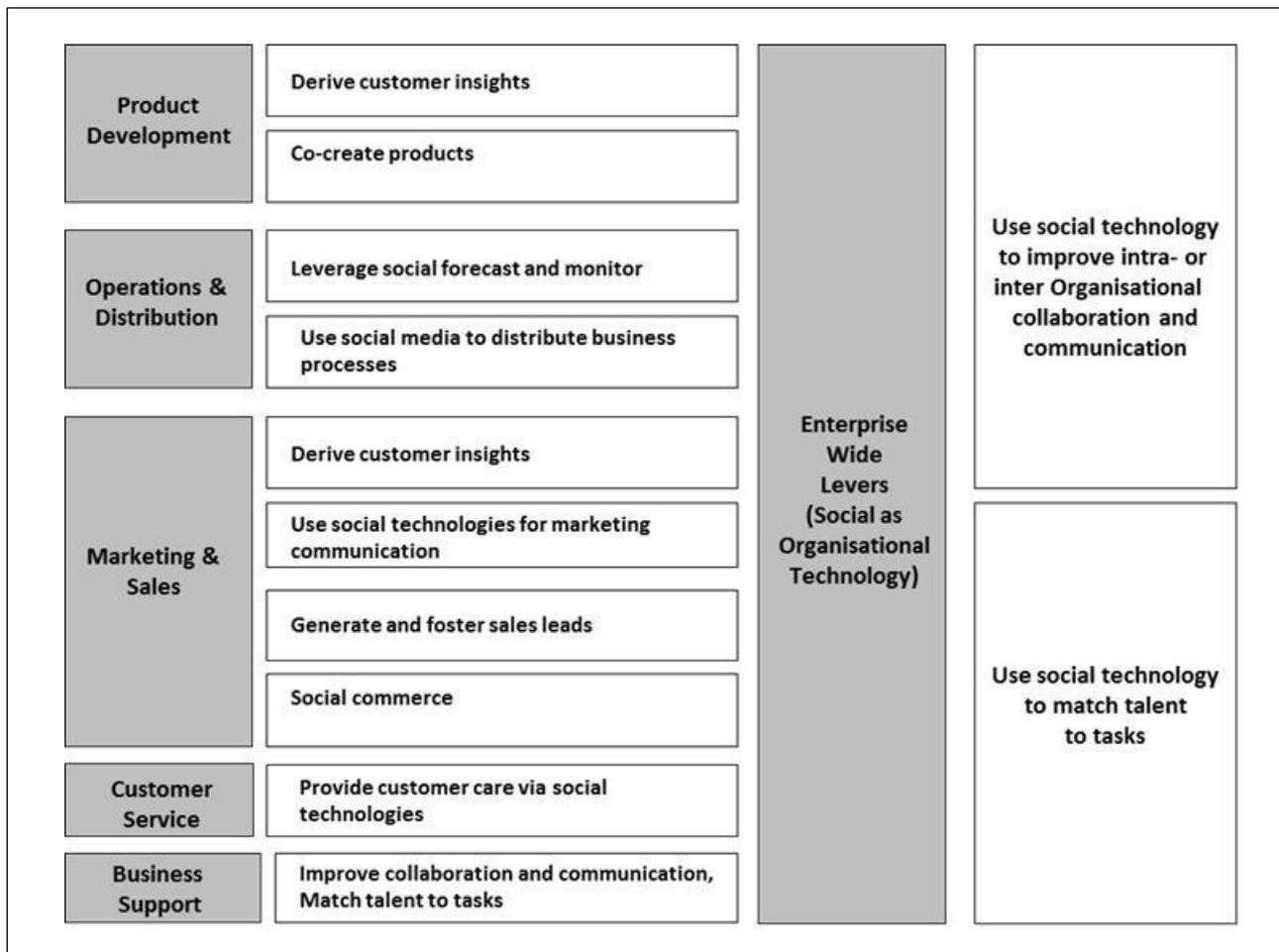
emerge. *“Furthermore, challenges may arise in managing a more diverse and complex workforce with significant differences in nationality, culture, socioeconomic background, lifestyle and education, in addition to traditional factors such as gender, race, ethnicity and religion”* (Deloitte, 2012: 7 ).

For companies to be able to manage a global talent pool of human capital, a different approach towards a technology platform is required. The Global Human Resource Information System consists of a number of component systems that are interdependent. *“The various components may be broadly classified into the following main sub-systems: data warehousing, data analytics and information delivery. These tools and systemic processes are critical to formulate questions or hypotheses, to design data and analytical models, to compute and communicate results to appropriate users, and then for the users to draw business insights from the results to shape business decisions and, ultimately, improve performance”* (Kapoor, 1996: 5). Internationalisation of a company’s operations results in competitive advantage only under certain conditions, and the global presence translates into competitive advantage when companies integrate local market differences, realise global economies of scale, and effectively transfer knowledge and technology across borders (Friedman, 2007).

A key issue for global talent management is the identification and quantification of existing talent and the alignment of available talent with the future talent requirements of the organisation.

#### **2.4.4. The impact of social media**

The potential impact of social media on organisations is much wider than originally thought. Figure 2.3 outlines the impact in the different areas of management.



**Figure 2.4: The potential impact of social media**

Source: Chui *et al.*, 2012.

Social media affects almost every area of management, from deriving ideas from consumers for developing new products to marketing communication with targeted customers. A major area of impact is internally, in managing organisations from an internal perspective. Collaboration between different functions, regions, teams and individuals will have a profound impact on business processes. The fact that most people connect to social media through mobile devices such as smart phones and tablets makes this impact that much more significant. This will enable employees to communicate and collaborate even if they are not at work.

From a human capital perspective the most important impact will be on how employees collaborate and learn on a global scale and how social media will provide a new platform for the management of global talent pools.

#### **2.4.5. Collaboration: A new way of work**

It is anticipated that in future the development of social collaboration technologies will significantly transform employees' work methods. It can be expected that these technologies will lead to more continuous and effective collaboration, enabling shortened cycle times, reduced duplication of

effort, and increased alignment between parts of the organisation, thus enabling the business to systematically apply the best approaches to every project and problem (Kim & Kass, 2012).

However, the search for the full possible advantages of these technologies requires much more than merely the use of existing social collaboration tools. Too many companies invest in technology to support collaboration before analysing the kinds of collaboration they truly need. Collaboration is a misleadingly broad term that encompasses disparate kinds of activities. The effort required to promote and support each kind of collaboration calls for a clear focus on what is crucial to attain the benefits promised by that particular form of collaboration (Kim & Kass, 2012).

In order to maximise the potential benefit from collaboration, the following mechanisms need to be implemented:

- Creating a platform where the work can be shared
- Defining information to be shared
- Creating mechanisms to implement the desired inter-group interfaces (Kim & Kass, 2012).

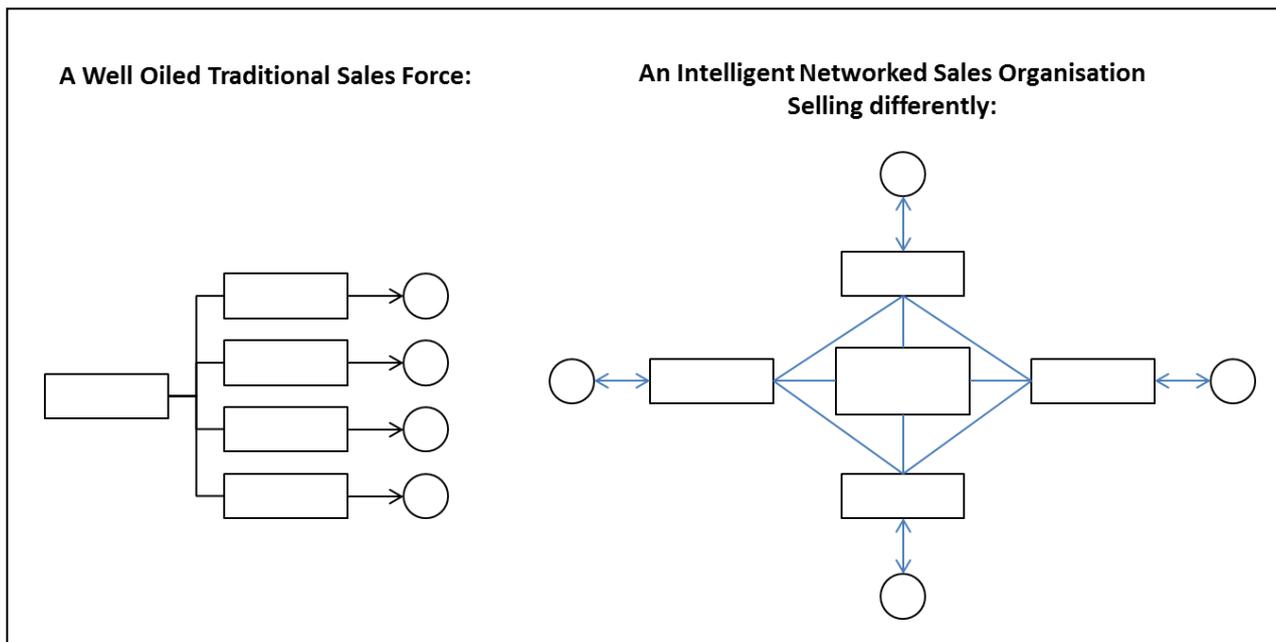
An example of this is the rise of the “new sales force”, a development which is the result of a combination of customer demand and technology advancement. What are the key factors driving the development of the new sales force? They are:

*New technologies.* Both buyers’ decisions and salespeople’s selling methods have been profoundly changed by technologies such as smart phones, tablets, social media, and the internet. Buyers now have infinite sources of information at their fingertips, making purchases for the human capital management through a variety of channels and using social media to form new kinds of relationships. Sales forces should use these technologies to their advantage, rather than falling victim to them.

*Analytics.* Advanced analytical tools can give salespeople a deeper understanding of their customers than before. Analytics can assist sales organisations to achieve more nuanced segmentation and evaluation of where to dedicate sales time and help direct customers to the most appropriate sales channel, some through face-to-face interaction, others through outbound calls, and others primarily through the internet. Analytics could also indicate which salespeople would likely be most productive.

As a result of these forces, a new sales force is developing. Figure 2.4 outlines this development.

This will not only require a new way of working, but also the development of new skills and competencies.



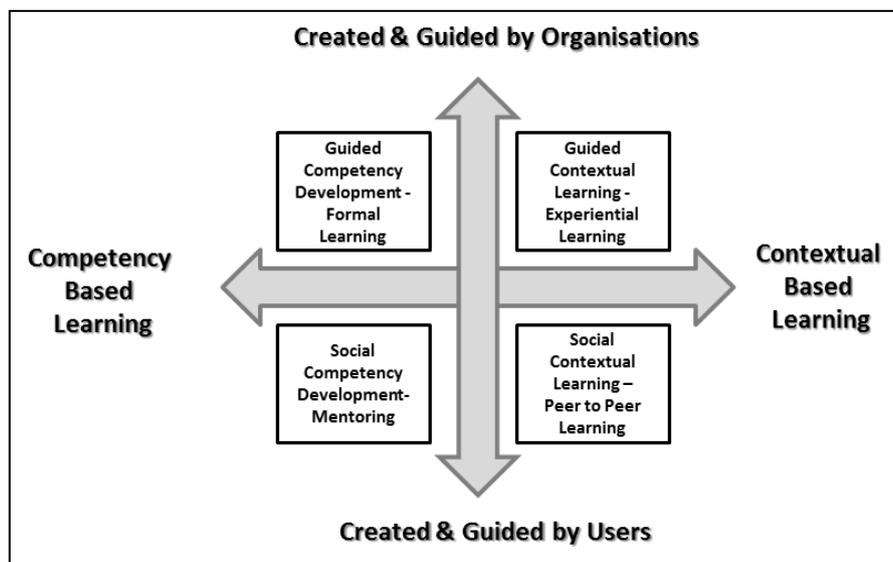
**Figure 2.5: The growth of the global networked organisation**

Source: Deloitte, 2012.

#### 2.4.6. The creation of a new learning ecosystem

Social learning is defined as the acquisition of knowledge and skills through methods that are collaborative, immediate, relevant, and presented in the context of an individual's unique work environment. The traditional approach towards learning and development relied heavily on classroom learning. While the modern approach added computer- and web-based training, social learning incorporates social media, gaming, real-time feedback, and advanced on-the-job methodologies (Meister & Willyerd, 2010). Social learning can also be defined as the serendipitous learning that takes place through social exchanges that result in knowledge negotiation (Silvers, 2012). In order to make the most of social learning, the creation of a social learning ecosystem is recommended. This is defined as: "A system that provides access to many different resources besides traditional e-learning. Content is contributed to and maintained by training organisations, as well as business-unit experts and thought leaders who are in closer proximity to the urgent business needs. In this way, employees have one place to go to search for or receive guidance on their personal development" (Silvers, 2012). Searching is an essential capability of the underlying platform: *"since employees store data about themselves in the system, the search engine intelligently matches the context of the employee's role to relevant search results. For example, if a manufacturing industry sales representative in Germany searches for content on lean manufacturing, the results will be served up with content specific to that representative's role, including collaborative results such as social bookmarks or the blogs of experts in the area. The results might direct the representative to embedded tools available for use on the job, formal*

classes, e-learning from internal and external course providers, or the names of external experts” (Meister & Willyerd, 2010: 2610). This model is depicted in Figure 2.5.



**Figure 2.6: A social learning ecosystem**

Source: Meister & Willyerd, 2010.

The model, the Social Learning Ecosystem, has four quadrants, with competency-based learning anchoring the left side and context-based learning anchoring the right. Context-based learning is the learning that occurs on the job and during the everyday performance of work. As a result, it tends to be more personalised. There is no clear cut-off point between the quadrants, and frequently programmes span quadrants because most organisations customise some level of learning to the requirements of the jobs involved. The upper quadrants of the figure include learning that involves planned events, typically documented on an employee’s development plans, and is created and endorsed by the organisation. The programmes that fall into these quadrants are generated by the organisation through some formal channel and typically have been documented in an information system, such as a learning management system (LMS). The lower quadrants include the activities that happen when people learn from one another, a kind of learning frequently ignored by employee development plans. Learning in these quadrants is, by definition, both social and collaborative and can include a hidden curriculum, what is learned on the job in order to mesh in with the culture but is not often discussed publicly (Meister & Willyerd, 2010).

Cloud computing reduces the barrier to entry for further implementation of these ecosystems. Cloud services empower human capital management with more control over its own tools: it can decide on the required reporting and analytics capabilities and then gain quick access to those capabilities with a smaller capital investment and faster implementation time. Furthermore, cloud applications are frequently updated to reflect the latest business practices, thus enabling human

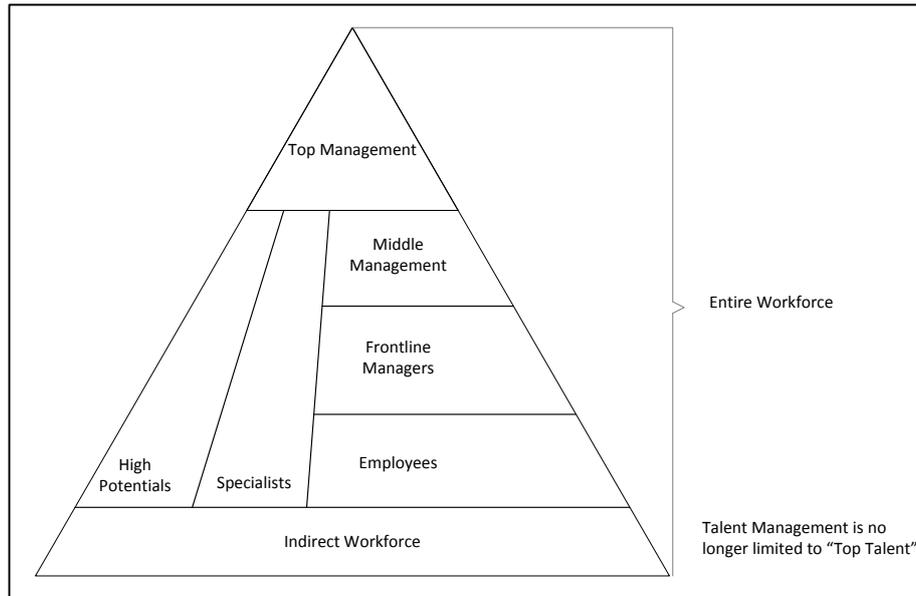
capital management to remain up to date (Deloitte, 2012). Some of these applications include the following:

- Human capital management service centres can grow into communities. Shared services centres can become shared services communities for employees, managers, vendors and alumni to help one another through the sharing of knowledge, and creating new ways of improving services, processes and policies. Similarly, centres of expertise can become communities of expertise, allowing access to wider knowledge and understanding through collaboration within and outside the enterprise.
- Human capital management portals are becoming social platforms. While human capital management portals have conventionally been structured around static content and predefined transactions, they now allow for personalised content and employee engagement. Through social media capabilities, employees can network with human capital management and other parts of the organisation, as well as with external vendors, alumni and colleges. Mobile devices enable deliver-on-demand service through easy-to-use universally available apps (Deloitte, 2012).
- To demonstrate the potential value from a social learning system, a recent case study of a technology company in Silicon Valley has provided some good insight. One of the major benefits of web-based learning compared to instructor-led learning is the reduced delivery cost. Experience has proved that 200 hours of development would be required for every one hour of content in web-based development. With a social learning platform, this has been significantly reduced. The outcome of the comparison is a reduction of 28 percent in the development cost of social learning and, given the employee participation, a return on investment of 75:1 was achieved compared to web-based training (Willyerd & Pease, 2011).

#### **2.4.7. Advancement of analytics**

The focus on analytics is twofold. The first aspect of analytics focuses on creating more human capital analytics to better analyse human capital performance and develop better insights into the performance of human capital. The second aspect of analytics is the emergence of a specialised group of people called “analysts”, or also called “data architects”, and the challenges in managing those people.

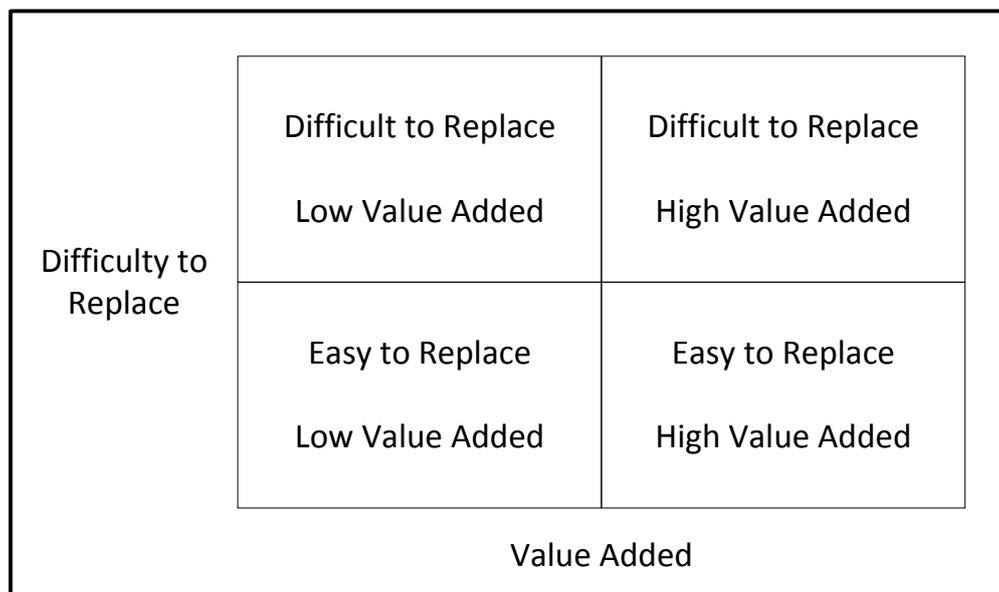
A key shift in approach towards managing analysts is to understand how to get maximum value from this resource. A first fundamental requirement is to apply segmentation of human capital, moving from a hierarchical segmentation of human capital to a different type of segmentation that is based on the relative value for the organisation or the relative risk. The example in Figure 2.6 below provides an illustration of this approach.



**Figure 2.7: Segmentation of human capital**

Source: Guthridge, Komm and Lawson, 2008.

In this example, human capital is segmented using a combination of organisational structure, potential of the individuals and the extent of specialisation. Another approach is to combine relative value added to the organisation with the relative risk of replacement. Figure 2.7 provides an illustration of this approach, human capital can be segmented into these segments and an appropriate strategy being formulated for each segment

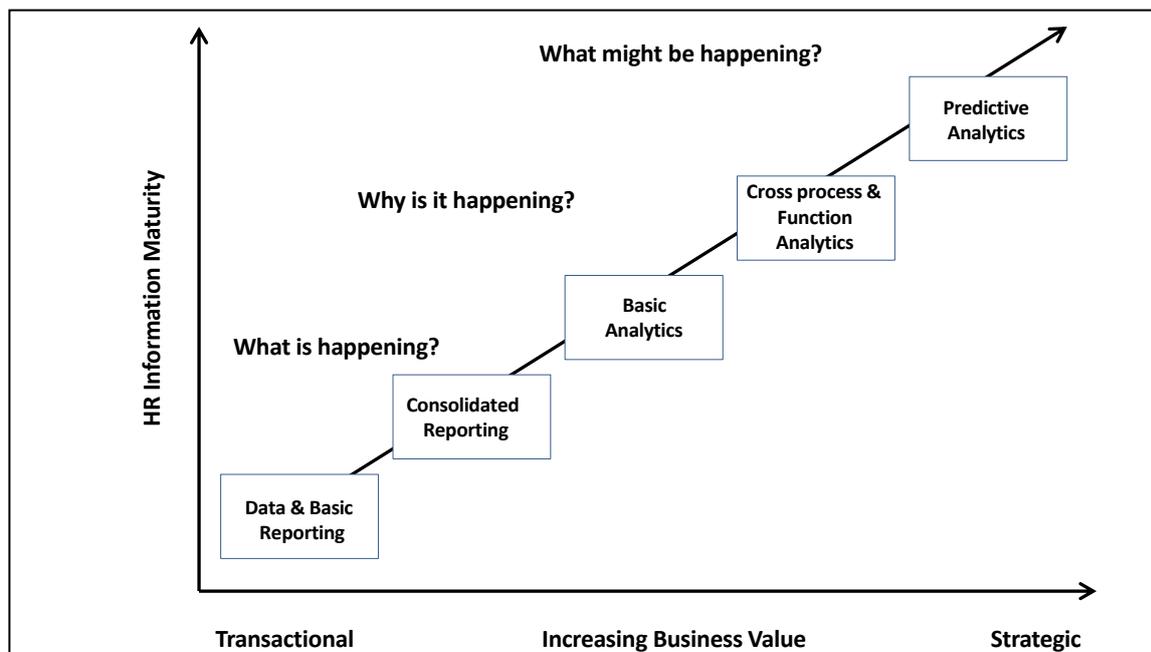


**Figure 2.8: Human capital segmentation based on scarcity**

Source: Lewis & Heckman, 2006.

The relevance of segmenting human capital with an increased focus on “analytics” is that analysts should be managed as a separate segment of human capital, a strategic source of competitive advantage, given the increased growth of data and its potential value.

Advancing to a state of advanced analytics involves a process of development. The different stages of the evolution are illustrated in Figure 2.8.



**Figure 2.9: Evolution of analytics maturity**

Source: Adachi, Helfrich, Gretzko and Schwartz, 2012.

The first stage is getting basic visibility in place through data and basic reporting. This involves getting the data about talent and human capital in place with some basic reporting across regions. The second stage is consolidated reporting with aggregated data across regions and segments to provide visibility on a global basis. Consolidated reporting provides the basis for basic analytics which compares competencies capability across different regions. This provides the basis for the next stage, which is cross function and process analytics.

Cross function and process analytics focus on the identification of talent available by a process aligned with dynamic capabilities. Predictive analytics focus on aspects such as predicting competency requirements for different strategy options and achieving different levels of organisational performance.

## 2.5. CONCLUDING COMMENTS

In order to better translate the impact of the key driving forces discussed in the previous section of this chapter, Table 2.5 provides a consolidated view of the future impact of key driving forces on

managing human capital. The strategic human capital model of Ulrich (cited in Friedman, 2007) is used as a basis.

To translate these changes into a process, Figure 2.9 provides an outline of a possible approach. The key driving force of human capital strategy is the organisation's strategic vision. Strategic vision determines the business strategy and required dynamic capabilities. These capabilities include reconfiguring, integration and recreation capabilities. Operational capabilities are driven by these dynamic capabilities and include operational processes and infrastructure requirements. Operational capabilities are the key drivers of human capital strategy. The human capital strategy translates operational capabilities into competency requirements that are converted through an organisational structure into individual competency requirements. This provides the basis for the more functional elements of human capital.

The functional elements include global talent management making use of predictive analytics to determine future talent requirements and existing talent gaps, given the availability of talent in the different global talent pools.

**Table 2.5: The impact of key driving forces on human capital management**

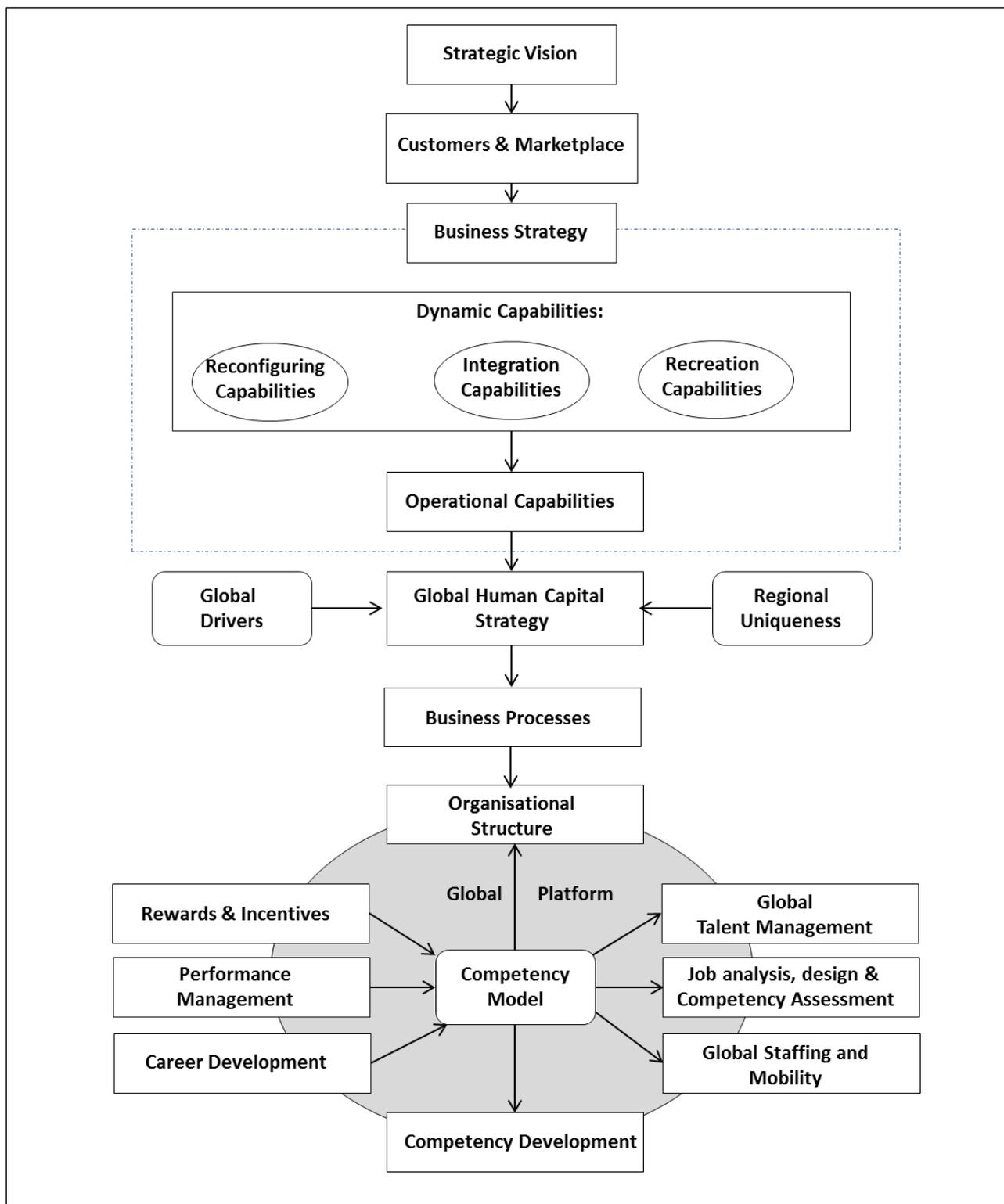
	<b>Strategic partner</b>	<b>Change agent</b>
<b>Deliverable</b>	<b>Align human capital management activities and results with company goals</b>	<b>Renew organisation that is more competitive</b>
	<ul style="list-style-type: none"> <li>• Translate dynamic capability requirements into knowledge creation and learning requirements</li> <li>• Use predictive analytics to determine future competency requirements for different strategies</li> <li>• Use customer behaviour as a key driver for alignment of human capital and company goals</li> </ul>	<ul style="list-style-type: none"> <li>• Create new capabilities through knowledge management and learning to deliver the business strategy through human capital</li> <li>• Use global competency assessments to determine competency gaps and align with operational process requirements</li> <li>• Ensure that the culture and human capability are aligned with customers and the marketplace</li> </ul>
	<b>Administrative expert</b>	<b>Employee champion</b>
<b>Deliverable</b>	<b>Increase efficiency of human capital management services</b>	<b>Maximise employee contributions</b>
	<ul style="list-style-type: none"> <li>• Develop global human capital management platforms enabled through social media and cloud computing</li> <li>• Use global collaboration to enable organisational learning and reduce the required investment in learning</li> </ul>	<ul style="list-style-type: none"> <li>• Provide collaboration opportunities for all human capital to collaborate with counterparts in other parts of the world</li> <li>• Provide collaboration processes for global teams to co-operate on projects to leverage the best competencies available</li> </ul>

	<p>platforms</p> <ul style="list-style-type: none"> <li>• Create global learning and development platforms allowing human capital to reduce learning lead time by learning from work done by counterparts in other parts of the world</li> <li>• Approach the organisation as a living organism constantly requiring change and improvement</li> </ul>	<ul style="list-style-type: none"> <li>• Use social media to match competency development requirements with the availability of external experts and learning material</li> <li>• Provide competency assessment platforms to enable human capital to determine competency gaps and available resources for competency development</li> <li>• Develop the culture and sub-culture required to deliver on the aligned model of strategy and human capability</li> </ul>
--	--	---

Source: Adapted from Ulrich cited in Friedman, 2007 & Gattorna, 2015.

Job analysis, design and competency assessment form the basis for linking individual competencies to operational dynamic capabilities. Competency modelling provides the basis for global staffing and creating mobility. Training and development, career development, performance development and rewards and incentives are all enabled through a global human capital platform. This platform is enabled through collaboration with social media and cloud computing as the technology building blocks that provide the basis for a global competency development.

Chapter 2 has provided a human capital management context to the study which has clearly indicated the increasing importance of a competency-based approach towards developing human capital. With this context, Chapter 3 will review the existing literature on competency development with the objective of developing a best practice framework for competency modelling.

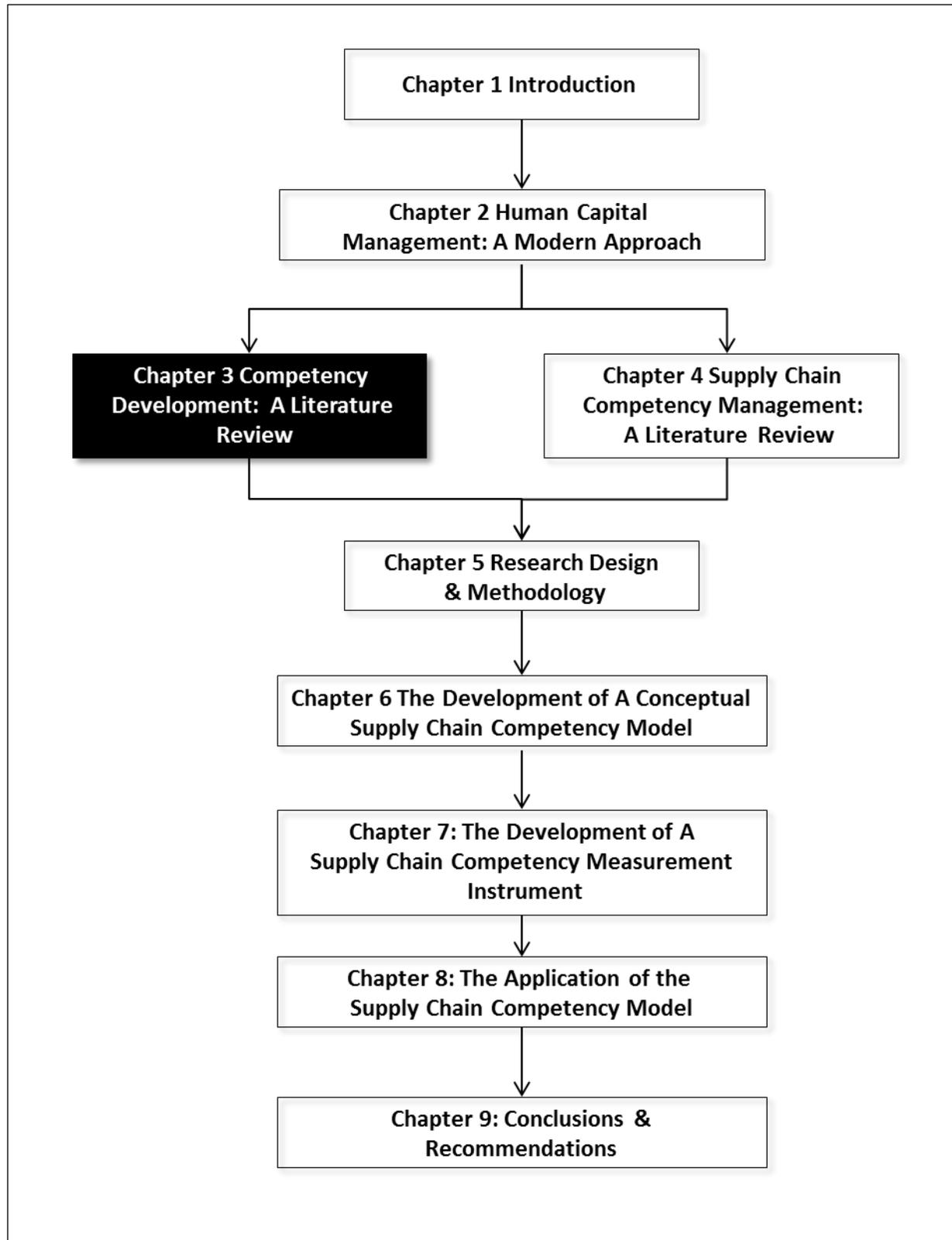


**Figure 2.10: Overview of modern human capital management**

Source: Adapted from Bingham, 2008 & Gattorna, 2015.

## CHAPTER 3

### COMPETENCY DEVELOPMENT: A LITERATURE REVIEW



### 3.1. INTRODUCTION

The aim of this chapter is to further explore the concept of competency-based human capital management by unpacking the following notions: a competency, competency modelling, and the best practices of competency-based management. The framework for human capital management outlined in Chapter 2 forms the contextual framework that is developed in more detail in this chapter. The chapter focuses specifically on the following aspects:

- Creating a better understanding for the concept of a competency;
- Defining competency models;
- Reviewing a number of competency models to create a better understanding; and
- Outlining the best practices for developing competency models.

### 3.2. DEFINITION OF A COMPETENCY

The concept of competency was developed by McClelland in the 1970s, which started the competency movement. In general, competencies can be defined as characteristics of people that differentiate performance in a specific job or role (Campion *et al.*, 2011).

Competencies are commonly conceptualised as a measurable pattern of knowledge, skills, abilities, behaviours, and other characteristics that differentiate high from average performance (Soderquist *et al.*, 2010). Competencies are conceptualised in Figure 3.1.



**Figure 3.1: Competencies defined**

Source: Sanghi, 2008.

In terms of this conceptualisation, motives and personal traits form the basis for skills and knowledge to generate certain observable behaviour.

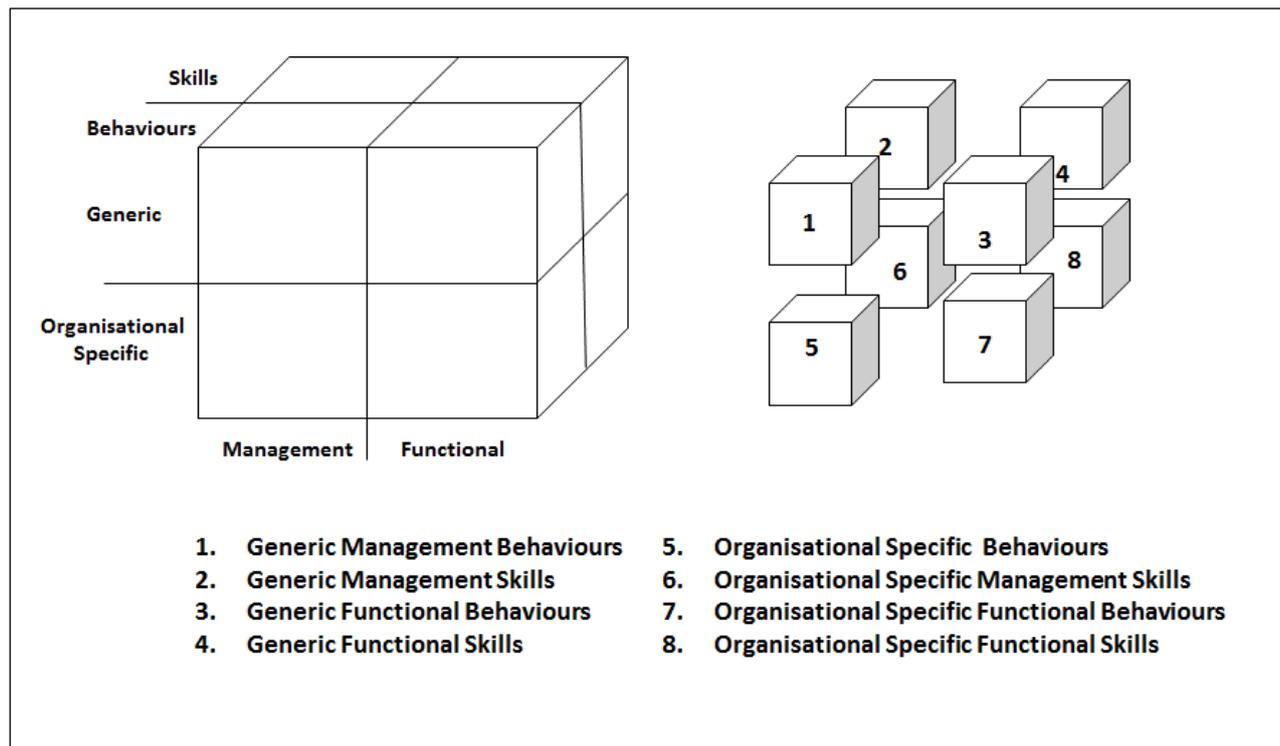
It is important to distinguish between different types of competencies. Table 3.1 below provides a typology of different types of competencies, their meaning, and the merits from a development perspective.

**Table 3.1: A summary of different perspectives on competencies**

Perspective on competencies	Definition/meaning of competencies	Major documented advantage	Major documented disadvantage
<b>Generic competencies</b>	Define common competencies across various organisations and levels of job positions	Defined from large samples and longitudinal field studies. Provide “ideas” for setting up corporate competency management systems	Too generally formulated. Many generic competencies might lack relevance in a particular sector and/or firm
<b>Organisation-specific competencies</b>	Are developed following specific methodologies relying on extensive interviewing in the concerned organisation	Provide specific and relevant competency frameworks for the particular needs of an organisation	Can sometimes lead to “invention” of competencies that are poorly formulated, and inadequately defined and assessed
<b>Managerial competencies</b>	Define essential managerial competencies in basic managerial functions such as planning, organising, controlling, motivating and coordinating	Support human resource management (HRM) of the managerial layers in an organisation. Help instil a spirit of flexibility and empowerment in all layers of the organisation	Tend to be very vaguely formulated if they are of a generic nature
<b>Operational/ Functional competencies</b>	Define specific job-related competencies in a job description manner	Enable organisations that undergo constant change to keep up with the competency evolution. Particularly useful in public organisations where market mechanisms of hire/fire cannot be applied	Are a “necessary minimum” and do not really contribute to competitive advantage. If not frequently updated, they might “freeze” the organisation in a system of outdated competencies
<b>Competencies as skills</b>	Define the objective threshold sufficiency, and higher levels of skills with respect to what people are doing in their job. Require an operational definition	Help in determining whether a person reaches a pre-defined threshold level or not, with respect to the ability of performing a specific job	Similar to operational competencies
<b>Competencies as behaviours</b>	Define the more subjective achievement of expectations and degree of excellence of different specific behaviours adopted when exercising a job	Help to determine whether a person is apt to excel in jobs where specific degrees of behavioural competencies are required. Enable competitive differentiation	Risk of “inventing” competencies that are not really professionally related. Such attributes should be included with much precaution

Source: Soderquist *et al.*, 2010.

The integration of the competency perspectives of Table 3.1 can lead to a competency typology consisting of a combination of the three identified clusters “Generic compared to Organisation-Specific Competencies”, “Managerial compared to Operational Competencies” and “Skills compared to Behaviours”. This can be illustrated in a box matrix, as in Figure 3.2, comprising eight specific types of competencies that can be used as a basis for developing an operational competency model in an organisation.



**Figure 3.2: The proposed typology comprising eight different types of competencies**

Source: Soderquist *et al.*, 2010.

These different competencies will now be integrated into a process for developing a competency model, which is the focus of the next section.

### 3.3. DEFINING COMPETENCY MODELS

Competency models refer to collections of knowledge, skills, abilities and other characteristics that are needed for effective performance in the jobs in question. The individual knowledge, skills, abilities and other characteristics or combinations of KSAOs are the competencies, and the set of competencies are typically referred to as the competency model (Campion *et al.*, 2011).

A competency model is a detailed description of behaviours and abilities that employees are required to have to be effective in a job (Mansfield, 1996). The competency model is useful to identify capabilities and attributes needed to meet current and future staffing needs, and to focus

employee development efforts to eliminate the gap between capabilities needed and those available (Campion *et al.*, 2011).

Competency models are often confused with job analysis and job descriptions and for clarity purposes, the differences are outlined in Table 3.2.

**Table 3.2: Key differences between competency modelling and job analysis**

1. Executives typically pay more attention to competency modelling.
2. Competency models often attempt to distinguish top performers from average performers.
3. Competency models frequently include descriptions of how the competencies change or progress with employee level.
4. Competency models are usually directly linked to business objectives and strategies.
5. Competency models are typically developed top down (start with executives) rather than bottom up (start with line employees).
6. Competency models may consider future job requirements either directly or indirectly.
7. Competency models may be presented in a manner that facilitates ease of use (e.g. organisation-specific language, pictures, or schematics that facilitate memorableness).
8. Usually, a finite number of competencies are identified and applied across multiple functions or job families.
9. Competency models are frequently used actively to align the HR systems.
10. Competency models are often an organisational development intervention that seeks broad organisational change as opposed to a simple data collection effort.

Source: Champion *et al.*, 2011.

Competency models translate the requirement for organisational capabilities into competency requirements for individual jobs or roles. They thus have a much wider and more strategic focus than job analysis and form a direct link to organisational strategy.

The terminology that is used in the process of developing competency models needs further clarification and these terms are defined in Table 3.3 below. The terminology through the remainder of the study is based on these definitions.

With the basic definitions clarified, a number of competency models will be discussed in the next section to create a basic understanding of competency models.

**Table 3.3: Competency modelling terminology**

Term	Definition	Degree of detail
<b>Competency framework</b>	Broad framework for integrating, organising and aligning various competency models reflective of the organisation's strategy and vision	<p style="text-align: center;"><b>Broad organisational focus:</b></p>  <p style="text-align: center;"><b>Specific job focus</b></p>
<b>Competency model</b>	Collection of competencies that are reflective of performance in a particular job, job family or functional area	
<b>Competency dimension/ Competency</b>	Cluster of related knowledge, skills, abilities and characteristics that affect major parts of a job, that correlate with performance on the job, and that can be measured against well accepted standards	
<b>Behavioural indicator</b>	Highly specific observable action that may be demonstrated on the job or what a particular person possesses	
<b>Proficiency level</b>	Reflect the skill level or expertise that is required to successfully complete a job	
<b>Competency profile</b>	Definition of the competency requirements for a specific job based on the job profile and the competency profile	
<b>Performance level</b>	Reflect the level of performance that is demonstrated by the individual performing the job and provides clarity on what is expected	

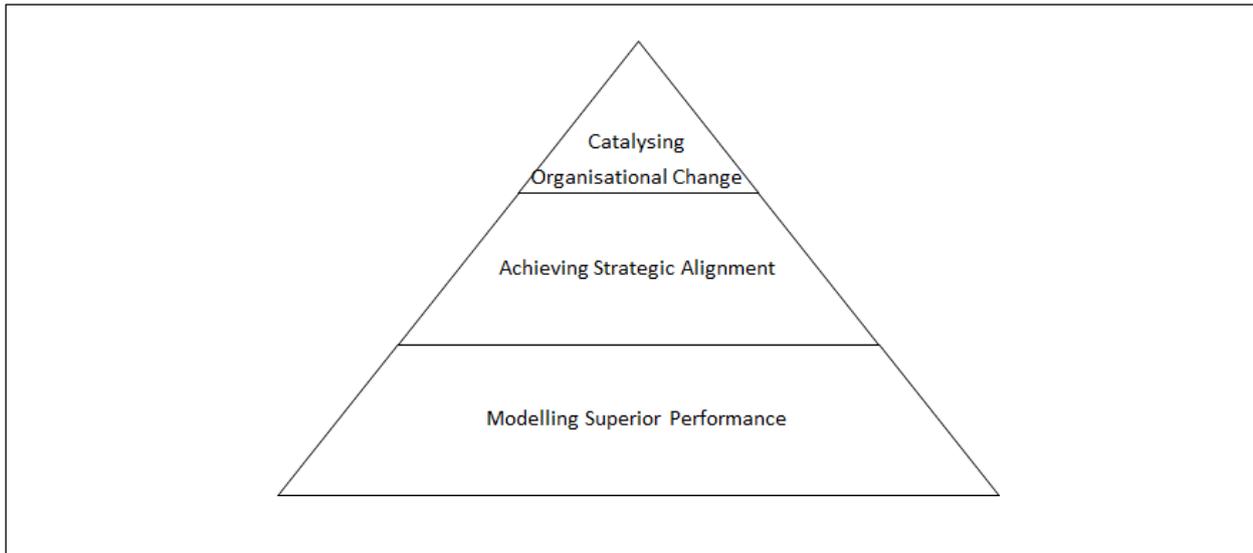
Source: Adapted from Campion *et al.*, 2011.

### 3.4. THE ROLE OF COMPETENCIES

The role of competencies in the organisation needs to be explored to provide further context to understanding competency models and the best practices for competency modelling. The next section seeks to provide an overview of the use and application of competencies within the organisation.

#### 3.4.1. Types of competency modelling

Different types of competency modelling exist. Figure 3.3 outlines types of competency modelling, namely modelling superior performance, achieving strategic alignment and catalysing organisational change. The initial focus of competency modelling was placed on modelling superior performance of job incumbents. The more strategic focus on human capital resulted in a different emphasis, that of achieving strategic alignment within an organisation. A more recent trend is that of being a catalyst for organisational change. The application of competency modelling has become more strategic in nature as management of human capital has become more competency based. Another contributing factor is globalisation of managing human capital (Dai & Liang, 2012). The increased strategic focus will be discussed in more detail.



**Figure 3.3: Types of competency modelling**

Source: Dai and Liang, 2012.

### 3.4.2. Strategic focus

An organisation's competitiveness is dependent on its capability to provide products and services more efficiently than competitors that focused on the same marketplace. Today's intense competition requires that organisations outperform the competition simultaneously in several areas such as innovativeness and responsiveness to their customers, without trade-off. Therefore, organisations should develop core competences that will provide a competitive advantage over their competitors in meeting fast changing market requirements. Organisations that are able to continually build new strategic assets faster and more cost effective than those of their competitors will create long-term competitive advantages. In this process, core competences have a pivotal role to play. The number of such core competences that a firm can develop is extremely limited and the firm has to excel in them in order to be successful (Narula & Hagedroon, 1999).

Prahalad and Hamel (1990) defined core competence as the combination of skills and technology that provides particular value to customers. Core competences are the basis of competitiveness and individual product or services are the outcomes. Any organisation that wishes to achieve growth and profitability targets in a future much more competitive market place, will be required to develop the competence that will make disproportionate contributions to future customer value. Developing core competences becomes important for sustainable competitive advantage because advantages resulting from the product-price-performance trade-offs are almost always short term (Kak & Sushil, 2002).

According to Errin (2004), in order to compete with their competitors, firms have to develop competitive competences. Core competences enable the organisation to envision the markets that do not yet exist. Top management of organisations should also have an idea of competitors'

competences, as the secret of sustainable competitive advantage lies in the core competencies that are difficult to replicate.

### 3.4.3. Other applications

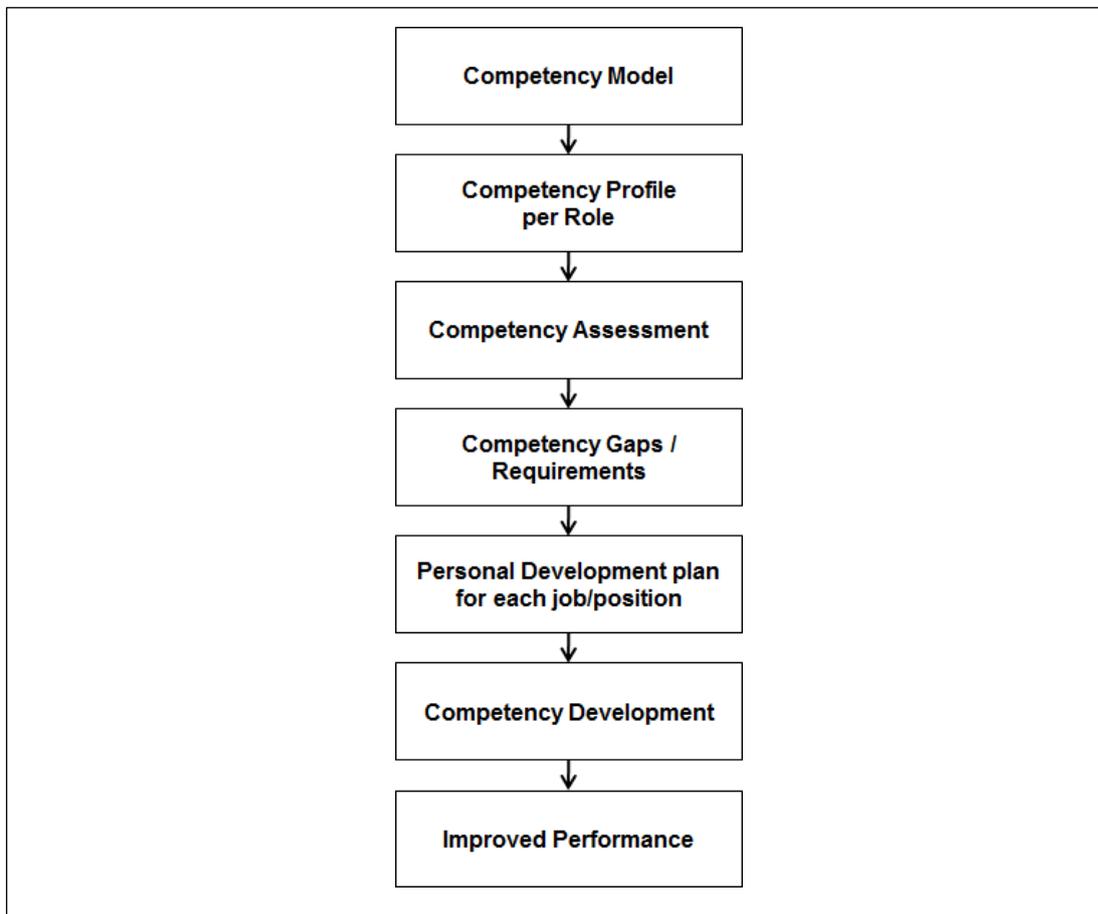
At the level of individual competencies, Schoonover, Schoonover, Nemerov and Ehly (2000) remarked that competencies provide significant help with key problems, such as clarifying workforce standards and expectations, and aligning individuals with the organisation's business strategies. Table 3.4 provides a summary of the potential benefits of a competency model for human resource management.

**Table 3.4: The application of competency models**

Human resource element	Potential benefits of a competency model
<b>Selection</b>	<ul style="list-style-type: none"> <li>• Provides a complete picture of the job requirements</li> <li>• Increases the likelihood of hiring people who will succeed in the job</li> <li>• Minimises the investment (both time and money) in people who may not meet the company's expectations</li> <li>• Ensures a more systematic interview process</li> <li>• Helps distinguish between competencies that are trainable and those that are more difficult to develop</li> </ul>
<b>Training and development</b>	<ul style="list-style-type: none"> <li>• Enables people to focus on the skills, knowledge and characteristics that have the most impact on effectiveness</li> <li>• Ensures that training and development opportunities are aligned with organisational values and strategies</li> <li>• Makes the most effective use of training and development time and dollars</li> <li>• Provides a framework for on-going coaching and feedback</li> </ul>
<b>Appraisal</b>	<ul style="list-style-type: none"> <li>• Provides a shared understanding of what will be monitored and measured</li> <li>• Focuses and facilitates the performance appraisal discussion</li> <li>• Provides focus for gaining information about a person's behaviour on the job</li> </ul>
<b>Succession planning</b>	<ul style="list-style-type: none"> <li>• Clarifies the skills, knowledge, and characteristics required for the job or role in question</li> <li>• Provides a method to assess a candidate's readiness for the role</li> <li>• Focuses training and development plans to address missing competencies</li> <li>• Allows an organisation to measure its "bench strength" (number of high-potential performers)</li> </ul>

Source: Lucia and Lepsinger, 1999.

Based on the potential benefits of a competency model on human capital management, the application process of a competency model is outlined in Figure 3.4. The competency profile for each position or job should form the basis for skills assessment and the subsequent development of a personal development plan.



**Figure 3.4: The application of a competency model in competency development**

Source: Adapted from Sanghi, 2008.

### **3.5. A REVIEW OF EXISTING COMPETENCY MODELS**

To provide a better understanding of competency models, a number of competency models were reviewed and are discussed in the following section. This also provides a background to establishing an approach and guidelines for developing competency models, which is discussed in the last section of the chapter.

#### **3.5.1. The Saville & Holdsworth Ltd (SHL) model**

SHL is a consulting company that specialises in the development and application of competency models focusing on human interaction in work environments. It has a specific area of focus on leadership development in which the company has established a worldwide track record. The SHL Universal Competency Framework (UCF) provides a framework that defines the relationship

between competency potential, competency requirements and the competencies themselves. The model provides a basis for the assessment and application of the model across a number of industries. It impacts not only the selection and development of people, but also how performance can be managed in the workplace (Bartram, 2011).

The UCF is defined in terms of a three-tier structure. The first tier consists of a set of 112 specific component competencies. The structure defines the relationships between these components, their mapping onto a set of 20 broader competency dimensions (the second tier) and their loadings on eight general competency factors (the third tier). This top tier is explained in Table 3.5.

**Table 3.5: The SHL “great eight” managerial competencies**

<b>SHL’s “great eight” competencies</b>	
<b>Leading and deciding</b>	Takes control and exercises leadership. Initiates action, gives direction and takes responsibility.
<b>Supporting and co-operating</b>	Supports others and shows respect and positive regard for them in social situations. Puts people first, working effectively with individuals and teams, clients and staff. Behaves consistently with clear personal values that complement those of the organisation.
<b>Interacting and presenting</b>	Communicates and networks effectively. Successfully persuades and influences others. Relates to others in a confident and relaxed manner.
<b>Analysing and interpreting</b>	Shows evidence of clear analytical thinking. Gets to the heart of complex problems and issues. Applies own expertise effectively. Quickly learns new technology. Communicates well in writing.
<b>Creating and conceptualising</b>	Open to new ideas and experiences. Seeks out learning opportunities. Handles situations and problems with innovation and creativity. Thinks broadly and strategically. Supports and drives organisational change.
<b>Organising and executing</b>	Plans ahead and works in a systematic and organised way. Follows directions and procedures. Focuses on customer satisfaction and delivers a quality service or product to the agreed standards.
<b>Adapting and coping</b>	Adapts and responds well to change. Manages pressure effectively and copes with setbacks.
<b>Enterprising and performing</b>	Focuses on results and achieving personal work objectives. Works best when work is related closely to results and the impact of personal efforts is obvious. Shows an understanding of business, commerce and finance. Seeks opportunities for self-development and career advancement.

Source: Bartram, 2011.

A means has been created of developing tailored, individual client competency models that are linked to a common, generic, foundation. Through this foundation, tools can be linked into the

range of assessments and integrated with a range of human capital processes. The key features of the SHL framework comprise the following:

- It is an integrated framework which covers all aspects from job analysis through to measurement in the employee lifecycle.
- It further enables the strategic (e.g. mergers and acquisitions, succession planning, change management) and tactical (e.g. selection, personal development) use of competency modelling in organisations.
- “Its structure provides for descriptions at a broad, psychometrically meaningful eight factor-level description, a more focused 20-dimensional level of description or a very detailed component level (112 components)” (Bartram, 2011).
- The toolset includes assessment items, behavioural anchors, everyday terms, development interventions and links to job tasks.

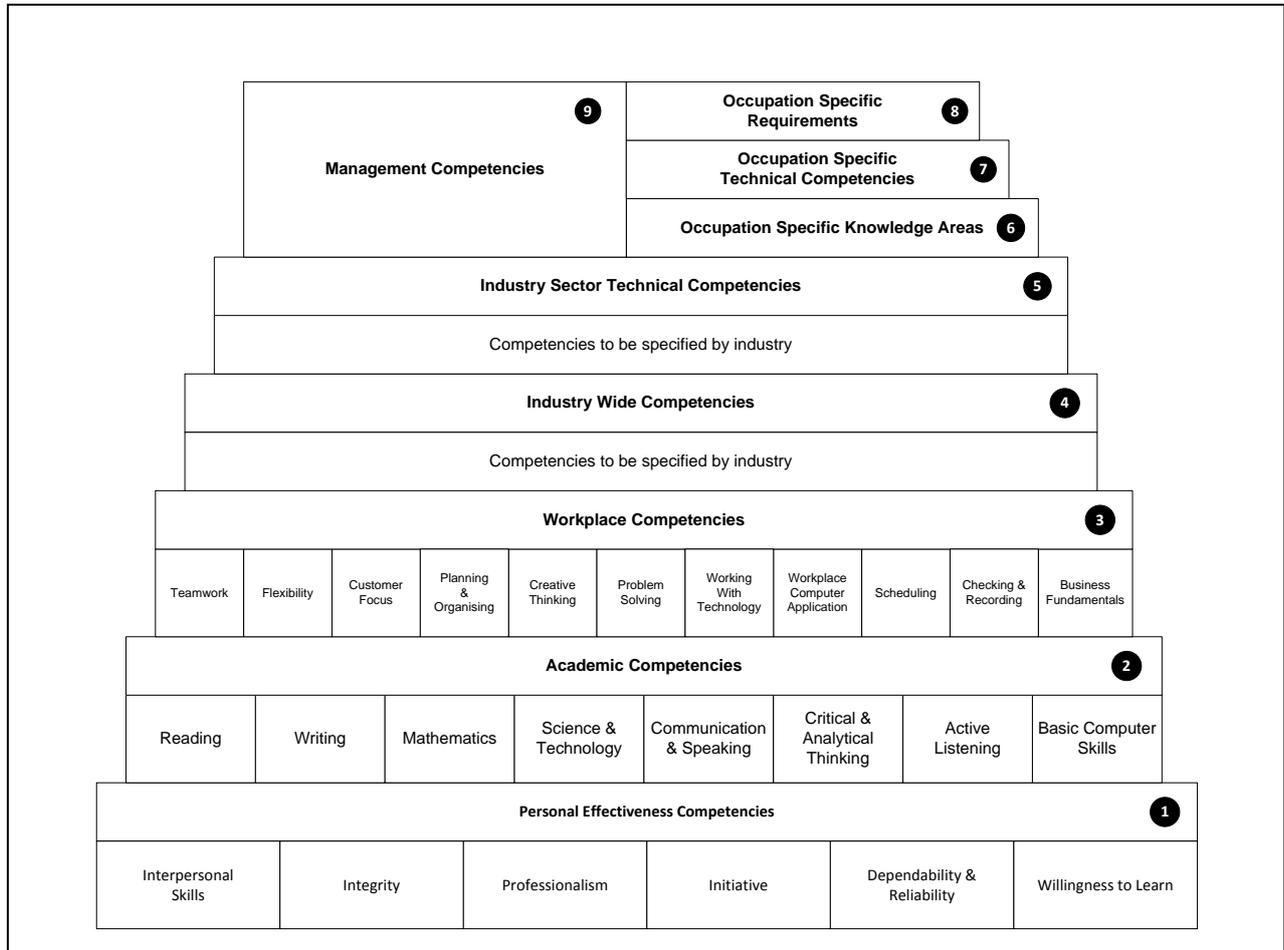
All SHL’s standardised competency models have been mapped to the component structure.

The framework has been used with a large number of major clients to build their own integrated corporate competency models. It has also been used to map existing client models (Bartram, 2011).

The SHL model focuses primarily on the human interaction element of jobs. Functional competencies are excluded from the model. The competencies outlined in Table 3.5 are enabled through a rigorous process of proficiency standards and measurement for assessment purposes. Unfortunately, due to the commercial nature of the company and the value of the intellectual property, these are not available in the public domain and can thus not be evaluated.

### **3.5.2. The Competency Model Clearinghouse**

The Competency Clearinghouse is an organisation that focuses on the development of competency models for various industries and applications. Figure 3.5 provides an overview of a typical competency model developed by the Competency Clearinghouse.



**Figure 3.5: The competency model from Competency Model Clearinghouse**

Source: Career One Stop, 2013.

The competency model from the Competency Model Clearinghouse provides a generic structure of competencies that can then be customised for different industry applications. The structure of the model defines nine different levels of competencies:

- Level 1: Personal effectiveness competencies
- Level 2: Academic competencies
- Level 3: Workplace competencies
- Level 4: Industry-wide competencies
- Level 5: Industry technical competencies
- Level 6: Occupation-specific knowledge areas
- Level 7: Occupation-specific technical competencies
- Level 8: Occupation-specific requirements
- Level 9: Management competencies.

The competencies start with a foundation basis that focuses on the individual with competencies that are applicable to most work environments. From the foundation level, more focus is provided through the levels up to level 8, which focuses on occupation-specific competencies (Career One

Stop, 2013). The detail descriptions of each competency within the different categories are provided in Appendix A. Although the model from the Competency Clearinghouse provides a basis for learning and development, no detail is provided on levels of proficiency required or the assessment of the different competencies.

### **3.5.3. The Human Resource competency model**

The Society for Human Resource Management (SHRM) developed a competency model for human resource management which was released in 2012. The model was developed through several phases of model development and content validation to provide specific behaviours that define proficiency at each stage of a human resource professional's career. This competency model is designed to serve as a resource for human resource professionals interested in developing proficiency within each critical competency, from professionals just entering their human resource career to those at the executive level (Society for Human Resource Management, 2013).

To create this model, the Society for Human Resource Management followed the best practices identified by the Society for Industrial Organizational Psychology (SIOP) taskforce on competency modelling and job analysis (Campion *et al.*, 2011; Shippmann *et al.*, 2000). The model was developed in three phases. The first phase was model development, the second phase was content validation, and the third phase was criterion validation. SHRM developed the initial model based on a thorough review and synthesis of the relevant literature, and input from over 1 200 HR professionals during 111 focus groups in 29 cities across the world. Together with the content validation, discussed next, the perspectives of HR professionals from 33 different nations were represented (Society for Human Resource Management, 2013).

The Society for Human Resource Management's Elements for HR Success comprise nine primary competencies:

- Human resource technical expertise and practice
- Relationship management
- Consultation
- Organisational leadership and navigation
- Communication
- Global and cultural effectiveness
- Ethical practice
- Critical evaluation
- Business acumen.

For each competency, an overall definition is provided, while sub-competencies are associated with the primary competency, including behaviours demonstrated by individuals highest in proficiency on that competency, and behavioural standards in which an HR professional at the relevant career stage should engage to be successful (Society for Human Resource Management, 2013). Each competency consists of five distinct elements, namely title, definition, sub-competencies, behaviours and proficiency standards. These elements are discussed in Table 3.6 below.

**Table 3.6: Elements of competency definition**

<b>Key</b>	
<b>Title</b>	This is the title of the competency
<b>Definition</b>	This is the overall definition of the competency
<b>Sub-competencies</b>	These are competencies related to and/or subsumed by the relevant general competency
<b>Behaviours</b>	These are behaviours demonstrated by individuals at the highest level of proficiency on the indicated competency
<b>Proficiency standards</b>	These are standards for proficiency at the four career stages (entry, mid, senior, and executive). Each proficiency standard represents a behavioural standard in which an HR professional at the relevant level should engage to be successful

Source: Society for Human Resource Management, 2013.

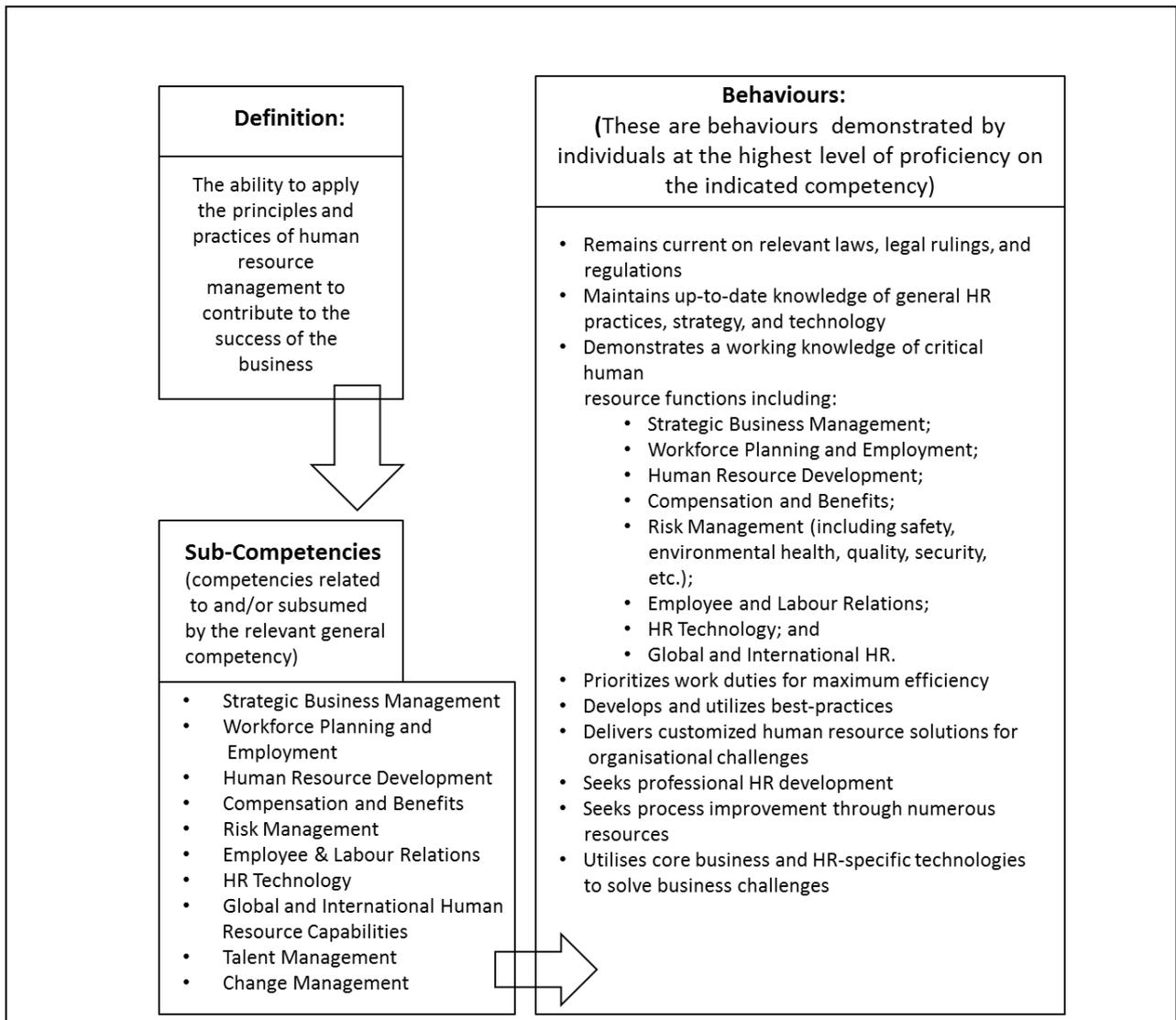
The next aspect of the competency model is the development of proficiency standards. The proficiency standards developed for each of the nine main competencies distinguish between four different career levels, namely entry, mid, senior, and executive. Four different levels of proficiency were identified and these are provided in the Table 3.7 below.

**Table 3.7: An example of proficiency standards**

<b>Level 1:</b>	<p>An <b>“entry level”</b> HR professional is characterised in the following way:</p> <ul style="list-style-type: none"> <li>• Has 0-2 years of HR experience</li> <li>• Is a specialist in a specific support function, or is a generalist with limited experience</li> <li>• Holds a formal title such as, but not limited to, HR assistant, junior recruiter, or benefits clerk</li> </ul> <p><b>For example:</b> Jamie is relatively new to the HR profession and has just over one year of experience as an HR professional. While Jamie is a specialist who supports a specific function in the HR department, Jamie has generalist colleagues with similar levels of experience and responsibility who support specific functions in the HR department. Jamie has responsibilities such as, but not limited to, supporting HR initiatives, executing tasks passed down from management, and operating at the tactical and transactional levels. Jamie and colleagues at Jamie’s level hold titles such as, but not limited to, HR assistant, junior recruiter, and benefits clerk.</p>
<b>Level 2:</b>	<p>A <b>“mid-level”</b> HR professional is characterised in the following way:</p> <ul style="list-style-type: none"> <li>• Has 3-7 years of HR experience</li> <li>• Is a generalist, or is a senior specialist</li> <li>• Manages projects or programmes</li> <li>• Holds a formal title such as, but not limited to, HR manager, generalist, or senior specialist</li> </ul> <p><b>For example:</b> Tyler has around five years of experience as an HR professional. While Tyler is an HR generalist, Tyler has colleagues with similar levels of experience and responsibility who are senior HR specialists. Tyler has responsibilities such as, but not limited to, managing projects, programmes, and initiatives, implementing plans passed down, and delegating tasks to entry-level staff. Tyler and colleagues at Tyler’s level hold titles such as, but not limited to, HR manager, HR generalist, and HR specialist</p>
<b>Level 3:</b>	<p>A <b>“senior level”</b> HR professional is characterised in the following way:</p> <ul style="list-style-type: none"> <li>• Has 8-14 years of HR experience</li> <li>• Is a very experienced generalist or specialist</li> <li>• Holds a formal title such as, but not limited to, senior manager, director, or principal</li> </ul> <p><b>For example:</b> Adison is a seasoned HR professional with around ten years of experience. While Adison is a very experienced specialist, Adison has colleagues with similar levels of experience and responsibility who are very experienced generalists. Adison has responsibilities such as, but not limited to, developing and leading implementation plans and analysing business information. Adison and colleagues at Adison’s level hold titles such as, but not limited to, director or principal.</p>
<b>Level 4:</b>	<p>An <b>“executive level”</b> HR professional is characterised in the following way:</p> <ul style="list-style-type: none"> <li>• Has 15 or more years of experience</li> <li>• Typically is one of the most senior leaders in HR</li> <li>• Holds the top HR job in the organisation or VP role</li> </ul> <p><b>For example:</b> Helen is the organisation’s most senior HR professional with 15 years of experience. As a member of the organisation’s executive committee, Helen serves as an organisational leader and designer of human capital strategy. While Helen knows of individuals with similar responsibilities at other organisations who have more years of experience as an HR professional, Helen and individuals at a similar level hold titles such as, but not limited to, chief human resource officer or vice president.</p>

Source: Society for Human Resource Management, 2013.

When this is applied to each of the main competencies, the outcome is illustrated in Figure 3.6 below.



**Figure 3.6: Competency definition**

Source: Society for Human Resource Management, 2013.

This competency definition and outline of associated behaviours of each competency is supported by a set of proficiency definitions as described in Tables 3.8 and 3.9.

**Table 3.8: Proficiency definitions for levels 1 and 2**

<b>Competency 1: Human resource technical expertise and practice</b>	
<b>Proficiency standards by career level - Behavioural standards in which an HR professional at the relevant level should engage to be successful</b>	
<b>Entry level</b>	<b>Mid-level</b>
<ul style="list-style-type: none"> <li>• Identifies ways to improve operational efficiency</li> <li>• Routes stakeholder questions to the appropriate area</li> <li>• Uses judgment to determine when to consult with higher-level management on problems or other issues</li> <li>• Provides service to stakeholders</li> <li>• Generates and, when appropriate, implements solutions within designated area of responsibility</li> <li>• Employs standard operating procedures and policies when performing HR transactions</li> <li>• Reports workplace risk management issues to leadership (e.g. safety, health, etc.)</li> <li>• Develops knowledge of general HR practices and technology</li> <li>• Executes transactions with minimal errors</li> <li>• Follows relevant laws and regulations</li> <li>• Works under the general direction of a more experienced HR professional</li> <li>• Uses relevant HR technology systems for administrative and service needs</li> <li>• Demonstrates a willingness to learn</li> </ul>	<ul style="list-style-type: none"> <li>• Serves as the HR subject-matter expert to managers</li> <li>• Conducts investigations of workplace policy violations</li> <li>• Manages day-to-day HR functions</li> <li>• Implements change based on proven change-management techniques</li> <li>• Applies policies and procedures across the organisation</li> <li>• Interprets both policies and changes to policy</li> <li>• Applies compliance knowledge to protect organisation</li> <li>• Oversees risk management issues (e.g. safety, health, legal issues, etc.)</li> <li>• Implements solutions within designated area of responsibility</li> <li>• Seeks ways to proactively improve organisational processes and outcomes</li> <li>• Implements HR technology plans</li> <li>• Applies experience and expertise to research solutions</li> <li>• Reports trends to senior leadership</li> <li>• Recommends policy changes to support business needs</li> </ul>

Source: Society for Human Resource Management, 2013.

The Society for Human Resource Management's competency model is one of the most recognised models recently developed, using the same best-practice framework for competency modelling that is discussed in the section of this chapter. More detailed information regarding aspects such as proficiency standards is also available in the public domain. It is therefore a good reference model to use.

**Table 3.9: Proficiency definitions for levels 3 and 4**

<b>Competency 1: Human resource technical expertise and practice</b>	
<b>Proficiency standards by career level - Behavioural standards in which an HR professional at the relevant level should engage to be successful</b>	
<b>Senior level</b>	<b>Executive level</b>
<ul style="list-style-type: none"> <li>• Provides expertise to support staff development</li> <li>• Implements HR operational strategy</li> <li>• Partners with executive-level staff throughout the organisation to get input on HR decisions</li> <li>• Ensures the delivery of high-quality HR processes</li> <li>• Evaluates potential issues or service needs and operationalises strategic response</li> <li>• Determines best practices to support organisational direction</li> <li>• Designs strategy for organisational culture</li> <li>• Mentors HR professionals and others within the organisation</li> <li>• Recommends methods for integration of HR services with organisational initiatives</li> <li>• Recommends HR technology decisions</li> <li>• Develops policies and procedures consistent with organisational values and goals</li> <li>• Analyses functional programmes</li> <li>• Assesses compliance risks</li> </ul>	<ul style="list-style-type: none"> <li>• Establishes criteria for compliance responsibilities</li> <li>• Assumes responsibility for HR and business outcomes</li> <li>• Assesses strategic organisational HR needs</li> <li>• Educates and advises executive team on strategic HR issues as a factor in decision-making</li> <li>• Applies broad-based HR knowledge to business needs in a proactive manner</li> <li>• Ensures alignment of HR policies and procedures with organisational values and goals</li> <li>• Influences direction and creates a vision for the HR team</li> <li>• Aligns the delivery of HR services to proactively integrate with organisational initiatives</li> <li>• Assesses business situations and develops strategies to improve organisational performance</li> <li>• Provides balanced long-term and short-term strategic vision</li> <li>• Evaluates potential issues or service needs and proactively develops strategic response</li> <li>• Designs proactive strategic initiatives</li> <li>• Oversees HR issues involving legal and financial risk to organisation</li> <li>• Provides vision for achieving mission objectives through human capital strategy</li> <li>• Evaluates strategic position in relation to internal and external forces</li> <li>• Sets HR technology strategy</li> </ul>

Source: Society for Human Resource Management, 2013.

### **3.6. DEVELOPING COMPETENCY MODELS**

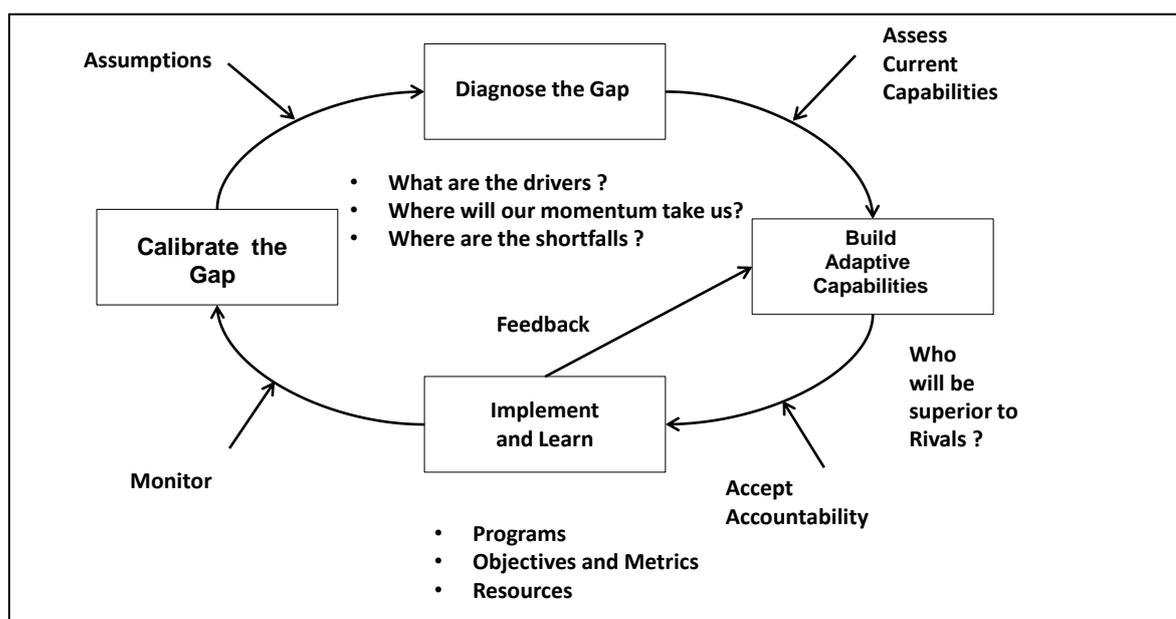
A best practice model was developed by Champion *et al.* (2011) for competency modelling and the development of competency models. This model was used as a basis for developing a methodology and approach towards developing competency models. A review of other research on competency modelling provided further guidelines which are discussed in the following sections and will be integrated with this framework.

### 3.6.1. Consider the organisational context

Competency models are often customised to specific requirements and strategic objectives of organisations. Customisation includes not only the specific competencies developed, but also the way in which the competencies are described. The context includes all those factors that influence the employee behaviours that the model is trying to improve, including the organisational culture, life stage, market, customers, and employee relations, presence of a union, and strengths and weaknesses of its management. In addition, although many organisations will adopt competencies that are similar in content and can be applied universally regardless of the organisational context (e.g. adaptability, communication skills), successful competency models also identify competencies that align to corporate strategy and foster competitive advantage (Campion *et al.*, 2011). Developing competency models thus always needs to be aligned with unique organisational requirements and practices. Generic competency models can provide a good basis but will have to be adapted and aligned with the unique requirements of the organisation.

### 3.6.2. Dynamic capabilities as the core driver

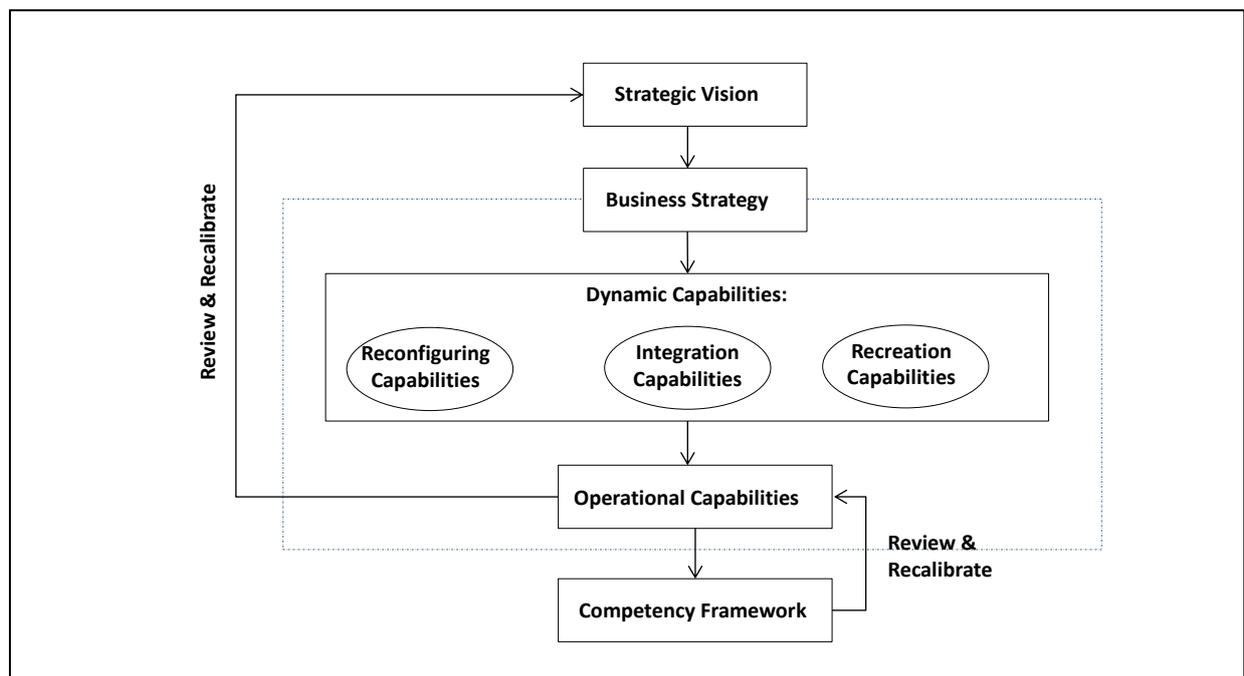
The concept of dynamic capabilities as replacement for the traditional concept of organisational strategy was explained in the previous chapter. Dynamic capabilities are also of key importance for developing competency models, which are thus essentially the mechanism for translating dynamic capabilities into individual competencies. The process of developing and updating dynamic capabilities can thus be seen as the key driver of competency models. This process is outlined in Figure 3.7 below.



**Figure 3.7: Capability development process**

Source: Adapted from Day, 2011.

The process of developing dynamic capabilities is a continuous process that is the fundamental principle of dynamic capabilities. These capabilities are constantly reviewed based on developments in the competitive landscape. As the competitive landscape is changing, a gap might develop in the current capability set of the organisation. Adaptive capabilities will constantly be developed and implemented through a learning process. Success is then monitored and the gap is calibrated. If this is translated into the process of developing and calibrating dynamic capabilities, the competency framework is dictated by the set of dynamic capabilities and the resulting operational capabilities. The process of developing the competency framework is illustrated in Figure 3.8 below.



**Figure 3.8: Process of developing the competency framework**

The competency framework is thus also dynamic in nature and will constantly evolve, based on the dynamic capabilities required to achieve the strategic vision of the organisation. The link between dynamic capabilities and competencies was already defined in work of Teece *et al.* (1997). The link between business strategy and a competency framework is also confirmed by Ulrich (cited in Friedman, 2007).

### 3.6.3. Involvement of the executive team

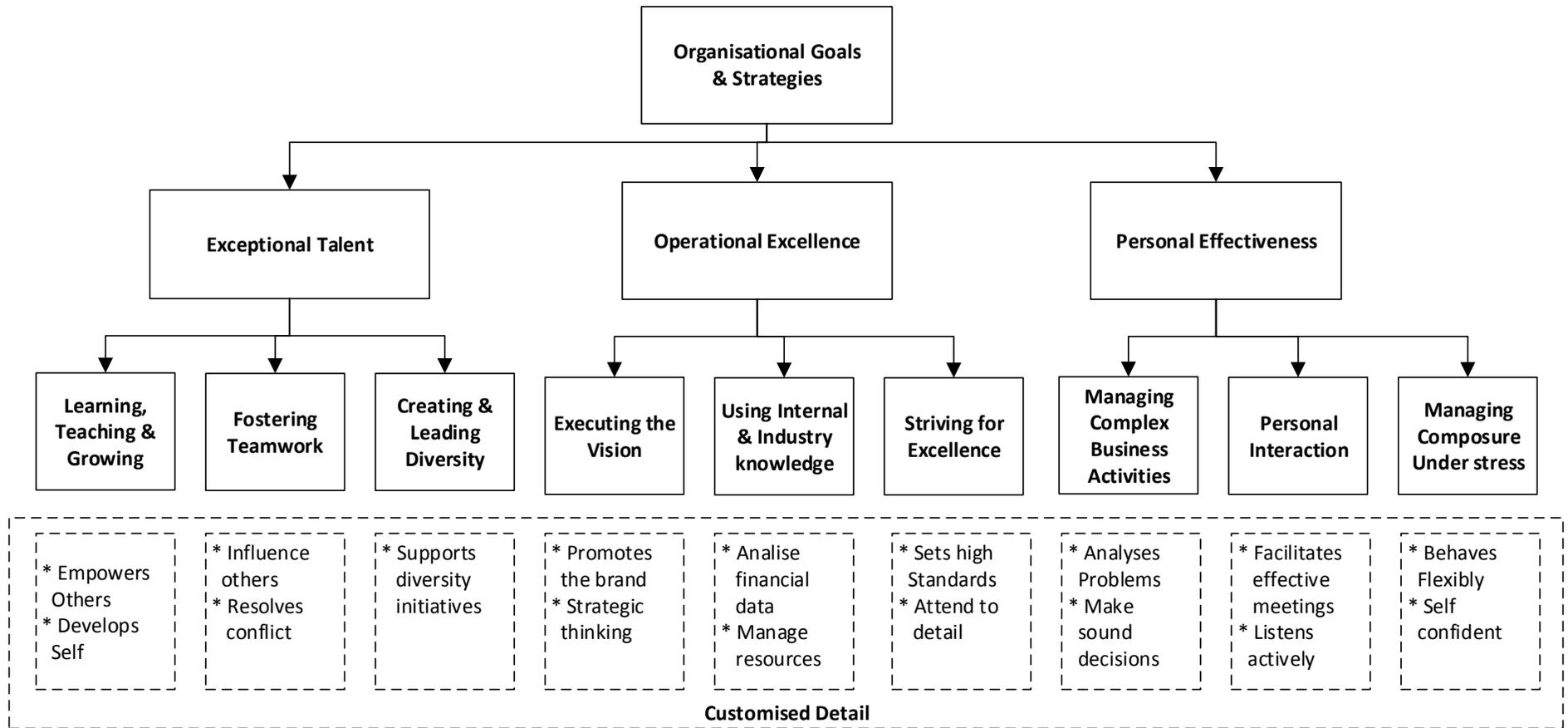
Traditional job analysis often starts with collecting information from employees. This certainly has its advantages, such as getting information from the people actually doing the work. However, it is better to start competency modelling with top executives (Campion *et al.*, 2011). Leadership engagement is also important because executives are more likely to have insight on the future

direction of the organisation and are thus in a better position to provide information on future job requirements. Top executives may also be more helpful in ensuring that the proper organisational language is used in the competency model. Although the effort will start with executives, all levels of employees will likely be involved in the development of the model as will be described in later sections of this document.

#### **3.6.4. Linking competency models to organisational goals and objectives**

The link between dynamic capabilities and organisational goals is that dynamic capabilities have less of a time dimension and are more strategic in nature. Organisational goals and objectives define organisational performance that needs to be achieved using the dynamic capabilities as mechanisms to achieve the performance. Organisational goals thus provide almost a performance target to the competency model, which provides guidelines of the level of competency required to achieve the set performance targets. As such, organisational goals need to be translated into competencies. Figure 3.9 provides an illustration of this principle.

Although competency development may start with a clear link to organisational goals, it is also quite likely that organisational goals will affect details such as the proficiency levels linked to the competencies. For example, much like establishing effective performance objectives in a performance management system, the most effective proficiency anchors will have a clear linkage or alignment to organisational goals. Thus, the factors that distinguish various levels of the competency all tie back to the goals of the business/organisation (Campion *et al.*, 2011).

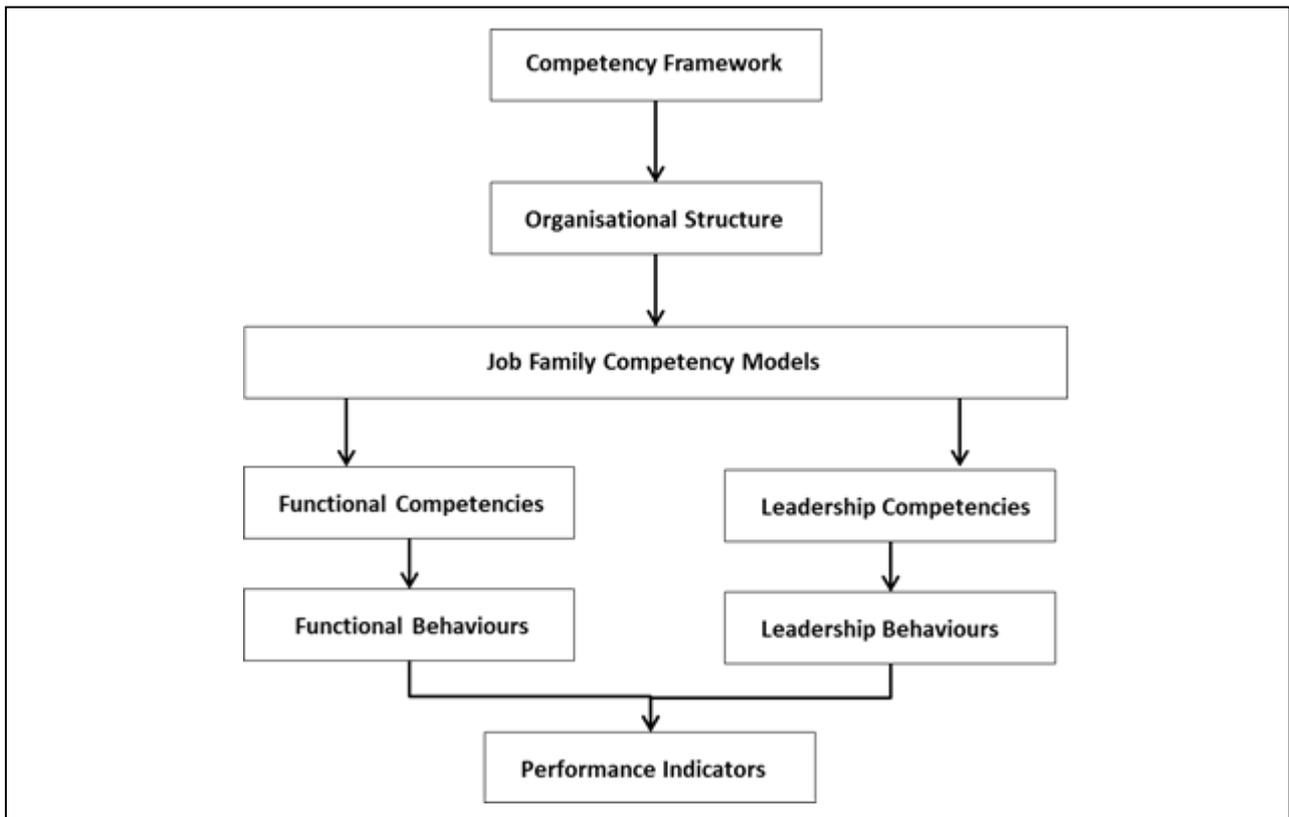


**Figure 3.9: A Draft competency model that evolved into a tailored organisational model**

Source: Campion *et al.*, 2011.

### 3.6.5. The link with the organisational structure

The competency framework provides the broad set of competencies required for delivering the dynamic capabilities and the organisational performance required. The competencies defined in the competency framework need to be translated into job specific requirements. The mechanism to translate the competency framework into specific requirements is the organisational structure. This process is illustrated in Figure 3.10.



**Figure 3.10: Translating the competency framework into specific requirements**

Source: Adapted from Campion *et al.*, 2011.

The organisational structure will identify the relevant job families and link specific jobs to the organisational processes defined by the dynamic capabilities. From this, the functional and leadership competencies will be determined. This creates the framework in which job analysis will be done to link competencies to the specific job or positions.

### 3.6.6. Using rigorous job analysis methods to develop competencies

The combination of traditional job analysis and competency modelling methods will create a highly robust approach to competency modelling. These methods include the use of multiple data collection methods such as observations, subject matter experts (SME) interviews, and structured brainstorming methods in focus groups to identify potential competency information; the use of clear construct definitions in the competencies and linkages to theory and literature; the use of

survey methodology to empirically identify the critical competencies and to differentiate the job grades where specific competencies emerge as most important (Lucia & Lepsinger, 1999; Parry, 1996; Rodriguez *et al.*, 2002 cited in Campion *et al.*, 2011).

Another way to enhance competency-modelling projects is to establish a project advisory group that can guide the process, make critical decisions, ensure buy-in, and garner support. The advisory group can also help define the organisation's business objectives, the purpose or function for which the model will be applied, the scope of positions and job titles to be covered by the model, and so forth. This systematic process of consulting with such a group around the purpose and scope of the project is essential to ensure that the model will be successful. As noted earlier, one key difference between competency modelling and job analysis is that competency modelling is a broader organisational development intervention that is facilitated by such advisory groups (Campion *et al.*, 2011).

### **3.6.7. Considering future-orientated job requirements**

Both by definition and by the methods used, job analysis captures the requirements of the current job (the status quo) but in most cases does not explicitly consider the requirements of the future. There are many methods that can be used to include future-orientated job requirements in competency modelling projects. Although they vary in methodological rigour, all might yield some useful insight. One simple approach is to conduct a literature review (Rodriguez, Patel, Bright, Gregory & Gowing, 2002) of emerging business models and their associated competency requirements. Another simple approach is to conduct interviews and focus groups on the topic of future-orientated requirements. Many executives and other key employees have insight into future requirements because of their broad perspective, access to information on new developments, and role in shaping the future (Campion *et al.*, 2011). Complementing this, some organisations may conduct in-depth analyses of long-range business strategies and then use subject matter experts to identify the key competencies required to execute those strategies. Where business executives may understand the need for boundary-spanning products, for example, they may not appreciate the type of collaboration skills required to successfully bring boundary-spanning products to market (Campion *et al.*, 2011).

### **3.6.8. Using additional unique methods**

Employee surveys, a favourite tool for job analysis, are also commonly used to help develop competency models. Aside from the usual rating scales measuring importance, needed at entry, complexity level, and so on, additional unique rating scales are sometimes used in competency modelling. Examples include:

- Rating the importance of the competency in the future compared to the present;

- Rating the extent to which the competency distinguishes high performing employees from average employees (Rodriguez *et al.*, 2002); and
- Rating the linkage of the competencies to organisational goals, objectives, or strategies.

Because competency models usually attempt to identify the most important KSAOs needed for successful job performance (as opposed to all KSAOs), it is common to study contrasting groups of employees such as highly successful employees and more average employees. These contrasting groups might be used in many ways. They might be used as the objects of discussion when asking executives about competencies, they might be the employees to invite to interviews and focus groups, or they might constitute the samples for a survey (Campion *et al.*, 2011).

A further value input to the process of competency modelling is the integration of industry best practices into the process. Certain techniques and principles from industry best practices can form the basis for developing competency requirements.

### **3.6.9. Defining the anatomy of a competency**

Competencies are usually described very thoroughly by including several parts:

- A descriptive label;
- A definition, usually describing how the competency appears on the job in detailed behavioural terms;
- A detailed description of the levels of proficiency for the competency.

In contrast, job analysis usually consists merely of a label and a brief description (Campion *et al.*, 2011). The levels of proficiency may describe progressive levels of competency development on the job (e.g. novice, master and expert), levels of competency performance (e.g. marginal, good and excellent), job grade level (e.g. associate engineer, staff engineer or senior engineer), or other levels, depending on the purpose. The levels are usually defined in terms of highly observable behaviours and may include contextual factors and contingencies in the appearance and appropriateness of the competency. An illustration of this is provided in Table 3.10.

In general, the finer the level of detail contained in the competency model, the broader the possible applications. For example, a relatively fine level of detail is needed to help design training programmes and performance management systems. However, such a model could also be used for multiple other practices that may not require that level of detail. That is not to say that one should always build the most detailed model simply to maximise possible functionality. Issues of cost, buy-in, clarity, parsimony, and so forth must also be considered as these may be paramount issues with some organisations (Campion *et al.*, 2011).

**Table 3.10: The anatomy of a competency**

<p><b>1. Competency Name:</b> A brief description of the type of behaviours the competency addresses</p> <p><b>2. Competency Definition:</b> Describes the observable behaviours that represent proficiency in the competency</p> <p><b>3. Proficiency Levels:</b> Behavioural descriptors representing demonstrated level of mastery. They are additive, building in complexity across the proficiency levels</p>	<p><b>Project Management:</b> ① ② Project management is the art of creating accurate and effective schedules with a well defined scope while being personally accountable for the execution and invested in the success of the project. People who exhibit this competency effectively and continuously manage risks and dependencies by making timely decisions while ensuring the quality of the project.</p>			
	<b>Proficiency Level 1:</b>	<b>Proficiency Level 2:</b> ②	<b>Proficiency Level 3:</b>	<b>Proficiency Level 4:</b>
	Identifies risks and dependencies and communicates routinely to stakeholders	Develops systems to monitor risks and dependencies and report changes	Anticipates changing conditions and impact to risks and dependencies and takes preventative action	Proactively identifies implications of related internal and external business conditions to risks and dependencies
	Appropriately escalates blocking issues when necessary	Works effectively across disciplines and organisational boundaries to gain timely closure on decisions that impact own project	Effects timely, mutually beneficial outcomes on decisions that impact the whole project, multiple projects or portfolios	Instils a system and culture that facilitates effective decision making across organisations, product lines or portfolios
	Understands project objectives, expected quality, metrics and the business case	Develops methods to track and report metrics, gains agreement on quality, and relates it to business value	Evaluates quality and metrics based on return on investment and ensures alignment to business need	Evaluates project results against related examples and incorporate best practices and key learning's for future improvements
Champions project to stakeholders and articulate business value	Asks the right questions to resolve issues and applies creative solutions to meet project objectives	Proactively inspires others to take action on issues and implications that could prohibit projects success	Champions business value across multiple organisations and gains alignment and commitment to prioritisation to ensure long-term project deliverables	

Source: Campion *et al.*, 2011.

**3.6.10. Defining levels of proficiency**

Although part of the competency anatomy, this is an especially important aspect of competency modelling and so is addressed in more detail here. The levels of proficiency may describe progressive levels of competency development on the job (e.g. novice, master and expert), levels of competency performance (e.g. marginal, good and excellent), job grade level (e.g. associate engineer, staff engineer or senior engineer), or other levels depending on the purpose. The levels are usually defined in terms of highly observable behaviours and may include contextual factors and contingencies in the appearance and appropriateness of the competency on the job (Rodriguez *et al.*, 2002). The number of levels should depend on the number of levels that can be perceived by the eventual user of the information, but frequently a five-point scale is used with the one, three, and five levels described (Campion *et al.*, 2011).

When used for development purposes as opposed to evaluation, the scales can be designed to motivate and grow skills by emphasising how to stretch and advance. As such, they usually focus on performance that ranges from good to excellent rather than bad to good. Table 3.11 illustrates examples of competencies and level definitions for typical line-facing and leadership roles.

**Table 3.11: Example of definition of levels of proficiency**

Competency	Level 1	Level 2	Level 3
<b>Production management</b>	Completes job with leader's help	Completes job with minimal help	Independently completes job effectively and efficiently
	Understands department's role in the company	Broadens knowledge of company's business	More involvement in the company as a whole
	Familiar with some equipment in the area	Familiar with all equipment in the area	Familiar with all equipment in the department
	Becomes familiar with processes and procedures	Ensures completion of processes and procedures	Manages/supervises processes and procedures
	Leaves area ready for next shift	Communicates all problems or changes to the next shift	Knows what other shifts have done and anticipates needs
	Has some responsibility for production numbers	Achieves production goals	Sets production goals

Source: Campion *et al.*, 2011.

### 3.6.11. Using organisational language

Although there are advantages of using common language to describe competencies across organisations, it is also desirable to tailor competency language to each organisation. Competency models strive to use the organisation's unique language. This unique language may include common expressions, acronyms, technology, job titles, business unit titles, products, and so forth. The advantage of using the organisation's unique language is not only that it enhances communication but also that it enhances ownership of the competency model by the organisational members. The use of familiar language will increase the likelihood that organisational members will refer to the competency model when making human capital decisions (Campion *et al.*, 2011).

Although there is a strong argument in favour of using an organisational own language, there is also a strong counter argument in favour of using standard industry knowledge. The advantage of using terminology that is standard across an industry is that the language used with customers and suppliers is becoming more standardised and hence contributes towards more standard business processes across organisations. The ultimate scenario is to maintain a balance between using standard industry reference terms and customising that to the unique application within the organisation.

### **3.6.12. Using both fundamental and technical competencies**

As with job analysis, some competencies may be common across jobs, whereas other competencies may be unique to specific jobs (Rodriguez *et al.*, 2002; Shippmann *et al.*, 2000). The distinction between fundamental and technical competencies is not important when a competency model is designed to apply to only one job. However, when developing competency models that span across jobs, it may be necessary to include both common or cross-job competencies (sometimes called “fundamental” competencies because they refer to basic capabilities) and unique or job-specific competencies (sometimes called “technical” competencies because they often refer to specific technical knowledge). Microsoft’s approach has been to identify a small set of “foundational” competencies, which are core and common across all competency models. These foundational competencies are essential to success in any role at Microsoft. These are then supplemented by other, more job-specific competencies. Additional competencies are defined for each profession in the company, although some, such as project management, are present in multiple profession models (Campion *et al.*, 2011).

### **3.6.13. Using competency libraries**

Competency libraries refer to lists of competencies from which to select when developing a competency model. The advantage of competency libraries is efficiency. They make the development of competency models easier and faster because the users simply have to select the competencies that apply to their jobs. Competency libraries capitalise on the experience gained in other competency modelling projects, either in other companies or elsewhere in the same organisation. Aside from efficiency, competency libraries have two other key advantages. First, they help ensure consistency of competency language across an organisation. The same competency is called the same thing in different parts of the organisation. Second, they help ensure that all the potentially relevant competencies are considered. A fairly thorough list of competencies reduces the possibility of overlooking an important competency (Campion *et al.*, 2011).

There are at least two potential disadvantages of competency libraries. First, they may not be tailored to the organisation. They may not use the organisation’s language as much as competencies developed from scratch. Second, organisational members may not be as committed to a competency model if they have not been deeply involved in its development, which might happen if they merely pick competencies off a list. Nevertheless, competency libraries are typically based on extensive research on particular job types and/or industries, and therefore they provide a valuable starting point for relevant competency modelling efforts. The time and cost saved by starting from a well-developed competency library can be significant relative to large-scale efforts that start from scratch (Campion *et al.*, 2011).

#### **3.6.14. Achieving the proper levels of granularity**

This is perhaps one of the most difficult issues in developing competency models. There is a tension between a desire for detail on the one hand and a desire for simplicity and parsimony on the other (Shippmann *et al.*, 2000). This issue refers not only to the number of competencies but also to the amount of detail in describing each competency. Generally speaking, most organisations try to limit the total number of competencies to a reasonable number, often those considered most important to distinguishing superior from average performance. But the amount of detail is another matter. Usually, each competency is described with a fair amount of detail (as explained above). A fully described competency may take half a page, or possibly even a full page, but rarely more. It is considered better to have fewer and more detailed competencies than a large number of brief descriptors, as is common in job analysis. Finally, competencies can be hierarchically arranged, meaning they can be divided into categories and subcategories. A hierarchical structure can often organise the competencies and simplify their presentation for the user, especially if there are a large number of competencies (Campion *et al.*, 2011).

During its competency-modelling project, the Boeing Company recommended choosing only those competencies that would contribute to job and organisational performance, distinguish high performers, and be directly used in management of employees (i.e. selection, promotion, retention and development). In total, leaders were limited within each job family to a maximum of 10 to 12 general competencies and an additional 10 to 12 technical competencies. Within a job family, a sub-set of competencies could be identified for lower job grades and higher job grades, which helped reduce the total number of competencies for a job family and focused employees' attention on those competencies most relevant to their work (Campion *et al.*, 2011).

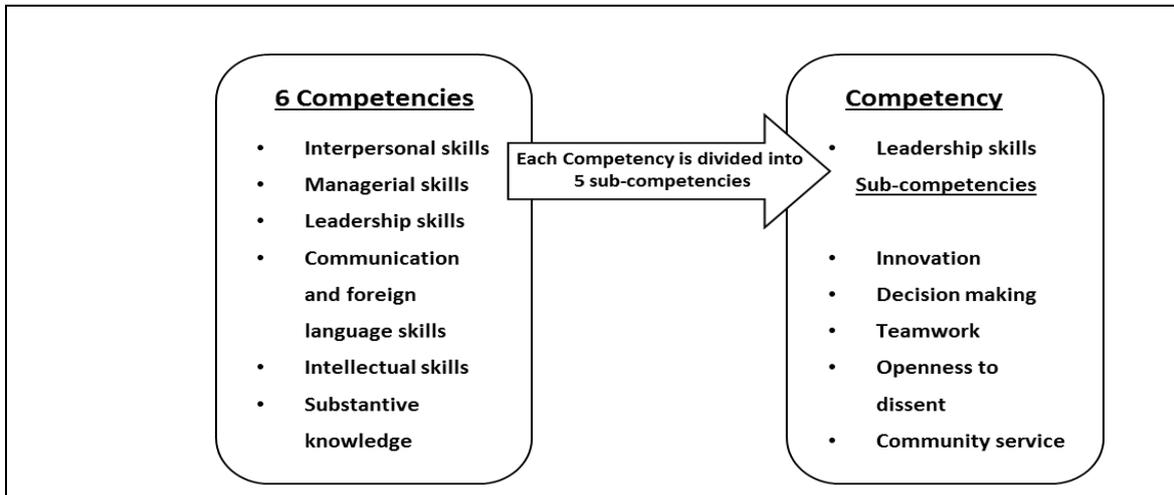
There really is no ideal number of competencies, and many factors such as the purpose of the model, the scope of the model, the organisation's preferences, and the organisation's experience with competencies and competency models can all influence the target number of competencies (Campion *et al.*, 2011).

#### **3.6.15. Using diagrams, pictures and heuristics to communicate models to employees**

Job analysis tends to rely on lists to communicate job information. Competency models often augment this with visuals. Such augmentation enhances communication by presenting information in multiple modes. It also helps enhance memorableness and is particularly important for people who think visually. The suggestion here is not to portray complex causal linkages that cannot be demonstrated but instead to consider augmenting lists of competencies with some sort of visual representation. When using visual portrayals of competency models, consider the following guidelines (Campion *et al.*, 2011):

- Simplicity will enhance memorableness.
- Focus on the core idea of the model. Not every detail of the model needs to be included.

The objective is to provide visual diagrams and explanations that will facilitate the understanding of the competency levels and how they relate to each other. This is illustrated in Figure 3.11.



**Figure 3.11: Levels of competencies**

Source: Campion *et al.*, 2011.

### 3.6.16. Using organisational development techniques to ensure competency modelling acceptance and use

Using good organisational development, defined here as widespread involvement of organisational employees in the creation of the competency model, may be more important than the model itself in terms of getting people to use the model. It is better to have a simple and crude model that people will use than a highly sophisticated, research-based model that people may ignore. Organisational development is at the core of competency modelling, unlike job analysis where it is usually a peripheral activity. Competency modelling fits the definition of an organisational development intervention in the following ways (Cummings & Worley, 2008 cited in Campion *et al.*, 2011):

- It is based on behavioural science.
- It is an adaptive and iterative process.
- There is extensive stakeholder involvement.
- The project includes model implementation, as well as model development.
- It focuses on both employee satisfaction and organisational effectiveness.

Furthermore, competency modelling combines the two most predominant approaches to organisational development: action research and social constructionism (Cummings & Worley,

2008 cited in Campion *et al.*, 2011). It is action research in the sense that data is collected and fed back to the organisation in the creation of competency models. It is social constructionism in the sense that a shared definition of a desired future of the organisation (in this case, employees with the attributes required for the success of the organisation) is created through consensus (achieved through widespread involvement in the creation of the model). Opportunities for organisational development exist at all stages of a competency-modelling project, as illustrated below:

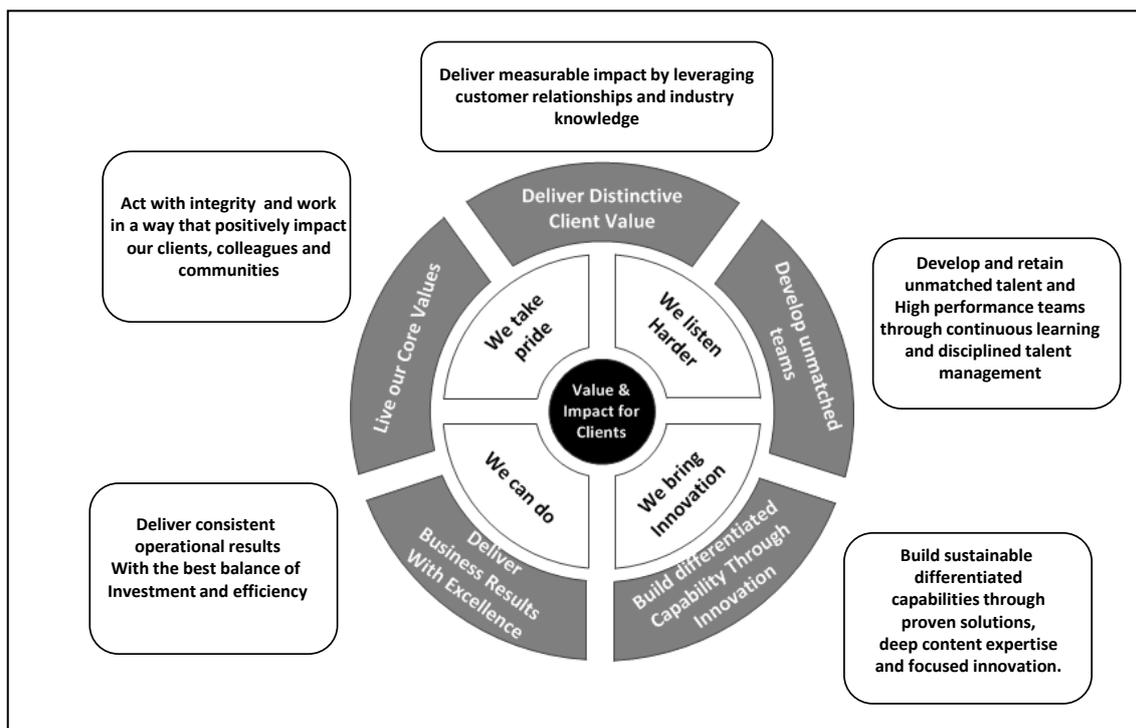
- Planning and initiating the project—such as involving senior management in planning the project objectives so they will be committed to the project and thus endorse and promote it;
- Collecting data and diagnosing—such as using various organisational development techniques like structured brainstorming, Delphi, and nominal groups;
- Developing and evaluating—such as using action research methods (survey feedback and action planning) to validate model components or make changes in the project direction; and
- Implementing and institutionalising—such as using the concepts of “unfreezing” and “refreezing” to communicate the importance of considering resistance to change and the challenges of sustaining momentum for the project.

Competency modelling projects offer an opportunity to enrol significant numbers of employees in the organisational development efforts. At Microsoft, leadership teams were created for each of the professions as part of the competency-model development process. These leadership teams were active from the beginnings of each project. Their use created an environment that eased implementation and institutionalisation (Campion *et al.*, 2011).

### **3.6.17. Using competencies to develop HR systems**

Competency models are much easier to use in creating human capital systems than traditional job analysis information, for the following reasons:

The descriptions for levels of proficiency that are part of most competency models make the development of many human capital systems virtually automatic. As noted, the level descriptions can be easily converted into rating scales for structured interviews, performance appraisals, job evaluations, measures of promotion readiness and career development guides. Figure 3.12 shows one example of such a use, illustrating how a competency model’s level descriptors were used to develop a performance appraisal for production supervisors.



**Figure 3.12: Using infographics with competency modelling**

Source: Adapted from Campion *et al.*, 2011.

The fact that competency models attempt to distinguish high from moderate or low levels of job performance make them appealing for developing human capital systems. That is, the resulting system would then presumably be useful for developing above-average employees (Campion, 2011).

Likewise, the linkage between the competency model and organisational goals and strategic objectives should help ensure that the resulting HR systems will also support and help attain those objectives. The use of organisational language makes their job relatedness clearer to employees (Rodriguez *et al.*, 2002).

### **3.6.18. Using competencies to develop a practical theory of effective job performance tailored to the organisation**

Competency models explain the nature of effective performance in an organisation. They describe what really matters in terms of job performance and how to be successful. In this way, they are not only much more than lists of Knowledge, Skills, Abilities, and Other characteristics (KSAOs) that result from job analysis, but instead are more of a theory in the following ways (Campion *et al.*, 2011):

- They explain why the KSAOs matter in terms of creating effective job performance, connecting with organisational goals, and so on.

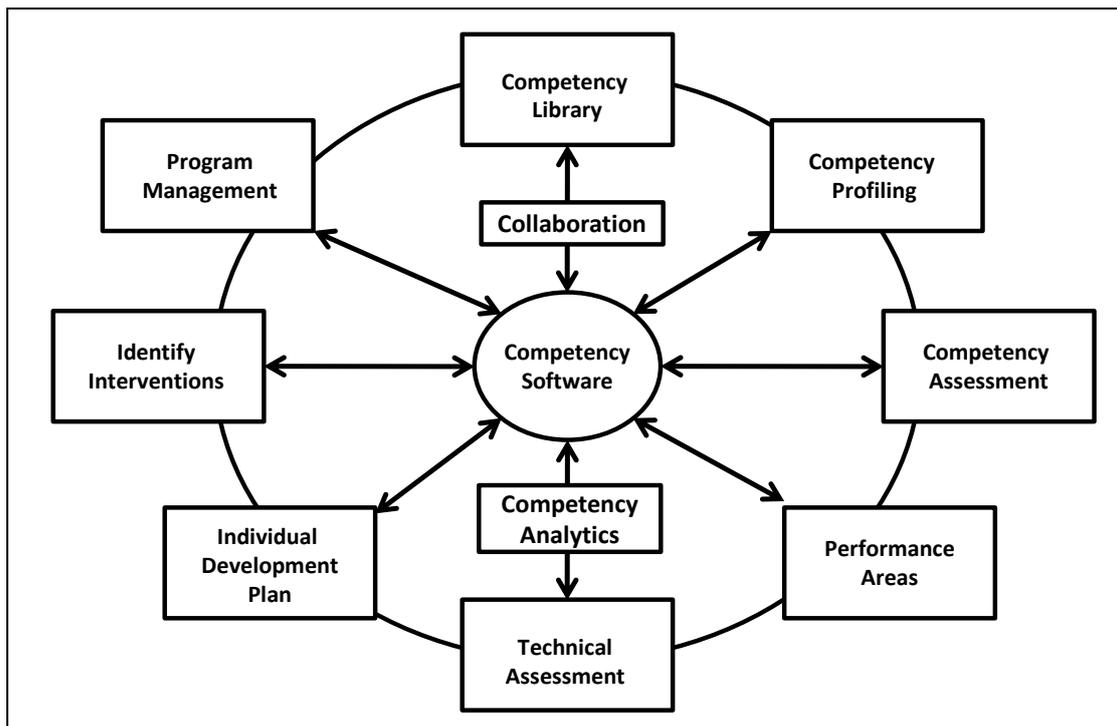
- They usually include a description of the process (how effective performance occurs) as well as the content (what is effective performance).
- They are internally consistent in that performance in one competency should not conflict with performance in another competency. They should reinforce each other in clear ways.
- They predict and explain successful performance in a wide range (hopefully all) of job domains.
- They may inform judgments with respect to likely outcomes (e.g. who will be hired, promoted or rewarded).
- They are provocative and promote thought and discussion about effective job performance. As such, they should yield more insight than a list of KSAOs.

### **3.6.19. Using information technology to enhance the usability of competency models**

Enabling competency modelling through technology is a key requisite for successful implementation. Some of the key challenges to be overcome with the implementation of a global competency model across regions and continents are the following:

- Access to information such as competency libraries and proficiency standards;
- Competency assessment must be available on-demand anytime, anywhere;
- Employees should be able to share information regarding learning and projects;
- Updating of information on a global basis is a major challenge without technology enablement; and
- Collecting and sharing competency analytics on a global basis will not be possible without technology support.

To achieve these objectives, a global competency management system should be implemented that offers basic functionality to support the challenges outlined above. An outline of the key functionality offered by such a system is provided in Figure 3.13.



**Figure 3.13: Competency management system**

Source: Adapted from Sanghi, 2007 & Lucia *et al.*, 1999

A competency management system provides functionality to enable all the requirements outlined above and provides on-demand access to all stakeholders on a global basis.

### 3.6.20. Maintaining the currency of competency over time

Organisations often invest considerable resources in the initial development and implementation of their competency models; however, equal consideration should be given to maintaining the currency and usefulness of the models over time. Many aspects of competency models can change over time, such as organisational objectives, senior management, environment, likely future, and language. So having a plan for updating is critical (Campion *et al.*, 2011). The alignment and link with dynamic capabilities discussed in an earlier section is critical. For the competency framework to stay relevant and aligned with the dynamic capabilities required, constant update is required. The competency framework and resulting competencies at job level should be reviewed constantly and adjusted as required. Ideally, this should form part of the annual planning and review process. A key element to achieving this integration is the constant collection of competency analytics and integrating that with the performance management process of the organisation.

### 3.6.21. Using competency modelling for legal defensibility

The legal defensibility of human capital systems is a key concern for many, if not most, large organisations. That is a key reason why many of them conduct job analyses. This is a potential concern for competency modelling, especially traditional competency models that may have been developed using less rigorous methods. However, if competency models are developed in scientifically rigorous ways, then they should be appropriate for demonstrating job relatedness. In fact, there are at least three major advantages of competency models for validation purposes:

- First, they are linked to organisational goals and objectives, and thus their “business necessity” should be more obvious and easier to document.
- Second, because competencies are usually described in terms of observable on-the-job behaviours, they may be more useful for showing content validity than many lists of KSAOs that result from job analysis.
- Third, because competency lists are usually shorter and broader than job analysis lists, it may be easier to show their linkages to HR systems and be more obvious to laypersons. When coupled with more traditional job analysis approaches (e.g. use of incumbent surveys to identify critical KSAOs), competency models provide a more comprehensive demonstration of job relevance than use of job analysis alone (Campion *et al.*, 2011).

The best practices for developing competency models discussed in this chapter will form the basis for developing a supply chain competency model. These best practices will be used as a set of guidelines. The relevant supply chain theory and previous research will first be reviewed.

## 3.7. CONCLUDING COMMENTS

The objective of this chapter was to review the competency modelling literature to develop a best-practice framework and a set of guidelines that could be used for the development of competency models. The original frameworks of Champion *et al.* (2011) and Shippmann *et al.* (2000) were enhanced with the integration of the concept of dynamic capabilities as company strategy. A competency model is a mechanism for translating dynamic capabilities required into a competency model and the individual competencies required to achieve the objectives of organisational strategy. Table 3.12 provides a summary of the framework and guiding principles that will be applied in developing a supply chain competency model.

**Table 3.12: Best practices in competency modelling**

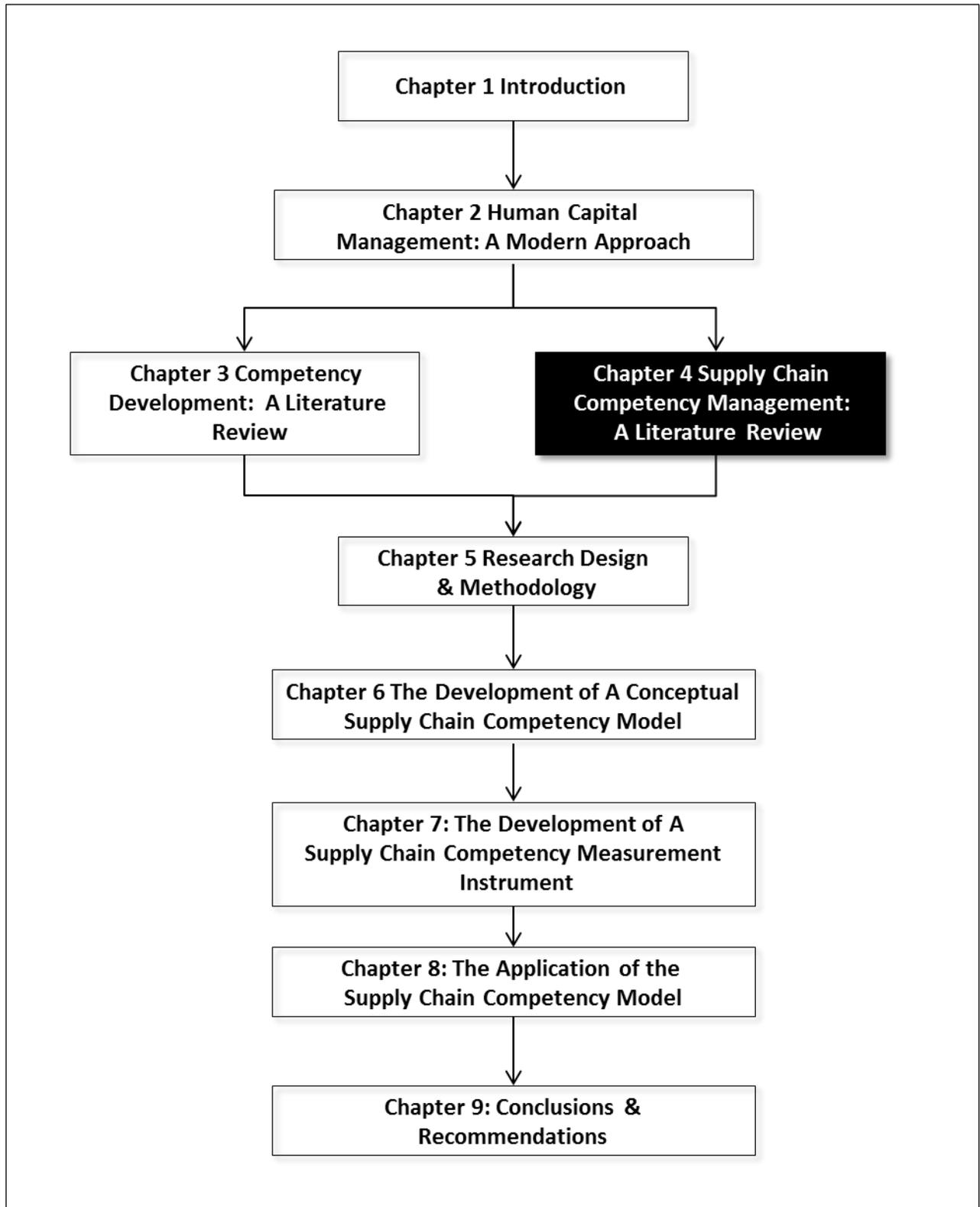
<p><b><u>Identification of required competencies:</u></b></p> <ol style="list-style-type: none"> <li>1. Consider the organisational context</li> <li>2. Dynamic capabilities as the core driver of competencies</li> <li>3. Link competency models to organisational goals and objectives</li> <li>4. Start at the top, involve executive management</li> <li>5. Use core business processes as driver</li> <li>6. Use rigorous job analysis methods to develop competencies</li> <li>7. Consider future-orientated job requirements</li> <li>8. Use additional unique methods</li> </ol>
<p><b><u>Organising and presenting competency information:</u></b></p> <ol style="list-style-type: none"> <li>9. Defining the anatomy of a competency (the language of competencies)</li> <li>10. Defining the levels of proficiency on competencies</li> <li>11. Using organisational language</li> <li>12. Including both fundamental (cross-job) and technical (job-specific) competencies</li> <li>13. Using competency libraries</li> <li>14. Achieving the proper level of granularity (number of competencies and the amount of detail)</li> <li>15. Using diagrams, pictures and heuristics to communicate models to employees</li> </ol>
<p><b><u>Using competency information:</u></b></p> <ol style="list-style-type: none"> <li>16. Using organisational development techniques to ensure competency modelling acceptance and use</li> <li>17. Using competencies to develop HR systems (hiring, appraisal, promotion, compensation)</li> <li>18. Using competencies to align HR systems</li> <li>19. Using competencies to develop a practical “theory” of effective job performance tailored to the organisation</li> <li>20. Using information technology to enhance the usability of competency models</li> <li>21. Maintaining the currency of competency over time</li> <li>22. Using competency modelling for legal defensibility (e.g. test validation)</li> </ol>

Source: Adapted from Campion *et al.*, 2011.

This framework for competency modelling is linked to the model for modern management of human capital which was developed in Chapter 2. The model for managing human capital positions competency models within the context of managing human capital. The framework from this chapter provides the guidelines for developing the competency model. The model in this chapter thus provides the strategic context, while the framework from Chapter 3 provides the implementation guidelines. The next chapter reviews the literature on supply chain competency modelling. The guidelines from this chapter will be combined with the literature from the next chapter to develop the supply chain competency model.

## CHAPTER 4

### SUPPLY CHAIN COMPETENCY MANAGEMENT: A LITERATURE REVIEW



#### 4.1. INTRODUCTION

The objective of this chapter is not to provide a comprehensive review of all recent developments in supply chain theory, but rather to focus on the key developments that have had a significant impact on the theory and approach towards supply chain management with specific reference to supply chain competencies. The key objectives of the chapter are to:

- Review the key supply chain models;
- Identify the core elements or building blocks of supply chain management;
- Review the literature on supply chain competencies; and
- Provide a framework for the development of a supply chain competency model.

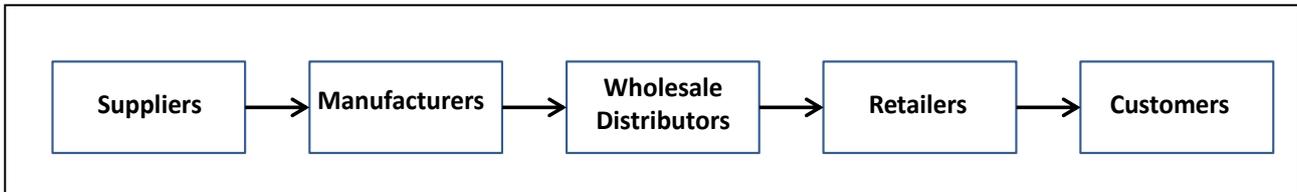
The overview starts by contrasting the traditional approach towards supply chain thinking with some of the more recent models.

#### 4.2. TRADITIONAL DEVELOPMENT

The 1970s have often been viewed as the decade of quality improvement, during which companies began to invest heavily in quality improvements, and total quality management became a buzzword. In the 1980s, with quality a given, the competitive landscape shifted to lean manufacturing, focusing on concepts such as just-in-time, flexible manufacturing, and zero inventory in order to achieve manufacturing excellence. In the 1990s, market globalisation, shortening product life cycles, and the disintegration of many industries created the race to improve the supply chain.

In the last decade, industry after industry has embarked on aggressive initiatives to improve operational efficiencies of their supply chains. Industry-wide efforts started with efficient consumer response for the grocery industry and expanded to other sectors such as food service, pharmaceutical, semiconductor, computer and electronics, telecommunications and automobile industries. Companies investing in supply chain efforts have found significant improvements in inventory, customer service, response times, and operational costs. To support this, significant growth of supply chain management (SCM) technology solutions have been experienced (Lee, 2003).

One of the key debates on the future of supply management focused on the fundamental design principle of the current supply chain thinking. Figure 4.1 is an illustration of a traditional supply chain.



**Figure 4.1: The traditional supply chain**

Source: Aquino and Draper, 2008.

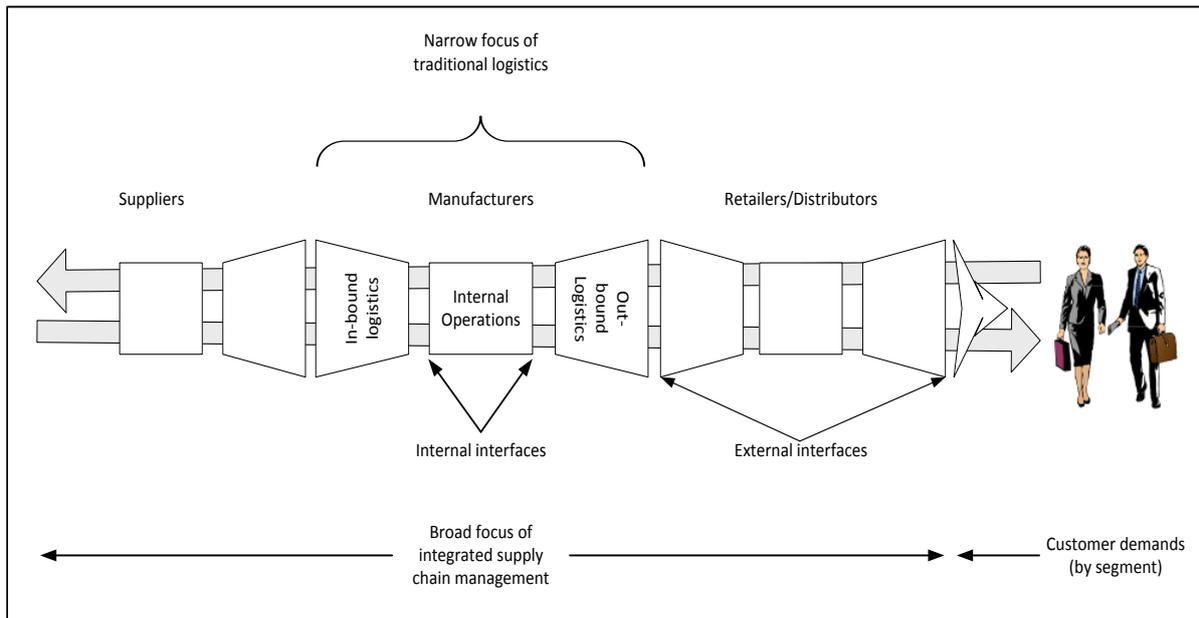
The traditional supply chain still mostly serves the factory, not the consumer. As a result, several critical deficiencies persist. They are the following:

- *The bullwhip effect*: Disruptions downstream ripple back ever more loudly, creating tremendous demand uncertainty with the result of \$3.0 trillion worth of inventory locked in the US and European supply chains as of June 2004.
- *Linear optimisation techniques*: Failing to account for variability is fine in a factory with known task cycle times, but it is no good across a network of flexible productive nodes. The result is a 20 percent order error rate across the US industry.
- *No support for product innovation*: The black box approach to research and development (R&D) assumes that new products go through the same chain as existing ones. This is slow, wasteful, and error prone. The result is 75 percent new product failure rate globally (Aquino & Draper, 2008).

Because of these deficiencies in the traditional approach to supply chain management, various models were developed which reflected new thinking. A modern definition of supply chain management which forms the basis for the development of the more recent models is:

*Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, and finance and information technology (Council for Supply Chain Management Professionals, 2014).*

This approach towards supply chain management is depicted in Figure 4.2.



**Figure 4.2: Modern supply chain management**

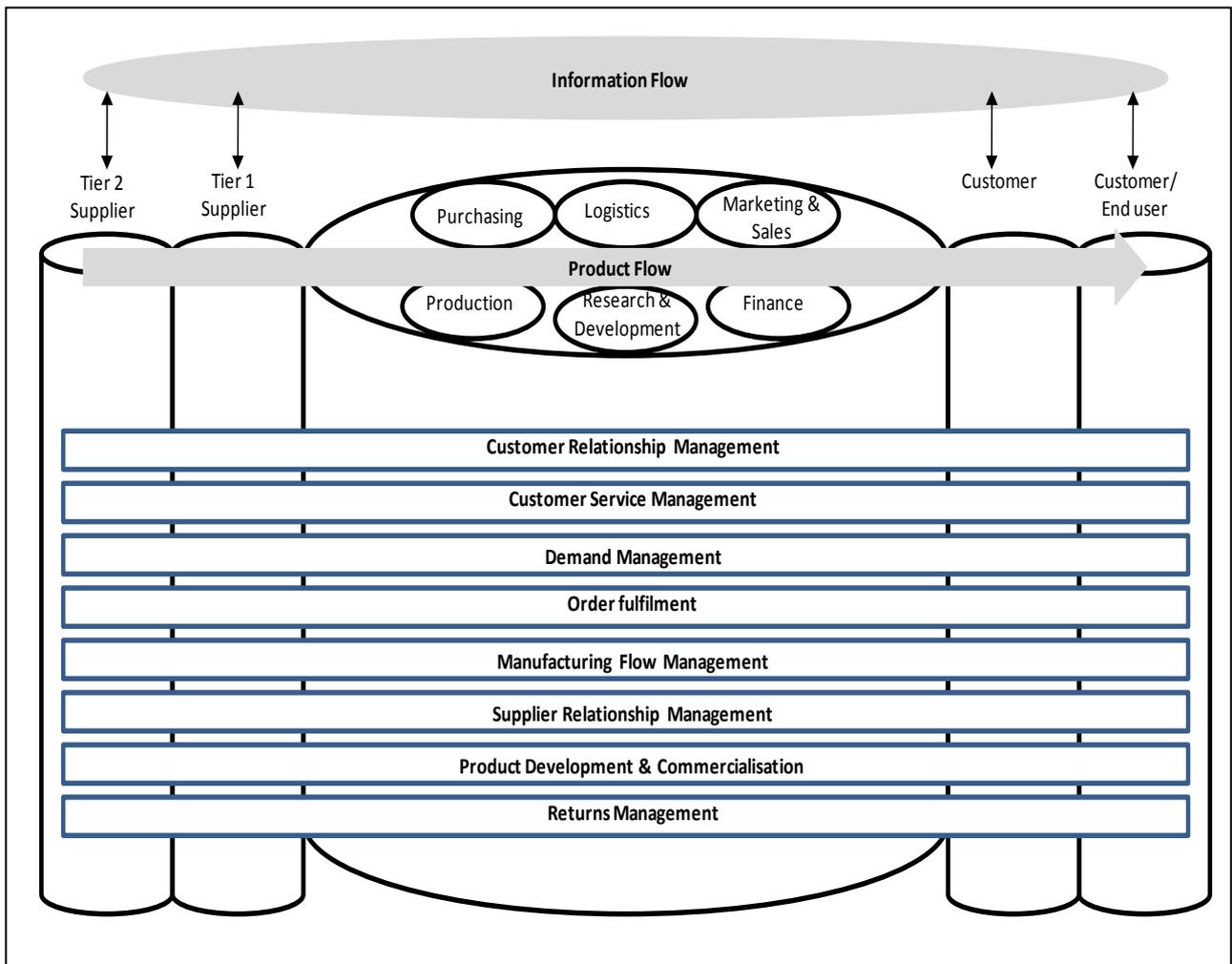
Source: Gattorna, 2006.

With this definition as point of departure, a number of different models of modern supply chain management are reviewed in the next section to develop an integrated set of competencies required. This will be the basis for developing a competency model.

### 4.3. NEW SUPPLY CHAIN MODELS

#### 4.3.1. The Lambert model

One of the leading models in the development of supply chain theory is the supply chain model developed by Douglas Lambert (Moberg, Vitasek, Stank & Pienaar, 2008). The Lambert Model is depicted in Figure 4.3. The model combines functions such as logistics, purchasing and others with processes that are defined as key cross-functional integrators.



**Figure 4.3: Integrating and managing business processes across the supply chain**

Source: Moberg *et al.*, 2008.

The cross-functional processes identified are:

- Customer relationship management
- Customer service management
- Demand management
- Order fulfilment
- Manufacturing flow management
- Supplier relationship management
- Product development
- Returns management.

Another key principle is the integration both downstream to the end customer and upstream with the supplier's supplier. Information flow forms a key element of cross function and cross-process integration. This model made a significant contribution towards the development of a supply chain process model which is a key part of modern thinking in supply chains.

### 4.3.2. Supply Chain Consortium model

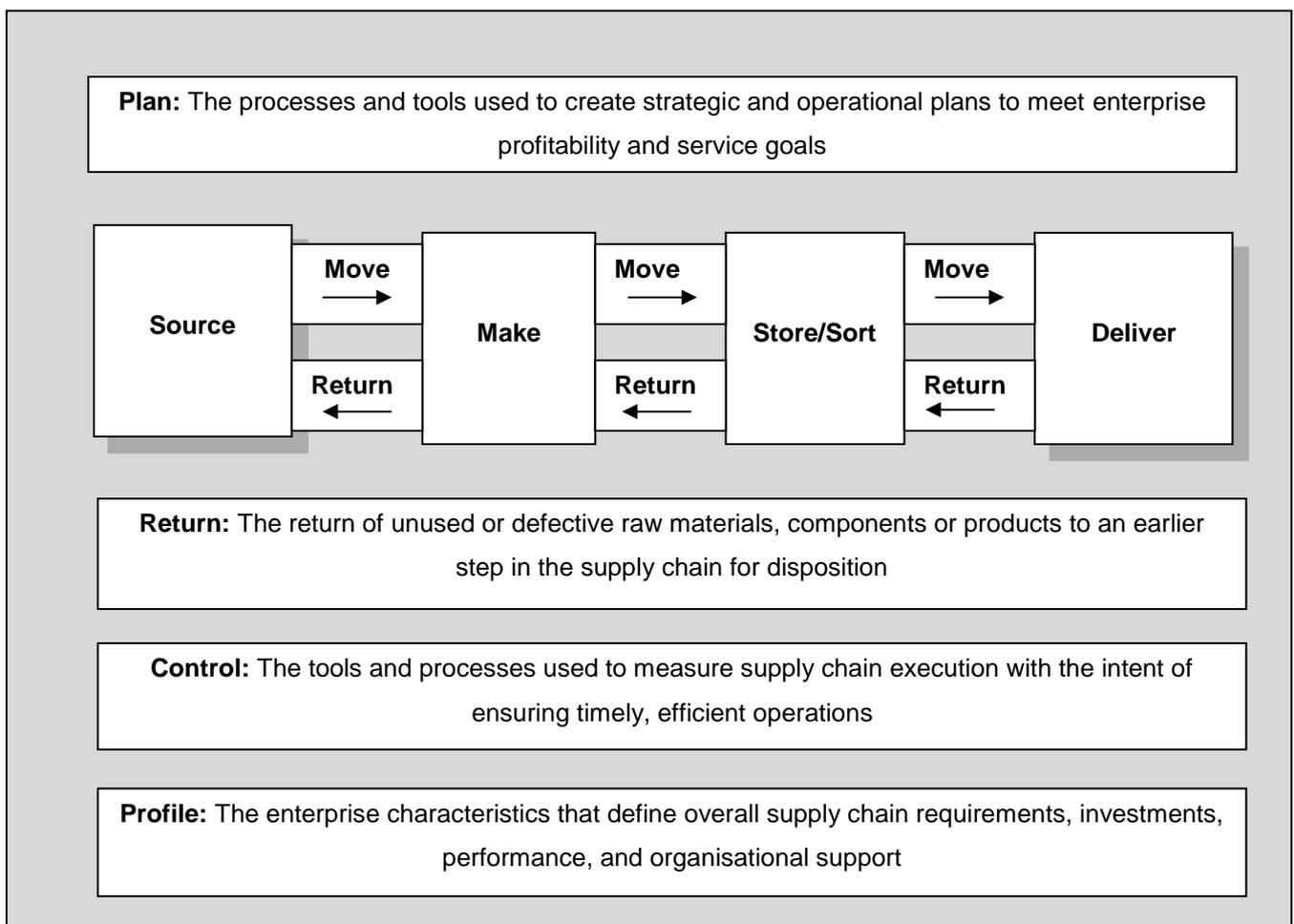
The Supply Chain Consortium developed a model that can be seen as the first model that focused on source, make, store and deliver, which are now the cornerstones of the SCOR model (Moberg *et al.*, 2008).

This model is depicted in Figure 4.4. The core functional elements of the model are:

- *Source*: This refers to the sourcing of products and raw material from suppliers.
- *Make*: The manufacturing process of converting raw materials into finished products.
- *Store*: The activity of storing or also warehousing products.
- *Deliver*: Delivering products to the market through transport.
- *Move*: Moving products between facilities in the supply chain (Moberg *et al.*, 2008).

These functional elements are enabled through the following cross-functional processes:

- *Plan*: The processes and tools used to create strategic and operational plans to meet enterprise profitability and service goals.
- *Return*: The return of unused or defective raw materials, components or products to an earlier step in the supply chain for disposition.
- *Control*: The tools and processes used to measure supply chain execution with the intent of ensuring timely, efficient operations.
- *Profile*: The enterprise characteristics that define overall supply chain requirements, investments, performance and organisational support (Moberg *et al.*, 2008).



**Figure 4.4: Supply Chain Consortium best practices framework**

Source: Moberg *et al.*, 2008.

The model from the Supply Chain Consortium also identifies key functions such as source, make, store and deliver. These functions are comparable with those of the Lambert model. In terms of processes, only the following four are identified:

- Plan
- Return
- Control
- Profile.

In comparison with the Lambert model, the same functions are identified with fewer cross-functional processes; only three cross-functional processes namely return, control and profile are identified. The similarity between the first two models is the focus on the cross-functional integration.

### 4.3.3. Supply Chain 2020

Supply Chain 2020 is a special research group formed at MIT to study supply chain excellence in the next century. The findings of this study to date are summarised below.

Qualitative research during phase one of SC2020 delved into nine industry drivers and challenges and the supply chain responses to them. In addition, the supply chains of 21 case-study companies were profiled to identify the important linkages that exist among competitive strategies, operating models, operations performance objectives, and business practices.

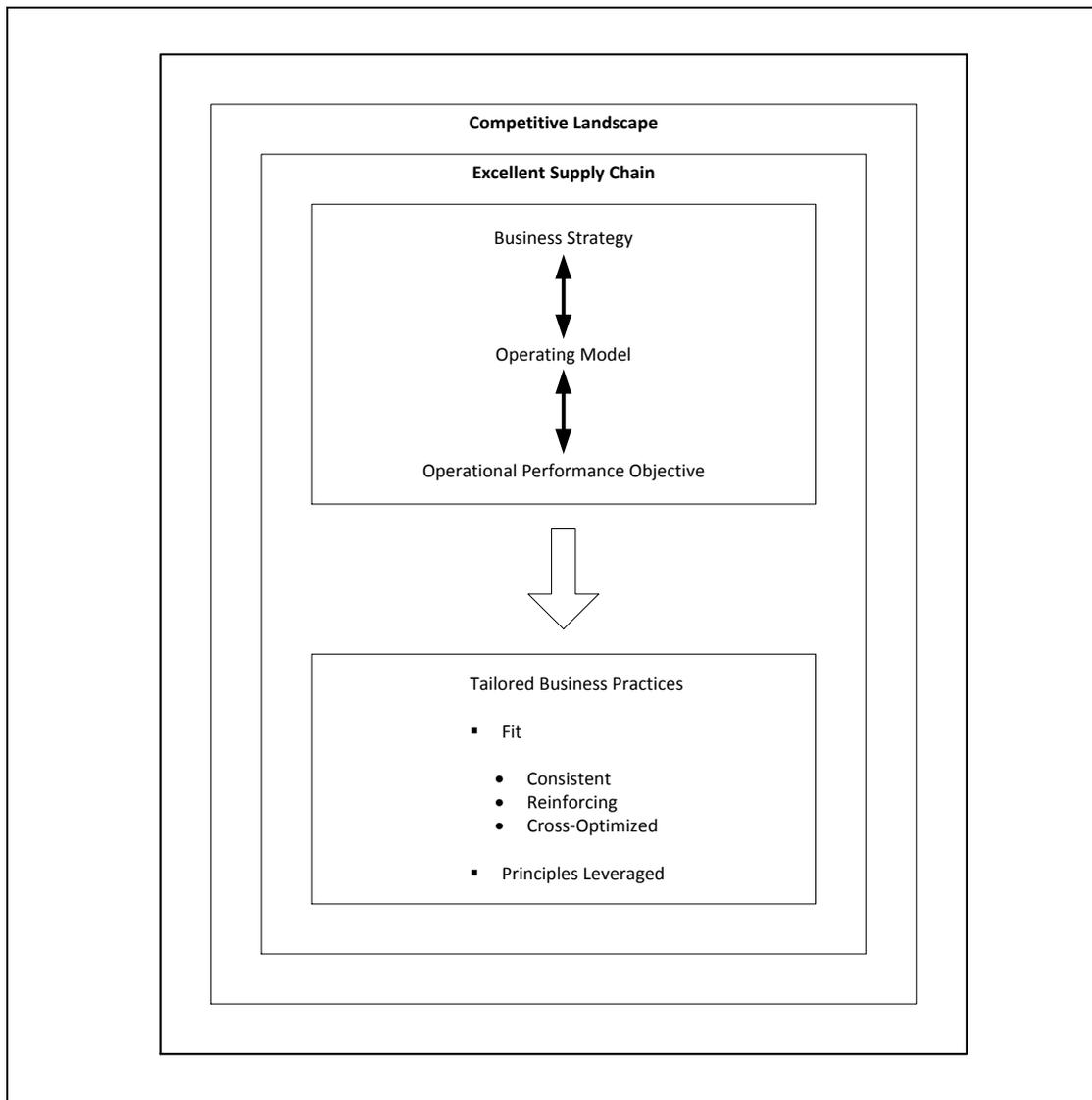
The research supported the premise that an excellent supply chain:

- supports, enhances, and is an integral part of a company's competitive business strategy;
- leverages a supply chain operating model to sustain a competitive edge;
- executes well against a balanced set of competitive operational performance objectives; and
- focuses on a limited number of "tailored" business practices that reinforce each other to support the operating model and best achieve the operational objectives (Bowman, 2005).

This thinking is reflected in the model presented in Figure 4.5.

To really understand tailored practices, however, it is crucial to understand the underlying principles. A basic premise of the SC2020 study is that there is a set of time-independent immutable operating principles that provide a basis for all supply chain best practices. In other words, while practices may change over time and across industries and between companies, the operating principles will:

- expand the sphere of influence;
- increase transparency;
- relax constraints;
- trade off inventory against cycle time; and
- use supply contracts (Bowman, 2005).



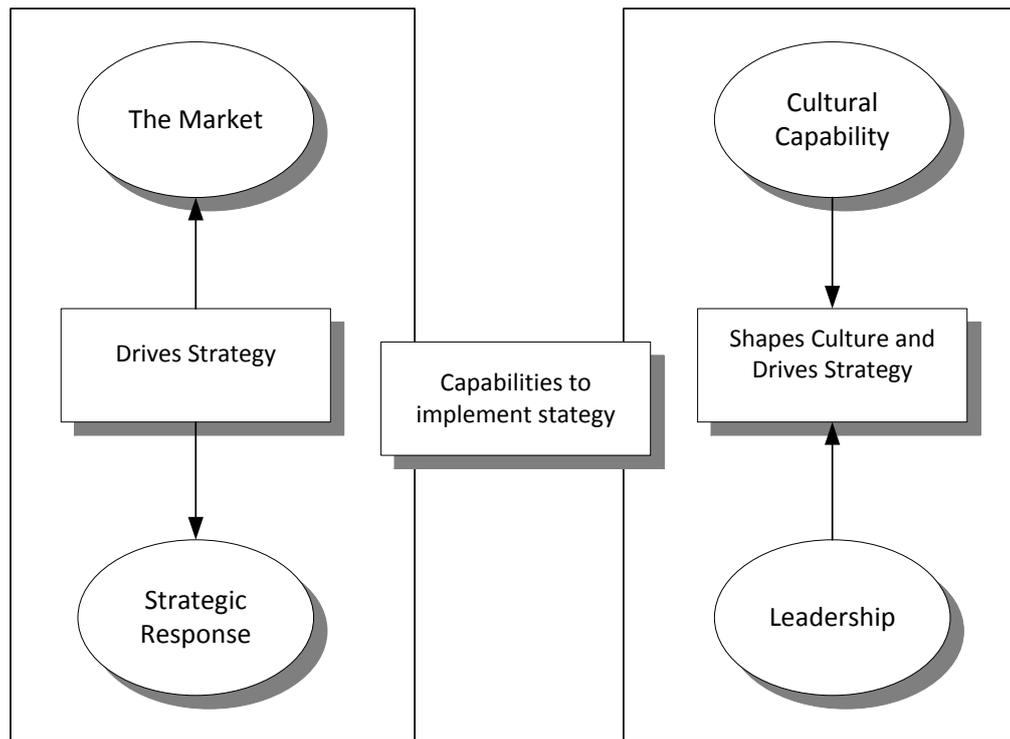
**Figure 4.5: Supply Chain 2020 framework for excellent supply chains**

Source: Bowman, 2005.

This model essentially focuses on the identification of the key principles that distinguish excellent supply chains. It does not identify specific functions or processes. The key operating principles might provide the basis for identification of core competences in excellent supply chains.

#### **4.3.4. Strategic alignment model**

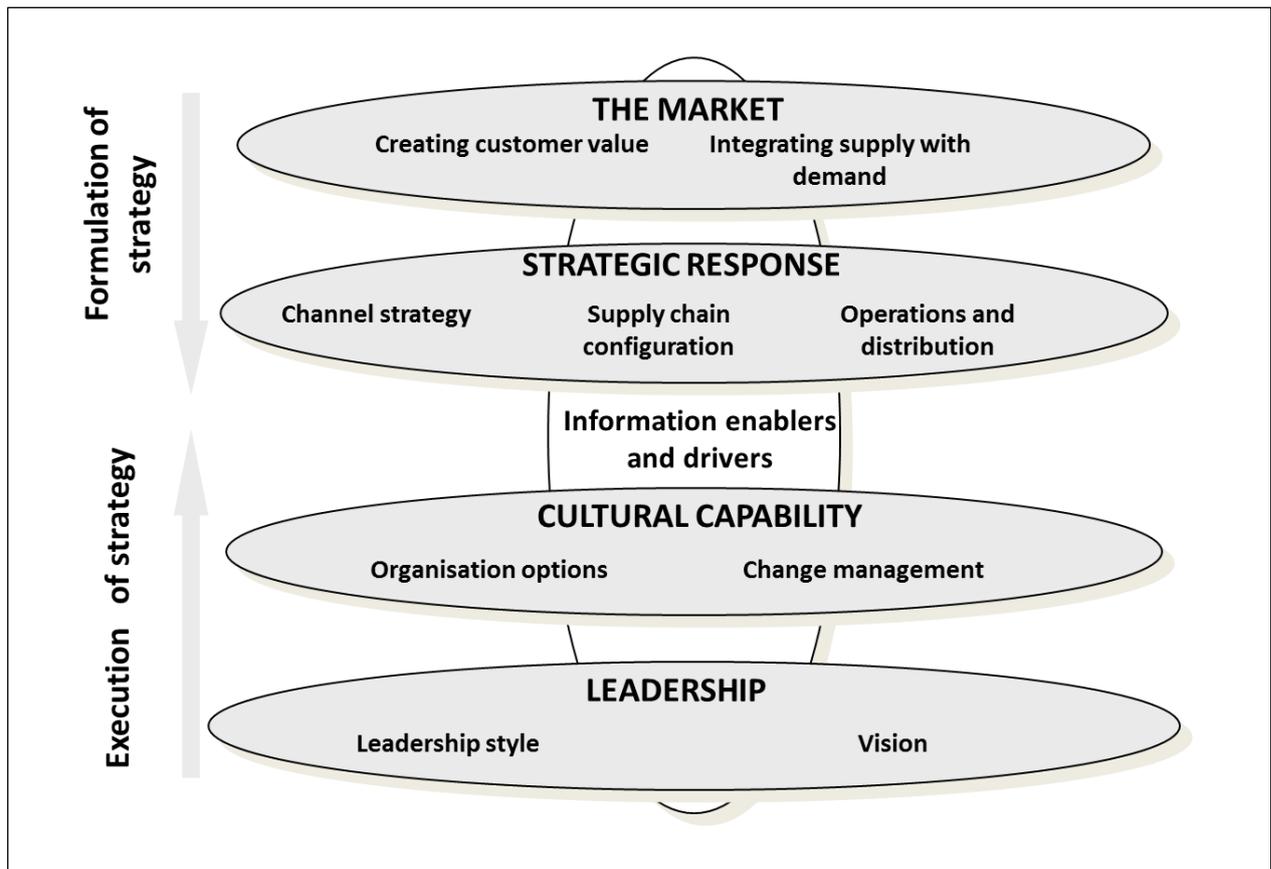
The concept of alignment between aspects of the supply chain, business strategy and the environment is central to the work of Gattorna (1998). The capabilities required to implement supply chain strategy are depicted in Figure 4.6 below.



**Figure 4.6: Gattorna elements for alignment**

Source: Gattorna, 1998.

To maximise the success of strategy implementation, these elements need to be aligned, which forms the basis for the concept of strategic alignment. The formulation of strategy needs to be aligned with the execution of that strategy. The elements that are involved in this alignment process are depicted in Figure 4.7.



**Figure 4.7: Gattorna supply chain alignment model**

Source: Gattorna, 1998.

The concept of strategic alignment which forms the basis for this model is not evident from the previous models. Cultural capability and leadership also form an important basis of this model.

The concept of alignment between strategic response, cultural capability and leadership has already been identified as a key principle in the development of competency models. A competency model needs to support the implementation of the core competence of the organisation.

#### 4.3.5. Demand-driven supply networks

What will be the next competitive battleground in the 21<sup>st</sup> century? It will be managing to demand for the total value maximisation of the enterprise and the supply chains – demand-based management. Demand-based management is critical to an enterprise in managing its supply chain, product development, technology strategy, service support, and organisation design. Application of demand-based management to integrate supply and demand management happens to be a big opportunity (Lee, 2003).

The focus of SCM is changing from planning, implementing, and controlling operations in order to meet customer demand to sensing demand, shaping a market response, and driving profitable and reliable supply. As this takes place, SCM is shifting from being a driver of efficiency, lowering costs, and manufacturing control to being an enabler of competitive differentiation and new business approaches. This is not a trivial transition by any means. Its implications are widespread and profound -particularly for the providers of supply chain solutions, whose technologies were developed more for demand and supply matching than for sense and respond.

This thinking of the demand driven supply chain forms the basis for the concept of “Demand Driven Supply Networks” (O’Marah & Souza, 2004). In terms of this approach, the following definition:

*A system of technologies and processes that senses and reacts to real-time demand across a network of customers, suppliers, and employees.*

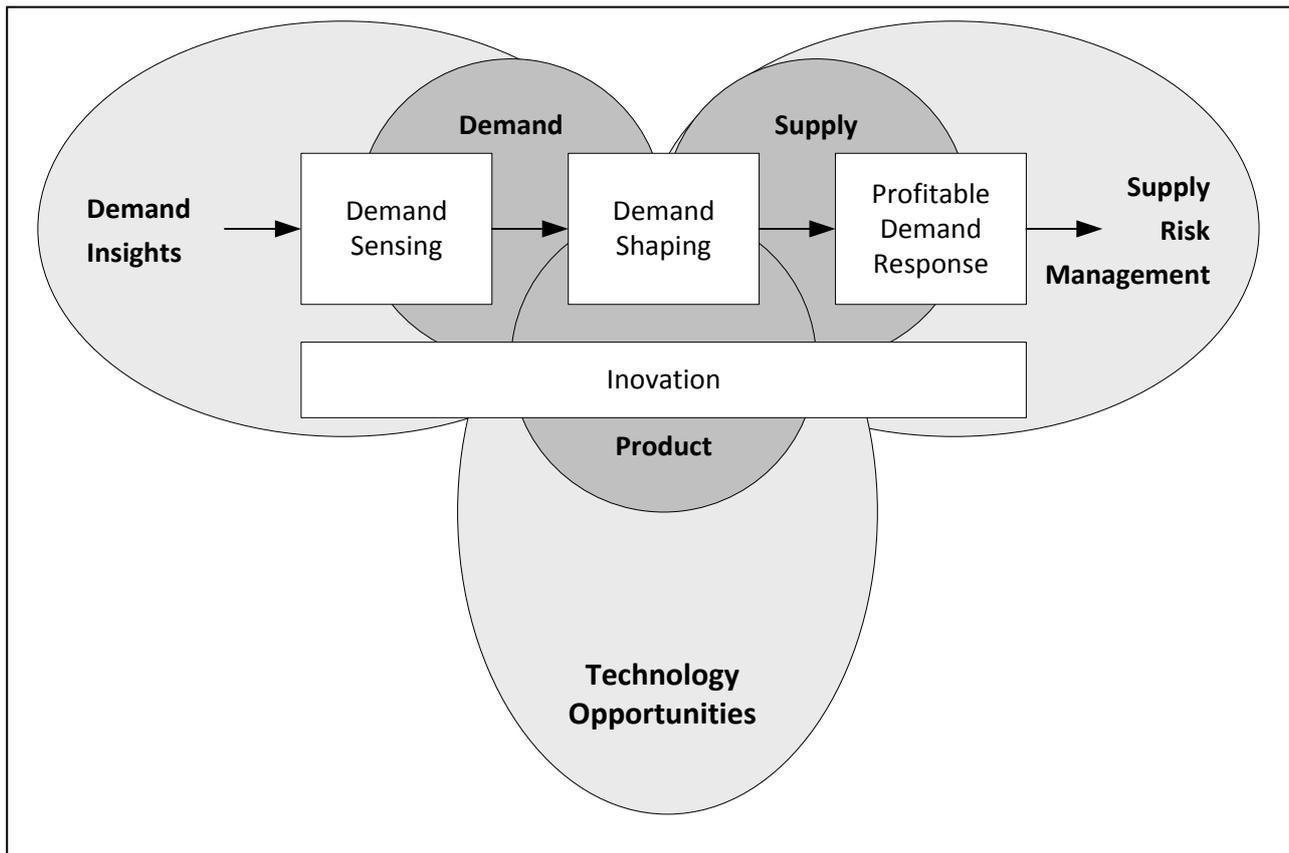
The key elements of this definition are:

*System* – To be effective, the next-generation supply chain must be scalable. Comprising technology life software applications and databases with business processes, demand driven supply networks (DDSN) need system architecture to scale without compromising flexibility.

*Demand* – Is demand an order? A forecast? An opportunity? For DDSN to take root, companies must learn to see demand at many levels, complete with buyers’ willingness to trade off one benefit, say availability, for another, like price. Sense and react to real-time demand does not simply mean fill the order. It means applying business judgment quickly across all demand.

*Network* – Contract manufacturers, outsourced design and development, and third-party logistics providers are all part of the rapid transformation of the supply chain away from vertically integrated corporations towards core-competence-based networks of businesses. For a network to succeed, standards and communication must be pervasive and reliable. The internet has kicked off with the transformation, but its effects have only just started to be felt (Cecere, Hofman, Martin & Preslan, 2005).

DDSN is about starting at the moment of truth and working backwards to instantiate the supply network that best meets demand. The moment of truth may be a consumer at the supermarket shelf making a choice, it may be a replacement part for a commercial jet waiting for clearance to fly, or it may be a full-volume production readiness with the hot toy for Christmas this year. The company best exemplifying this mentality is Proctor & Gamble, whose Consumer-Driven Supply Network embodies much of what is best in DDSN (Cecere *et al.*, 2005). This concept is illustrated in Figure 4.8 below.



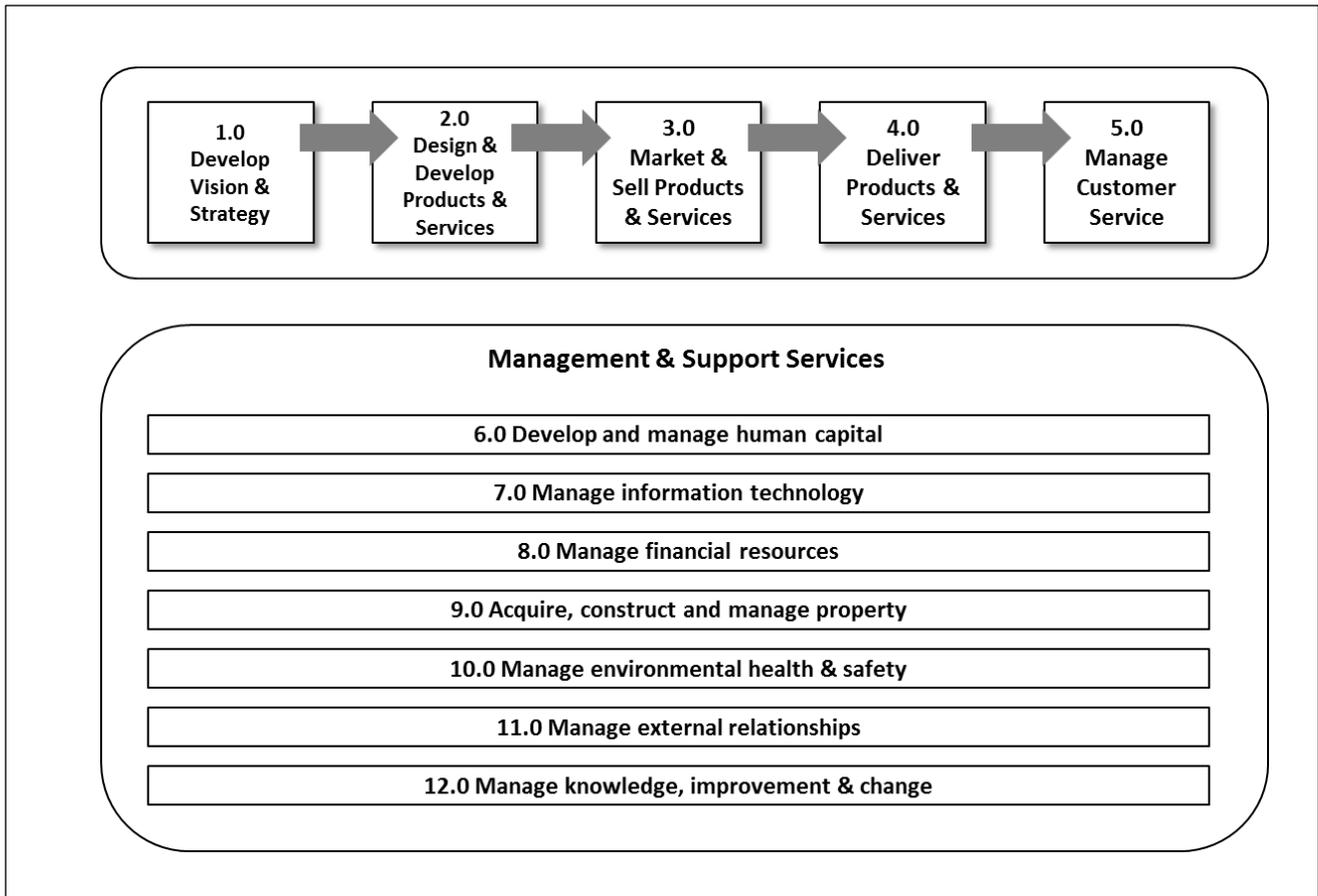
**Figure 4.8: Elements that support demand driven supply networks**

Source: Cecere *et al.*, 2005.

The “demand driven supply network” concept places significantly more emphasis on the process of proactive demand management. It further expands the concept of customer integration identified in some of the previous models to a level where demand is actually shaped. In most of the previous models demand is positioned as the driver of the supply chain in the sense that supply chains merely respond to demand as opposed to shaping it. This model undoubtedly identifies new core competence in demand management compared to previous models and is widely practiced in many different industries.

#### 4.3.6. American Quality and Productivity Centre

The American Quality and Productivity Centre has developed a model which is currently the model being used by the Council for Professional Supply Chain Management. The model is outlined in Figure 4.9.



**Figure 4.9: Process configuration framework**

Source: Council for Supply Chain Management Professionals, 2014.

This model uses a process focus as the key driver of supply chain thinking. The following core processes are identified:

- Develop vision and strategy
- Design and develop products
- Market and sell services
- Deliver products and services
- Manage customer service.

The following management and support processes are identified:

- Develop and manage human capital
- Manage information technology
- Manage financial resources
- Acquire and manage property
- Manage health and safety
- Manage external relationships

- Manage knowledge and change.

Knowledge management and human capital are management processes which are not included in the previous models. The fundamental difference with this model compared to the other models, is the fact that it is fundamentally only process focused with no reference to any functions such as logistics, purchasing or manufacturing.

#### 4.3.7. The Supply Chain Council

The Supply Chain Council has developed a model of the supply chain which is much further advanced than most other models. The major elements of the model include:

- Performance metrics
- Process models
- Best Practices
- People.

This forms the core building blocks of the supply chain model and provides a basis for companies across industries to use the model for the purpose of development and standardisation of processes. The building blocks will now be elaborated on.

##### 4.3.7.1. Performance metrics

Performance metrics as the outcome of the application of supply chain management forms the core driver of management practices. A standard set of performance measures was developed. This can be summarised in Table 4.1.

**Table 4.1: Alignment of performance attributes with performance metrics**

Performance attribute	Performance metric
Reliability	Perfect order fulfilment
Responsiveness	Order fulfilment cycle time
Agility	Upside flexibility
	Upside adaptability
	Downside adaptability
	Overall value at risk
Cost	Total cost to serve
Asset management efficiency	Cash-to-cash cycle time
	Return on fixed assets
	Return on working capital

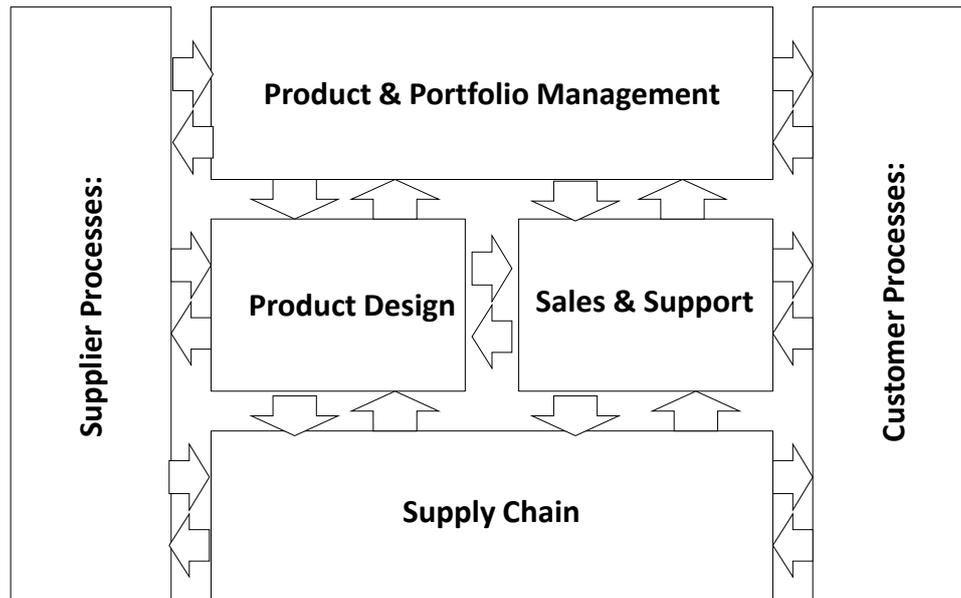
Source: Supply Chain Council, 2014.

Detail definitions and guidelines for calculating the performance measures provide the basis for standardisation and integration. The key performance indicators are used as the key drivers of the

model across the different levels which include process definitions and best practices. An inherent causal relationship between processes and best practices linked with the performance indicators are used as a key design mechanism.

#### 4.3.7.2. Process models

The supply chain is categorised into different sets of processes. The different process sets are outlined in Figure 4.10.



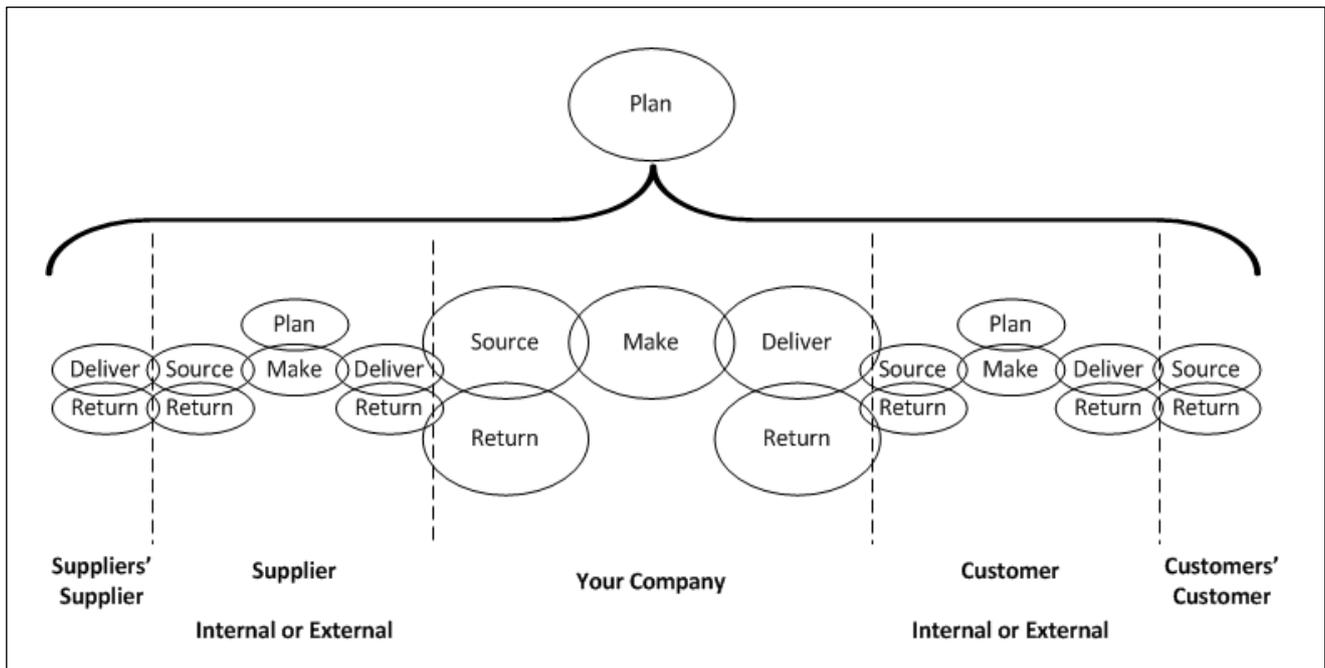
**Figure 4.10: Supply Chain Council defined process categories**

Source: Supply Chain Council, 2014.

The following process categories are identified:

- Product / portfolio management
- Product Design
- Sales & Support
- Supply Chain.

For each of these process categories, the individual processes are defined and process standards are developed for each process. Figure 4.11 outlines the different processes defined for the supply chain.



**Figure 4.11: SCOR model – Core processes**

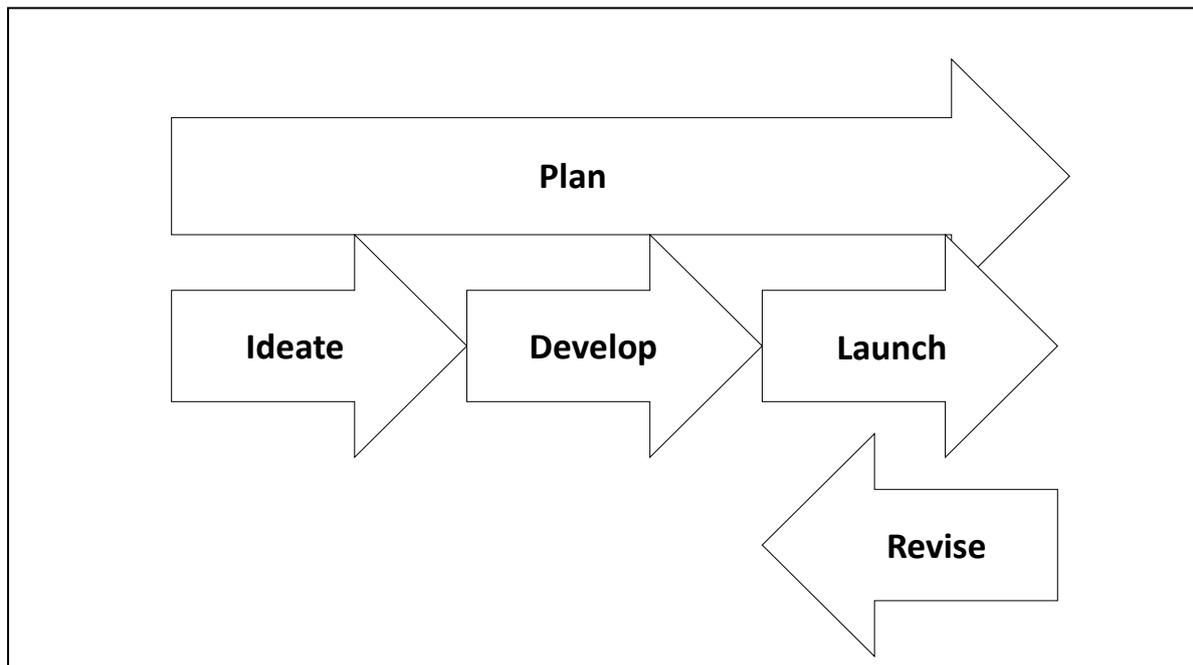
Source: Supply Chain Council, 2014.

The core processes identified in the supply chain model are:

- Plan
- Source
- Make
- Deliver
- Return
- Enable.

The processes defined for product and portfolio management are outlined in Figure 4.10 and include the following processes:

- Ideate
- Develop
- Launch
- Revise.

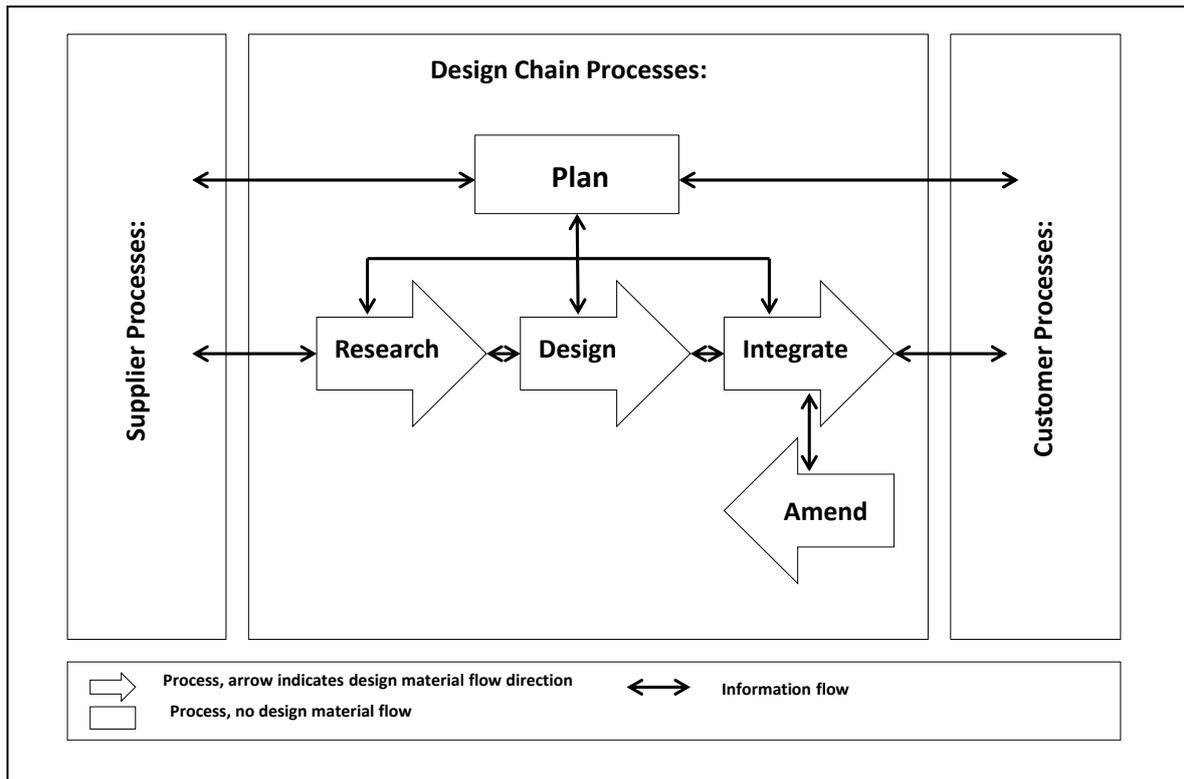


**Figure 4.12: Product and portfolio management processes**

Source: Supply Chain Council, 2014.

Product design processes, which are outlined in Figure 4.12, include:

- Plan the design
- Research
- Design
- Integrate
- Amend.



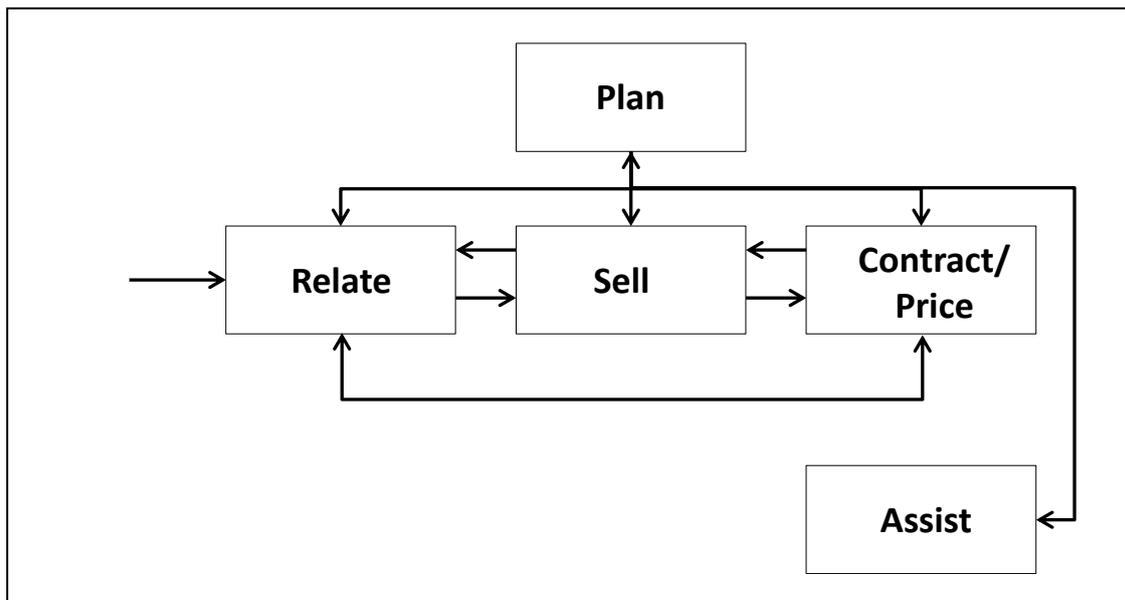
**Figure 4.13: Design chain processes**

Source: Supply Chain Council, 2014.

The sales and support processes are:

- Plan sales and support
- Relate
- Sell
- Contract/Price
- Assist.

These are outlined in Figure 4.14.



**Figure 4.14: Supply chain processes for sales and support**

Source: Supply Chain Council, 2014.

For each of these processes a multi-level model is developed to support the implementation. The detail is outlined in Figure 4.15. The process documentation covers four levels with more detail added across each level. This provides the basis for standardisation across different companies and industries.

	Level		Examples	Comments
	#	Description		
Within scope of SCOR	1	 Process Types (Scope)	Plan, Source, Make, Deliver, Return and Enable	Level-1 defines scope and content of a supply chain. At level-1 the basis-of-competition performance targets for a supply chain are set.
	2	 Process Categories (Configuration)	Make-to-Stock, Make-to-Order, Engineer-to-Order, Defective Products, MRO Products, Excess Products	Level-2 defines the operations strategy. At level-2 the process capabilities for a supply chain are set. (Make-to-Stock, Make-to-Order)
	3	 Process Elements (Steps)	<ul style="list-style-type: none"> <li>• Schedule Deliveries</li> <li>• Receive Product</li> <li>• Verify Product</li> <li>• Transfer Product</li> <li>• Authorize Payment</li> </ul>	Level-3 defines the configuration of individual processes. At level-3 the ability to execute is set. At level-3 the focus is on the right: <ul style="list-style-type: none"> <li>• Processes</li> <li>• Inputs and Outputs</li> <li>• Process performance</li> <li>• Practices</li> <li>• Technology capabilities</li> <li>• Skills of staff</li> </ul>
Not in scope	4	 Activities (Implementation)	Industry-, company-, location- and/or technology specific steps	Level-4 describes the activities performed within the supply chain. Companies implement industry-, company-, and/or location-specific processes and practices to achieve required performance

**Figure 4.15: Multi-level processes model**

Source: Supply Chain Council, 2014.

#### 4.3.7.3. Best practices from the SCOR model

A practice is a unique way to configure a process or a set of processes. The uniqueness can be related to the automation of the process, a technology applied in the process, special skills applied to the process, a unique sequence for performing the process, or a unique method for distributing and connecting processes between organisations. All practices have links to one or more processes, one or more metrics and, where available, one or more skills (Supply Chain Council, 2014).

SCOR recognises that several different types of practices exist within any organisation:

- Emerging practices
- Best practices
- Standard practices
- Declining practices.

These practices are classified into different categories to provide some structure. Categories can be linked to different processes. Table 4.2 provides more detail regarding the practice categories.

**Table 4.2: Practice categories**

<ul style="list-style-type: none"> <li>• Business Process Analysis/Improvement Planning and Forecasting</li> <li>• Customer Support Product Lifecycle Management</li> <li>• Distribution Management Production Execution</li> <li>• Information/Data Management Purchasing/Procurement</li> <li>• Inventory Management Reverse Logistics</li> </ul>	<ul style="list-style-type: none"> <li>• Material Handling Risk/Security Management</li> <li>• New Product Introduction Sustainable Supply Chain Management</li> <li>• Order Engineering (ETO) Transportation Management</li> <li>• Order Management Warehousing</li> <li>• People Management (Training)</li> </ul>
---	---

Source: Supply Chain Council, 2014.

#### 4.3.7.4. People

The last element that the supply chain model focuses on is people. For people the key elements defined are skills, experiences, aptitudes and trainings and competency levels.

- Skill

Skill is the capacity to deliver pre-determined results with minimal input of time and energy. Skills are further defined by experiences, aptitudes, trainings and competency levels. Examples of supply chain skills include Master Scheduling, Import/Export Regulations, Production Planning, and Risk Mitigation.

- Experience

Experience is the knowledge or ability acquired by observation or active participation. Experience is obtained by doing the work in a real-life environment and undergoing different situations that require different actions. Example experiences include Cycle Counting, Cross Docking, and Hazardous Materials Handling.

- Aptitude

Aptitude is a natural, acquired, learned or developed ability to perform a certain kind of work at a certain level. Example aptitudes include Accuracy, Analytical, and Natural leadership.

- Training

Training develops a skill or type of behaviour through instruction. Examples of training include formal trainings such as SCOR-S certification, but also include courses and on-the-job training.

- Competency

Competency Level describes the level or state of qualification to perform a certain role or tasks.

SCOR recognises five commonly accepted competency levels:

- Novice: Untrained beginner, no experience, requires and follows detailed documentation to be able to perform the work.
- Beginner: Performs the work, with limited situational perception.
- Competent: Understands the work and can determine priorities to reach goals.
- Proficient: Oversees all aspects of the work and can prioritise based on situational aspects.
- Expert: Exhibits intuitive understanding. Experts can apply experience patterns to new situations (Supply Chain Council, 2014).

The Supply Chain Council model or SCOR model is by far the most comprehensive model available. Concerning the people element of the model, although competency and competency levels are described, no levels of proficiency are developed. If these are developed then it might not be available in the public domain.

#### **4.4. SUPPLY CHAIN COMPETENCIES: A REVIEW OF PREVIOUS RESEARCH**

The concepts of capabilities and competencies were defined from a generic perspective in Chapter 2 section 2.4.2, Table 2.4. Before the application of these definitions in supply chain management is explored, the relevant definitions are repeated to ensure consistency in the application.

Whilst the notions of competency and capability have, at times, been used interchangeably, capability typically refers to distinctive strengths at the collective or organisational level, and as such is distinguished from competency, which usually applies at the individual level. In human capital management literature, competency refers to how the individual excels in specific job positions and responsibilities. It is distinguished from the term competence, which relates to a particular skill that an employee possesses (Soderquist *et al.*, 2010). This is summarised in Table 4.3:

**Table 4.3: Core competencies versus workplace competencies**

	<b>Core</b>	<b>Workplace</b>
Scope	Organisation	Individual
Purpose	Strategic	Tactical
Participants	Business unit	Worker
Task	Processes	Activities
Competencies	Global	Position

Source: Sanghi, 2008.

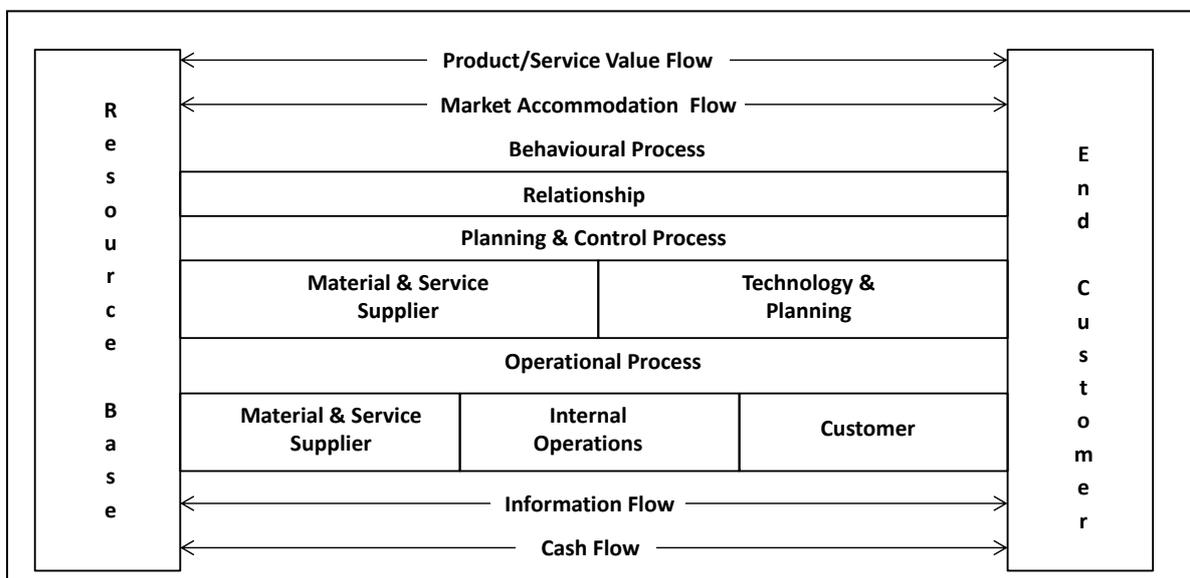
The term “capabilities” reflects the major role of strategic management in adapting, integrating and reconfiguring resources, organizational skills and functional competencies to respond to the challenges of the external environment. Capabilities, which are complex bundles of skills and accumulated knowledge, determine a company’s capacity of general efficiency and ability (Morash *et al.*, 1996). When they are employed through organisational processes they enable firms to coordinate activities and efficiently use assets (Day, 1994). Morash *et al.* (1996) refer to capabilities as “those attributes, abilities, organizational processes, knowledge, and skills that allow a firm to achieve superior performance and sustained competitive advantage over competitors”.

The application of this to supply chain would imply that supply chain capabilities refer the distinctive strengths at the collective or organisational level and supply chain competency thus refers to the individual level, how well individuals perform in specific jobs or positions. Based on the process model outlined in Chapter 2 under section 2.5, Figure 2.10, competencies are determined by the capability requirements at organisational level.

Supply chain capabilities would thus be the key drivers of what competencies at job level will be required. It is therefore fundamental to review the previous research on supply chain capabilities before competency research is reviewed.

#### 4.4.1. Supply Chain Capabilities

The 21<sup>st</sup>-century logistics framework outlined in Fig 4.16 from Bowersox *et al.* (1999) was one of the first key works on supply chain capabilities, six capabilities critical for logistics and supply chain management were identified. Each capability is composed of multiple underlying capabilities that guide philosophies and processes to complete specific logistics and supply chain activities. The competencies leading to high supply chain performance can be grouped into operational, planning, and behavioural processes. Within the operational process, firm competencies include customer integration, internal integration, and supplier integration (whether material or service suppliers). *Customer integration* builds lasting distinctiveness with customers of choice. *Internal integration* links internally performed work to support customer requirements, and *supplier integration* links externally performed work into a seamless congruency with internal work processes (Bowersox *et al.*, 1999).



**Figure 4.16: Supply chain 2000 framework**

Source: Bowersox *et al.*, 1999.

The planning process includes competencies of technology and planning integration and measurement integration. *Technology and planning integration* refers to information systems capable of supporting the wide variety of operational configurations needed to serve diverse market segments. *Measurement integration* refers to the development of measurement systems that facilitate segmental strategies and processes. Finally, in the behavioural process, *relationship integration* refers to the ability to develop and maintain a shared mental framework with customers and suppliers regarding inter-enterprise dependency and principles of collaboration (Bowersox *et al.*, 1999).

A more detailed analysis of the different competencies is outlined in Table 4.4.

**Table 4.4: Supply Chain Capabilities**

<b>Customer integration</b>	
<b>Competency</b>	<b>Definition</b>
Segmental focus	Development of customer-specific programmes designed to generate maximum customer success
Relevancy	Maintenance and modification of customer focus to continuously match changing expectations
Responsiveness	Accommodation of unique and/or unplanned customer requirements
Flexibility	Adaptation to unexpected operational circumstances
<b>Internal integration</b>	
<b>Competency</b>	<b>Definition</b>
Cross-functional unification	Operationalisation of potentially synergistic activities into manageable operational processes
Standardisation	Establishment of cross-functional policies and procedures to facilitate synchronous operations
Simplification	Identification, adoption, implementation, and continuous improvement of best practice
Compliance	Adherence to established operational and administrative policies and procedures
Structural adaptation	Extent to which the network structure and deployment of physical assets has been modified to facilitate integration
<b>Material/service supplier integration</b>	
<b>Competency</b>	<b>Definition</b>
Strategic alignment	Development of a common vision of the total value creation process and planning clarity concerning shared responsibility
Operational fusion	Linkage of systems and operational interfaces to reduce duplication, redundancy, and dwell while maintaining operational synchronisation
Financial linkage	Willingness to structure joint financial ventures with suppliers to solidify goal attainment
Supplier management	Extended management to include hierarchical structures of supplier's suppliers
<b>Technology and planning integration</b>	
<b>Competency</b>	<b>Definition</b>
Information management	Commitment and capability to facilitate supply chain resource allocation through seamless transactions across the total order-to-delivery cycle
Internal communication	Capability to exchange information across internal functional boundaries in a timely, responsive, and usable format
Connectivity	Capability to exchange information with external supply chain partners in a timely, responsive, and usable format
Collaborative forecasting and planning	Customer collaboration to develop shared visions and mutual commitment to jointly generated action plans

**Table 4.4: Supply Chain Capabilities (continued)**

<b>Measurement integration</b>	
<b>Competency</b>	<b>Definition</b>
Functional assessment	The development of comprehensive functional performance measurement capability
Activity-based and total cost methodology	Adoption and commitment to activity-based costing, budgeting, and measurement for comprehensive identification of cost/revenue contribution of a specific entity such as a product
Comprehensive metrics	Establishment of cross-enterprise and overall supply chain performance standards and measurements
Financial impact	Direct linkage of supply chain performance to financial measurement such as EVA (Economic Value Added), RONA (Return on Net Assets).
<b>Relationship integration</b>	
<b>Competency</b>	<b>Definition</b>
Role specificity	Clarity concerning leadership process and establishment of shared versus individual enterprise responsibility
Guidelines	Rules, policies and procedures to facilitate inter-enterprise collaboration, leverage and conflict resolution
Information sharing	Willingness to exchange key technical, financial, operational and strategic information
Gain/Risk sharing	Framework and willingness to apportion fair share reward and penalty

Source: Bowersox *et al.*, 1999.

Table 4.5 provides a summary of further capabilities identified from the research of various other authors. These further capabilities will provide valuable input towards the development of a competency model.

**Table 4.5: Further Research on additional Supply Chain Capabilities**

<b>Capability:</b>	<b>Definition:</b>	<b>Source:</b>
Agility	Measure of a firm's ability to determine and quickly respond to changing requirements	Winter (2003)
Collaboration	An interdependent relationship where parties work closely together to create mutually beneficial outcomes	Christopher (2000) and GLRT-MSU (1995)
Customer focus	Superior skills in understanding and satisfying customers. Dimensions of this capability include: segmental focus; relevancy; responsiveness; flexibility	Sinkovics and Roath (2004)
Customisation	Customizing transportation attributes for specific market segments; could also apply to logistics functions other than transportation	Zhoa <i>et al.</i> (2001)

**Table 4.5: Further Research on Supply Chain Capabilities (continued)**

<b>Capability:</b>	<b>Definition:</b>	<b>Source:</b>
Delivery reliability	The ability to exactly meet quoted or anticipated delivery dates and quantities	Morash and Clinton (1997)
Delivery speed	The ability to reduce the time between order taking and customer delivery to as close to zero as possible	Morash <i>et al.</i> (1996)
Distribution service performance	The provision of logistics/distribution services at a higher level than that which is generally available through competitors. This term should be considered as very similar to logistics capability	Morash <i>et al.</i> (1996)
Fast cycle capability	Improving customer responses through making decisions faster, developing new products earlier, and converting customer orders into deliveries sooner than competitors	Daugherty <i>et al.</i> (1998)
Information focus	The use of technology and information to achieve competitive advantage. Dimensions of this capability include: information technology, information sharing, and connectivity	Fawcett <i>et al.</i> (1996) and Morash and Clinton (1997)
Information sharing	A strategy adopted by the headquarters organization to integrate and coordinate the supply chain	Zhoa <i>et al.</i> (2001)
Innovation	Using new ideas, new technologies, and new techniques to develop creative product offerings	Shore and Venkatachalam (2003)
Integration	Techniques used in achieving internal logistical operational excellence and development of external supply chain relationships	Hayes and Wheelwright (1984) and Hayes <i>et al.</i> (1988)
Learning	Ability of a logistics organization to effectively maintain and manage learning organization characteristics and convert learning outcomes to new logistics management strategies, tactics, and operations in support of further developing other logistics capabilities	Esper <i>et al.</i> (2007)
Logistics capability	1) Activities managed under the logistics umbrella provide an area of unique organizational skills and processes [ . . . ] that can provide the firm a competitive advantage; or (2) managing activities of the logistics functional area to provide sustainable competitive advantage. Dimensions of this capability include: process capabilities and value-added services	GLRT-MSU (1995)
Logistics information technology	Using information technology as a means of creating competitive advantage, and as a tool for ensuring that service levels are met at the least total cost	Fawcett <i>et al.</i> (1997) and Lynch <i>et al.</i> (2000)
Low total cost distribution	The ability to minimize the total cost of distribution	Closs and Goldsby (1997) and Closs and Xu (2000)
Measurement	Monitoring of internal and external operations	Morash <i>et al.</i> (1996)
Operational flexibility	The firm's ability to deal with shortages in inventory, responses to customer's short-term fluctuations in demand, or problems that occur in production due to product design changes	GLRT-MSU (1995)

**Table 4.5: Further Research on Supply Chain Capabilities (continued)**

<b>Capability:</b>	<b>Definition:</b>	<b>Source:</b>
Pre-sale customer service	The ability to service the customer during the purchase decision process (before the customer buys the product)	Sinkovics and Roath (2004)
Positioning	The selection of strategic and structural approaches to guide logistical operations	Morash <i>et al.</i> (1996)
Post-sale customer service	The ability to service the customer after the sale of the product to ensure continuing customer satisfaction	GLRT-MSU (1995)
Transportation reliability	Reduced variability of shipment times around the mean transit time. Also, may be considered as the absence of loss or damage	Morash <i>et al.</i> (1996)
Responsiveness to target markets	The ability to respond to the needs and wants of the firm's target markets	Morash and Clinton (1997)
Selective distribution coverage	The ability to effectively target selective or exclusive distribution outlets	Morash <i>et al.</i> (1996)
Standardisation	Necessary for supply chain integration; eliminates exception processing	Morash <i>et al.</i> (1996)
Time compression	Temporal qualities of transportation used primarily to reduce supply chain inventories including expedited transportation, increased inventory velocity and minimum dwell times	Morash and Clinton (1997)
Time responsiveness	Focuses on strategies that include manufacturing, rapid response, expanded variety, and innovation	Morash and Clinton (1997)
Widespread distribution coverage	The ability to effectively provide widespread and/or intensive distribution coverage	McGinnis and Kohn (1990)

Source: Defee and Fugate, 2010.

The work of Gilgor and Holcomb (2012) categorised capabilities into five major categories which are outlined in Table 4.6.

**Table 4.6: Categorisation of Supply Chain Capabilities**

Capability:	Definition:	Source:
Demand-management capability	Product or service differentiation; service enhancement for continuous distinctiveness by targeting a given customer base; unique, value-added activities Supply-management	Morash <i>et al.</i> , 1996; Stank and Lackey, 1997; Bowersox, 1999; Lynch <i>et al.</i> , 2000; Zhao, 2001; Mentzer <i>et al.</i> , 2004; Esper <i>et al.</i> , 2007
Supply-management capability	Total system cost minimization with explicit consideration of cross-functional trade-offs; effective management of time to eliminate wasted capital and inventory; response to demand fluctuations with less distortion of the order cycle process; use of resources to enable postponement speculation, modularization, and standardization	Murphy and Farris, 1993; McGinnis and Kohn, 1993; Daugherty and Pittman, 1995; Morash <i>et al.</i> , 1996; Mentzer <i>et al.</i> , 2001; Lowson, 2003; Esper <i>et al.</i> , 2007
Integration capability	A state that exists among internal organizational elements that are necessary to achieve unity of effort to meet organizational goals; includes internal and external components	Kahn and Mentzer, 1996; Daugherty <i>et al.</i> , 1998; Bowersox <i>et al.</i> , 2003; Stank <i>et al.</i> , 2005; Esper <i>et al.</i> , 2007
Measurement capability	Degree to which a firm monitors internal and external operations; aligned with strategy to make accurate, detailed, relevant, and timely information accessible for strategic planning and daily decision making; enables the translation of business objectives into measurement specific operational and financial targets	Global Logistics Research Team, Michigan State University, 1995; Fawcett <i>et al.</i> , 1997; Gilmour, 1999; Bowersox <i>et al.</i> , 2000; Holmberg, 2000; Esper <i>et al.</i> , 2007
Information exchange	Information exchange Acquires, analyses, stores, and distributes tactical and strategic capabilities information both inside and outside the firm; involves the application of hardware, software and networks	Closs <i>et al.</i> , 1997; Zhao <i>et al.</i> , 2001; Mentzer <i>et al.</i> , 2004; Esper <i>et al.</i> , 2007; Jack <i>et al.</i> , 2009

Source: Gilgor and Holcomb, 2012.

While previous research has explored important capabilities within these main categories, much of the work has been rooted in the belief that capabilities, once established, create barriers strong enough to ensure a long period of sustainability (Aragon-Correa & Sharma, 2003; Reed & DeFillippi, 1990; Wernerfelt, 1984 cited in Defee & Fugate, 2010). The realities of the global marketplace have brought forth new competitors and increased the speed of innovation needed to battle competitive threats. These new realities limit the duration of advantage available from traditionally conceptualised capabilities (Bowersox, et al., 1999). The belief that capabilities are of a static nature was thus challenged.

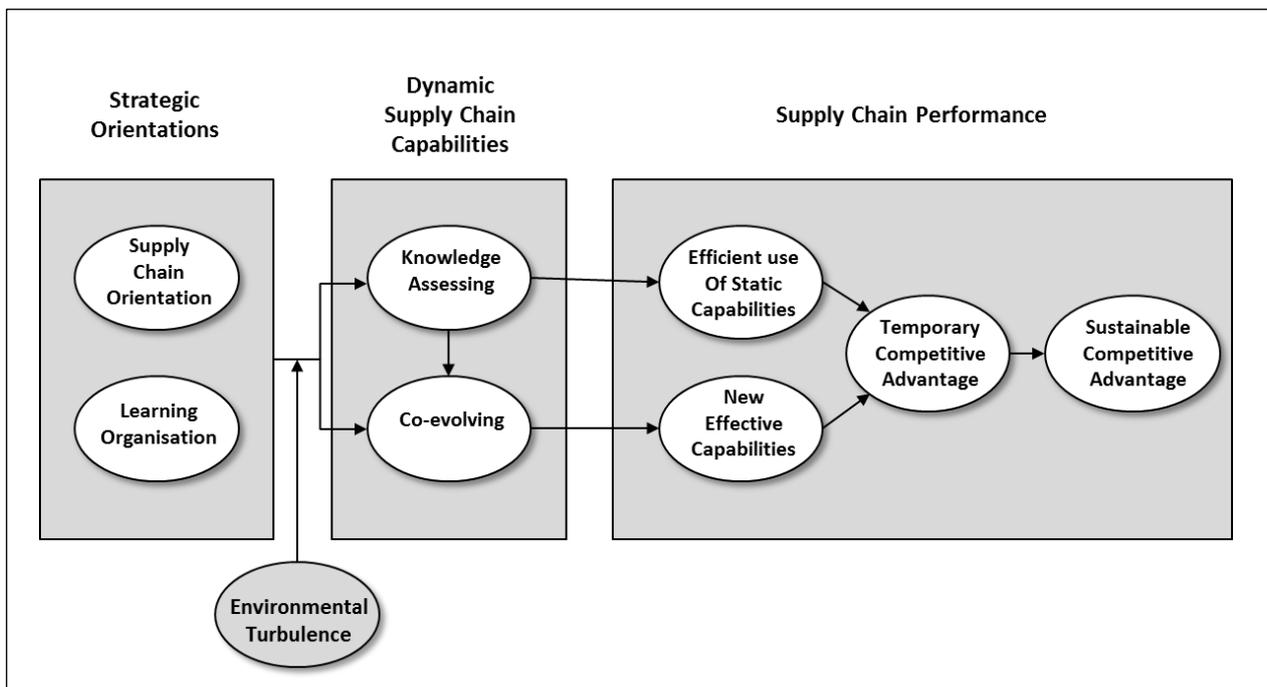
#### 4.4.2. Dynamic Supply Chain Capabilities

Taking the concept of dynamic capabilities as referenced in Chapter 2 by Teece *et al.* (1997) further within a supply chain context, a definition for dynamic supply chain capabilities is required. For this purpose, the work of Zollo and Winter (2002 cited in Defee & Fugate, 2010) is adopted where dynamic supply chain capabilities are defined as a developed pattern of cross-organisational processes which enable the development of new static capabilities or the modification of existing capabilities across multiple supply chain members.

The conceptualisation of dynamic supply chain capabilities (DSCC) is distinct from previously described dynamic capabilities. While dynamic capabilities are firm-centric, DSCCs are embedded within the collaborative routines formed between multiple supply chain partners. Thus, multiple partners may jointly develop and use DSCCs to reenergize and update existing (static) capabilities or form entirely new capabilities (Defee & Fugate, 2010).

An important issue to be explored is how these dynamic supply chain capabilities are developed. The work of Chien and Tsai (2012) referenced in Chapter 2 emphasised that dynamic capabilities are formed through a process of where existing knowledge is changed through a process of sensing and learning. The concept of a learning organisation is thus central to the development of dynamic capabilities. Defee and Fugate (2010) take this further with the application within a supply chain context by adding a supply chain orientation to the learning organisation as strategic orientation. A core driver of supply chain management is the interdependence of supply chain members, which introduces the concept of co-evolving. Co-evolving is defined as “the set of routines businesses use to reconnect webs of collaborations within and across companies to generate new and synergistic capabilities” (Eisenhardt & Martin, 2000 cited in Defee & Fugate, 2010). The notion of reconnecting collaborative webs implies collaboration cannot be viewed as a static exercise. Each collaboration, or each link between organisations, must have a defined goal of improving performance through the creation of a new capability (Eisenhardt & Galunic, 2000 cited in Defee & Fugate, 2010).

In a supply chain context, co-evolving is defined as: “a DSCC held by two or more supply chain members that facilitates the joint development of new capabilities between supply chain-oriented firms that aspire to compete on the basis of superior supply chain capabilities” (Defee & Fugate, 2010). A first model of dynamic supply chain capabilities is depicted in Figure 4.17 in which knowledge assessing and co-evolving are identified as key dynamic supply chain capabilities.



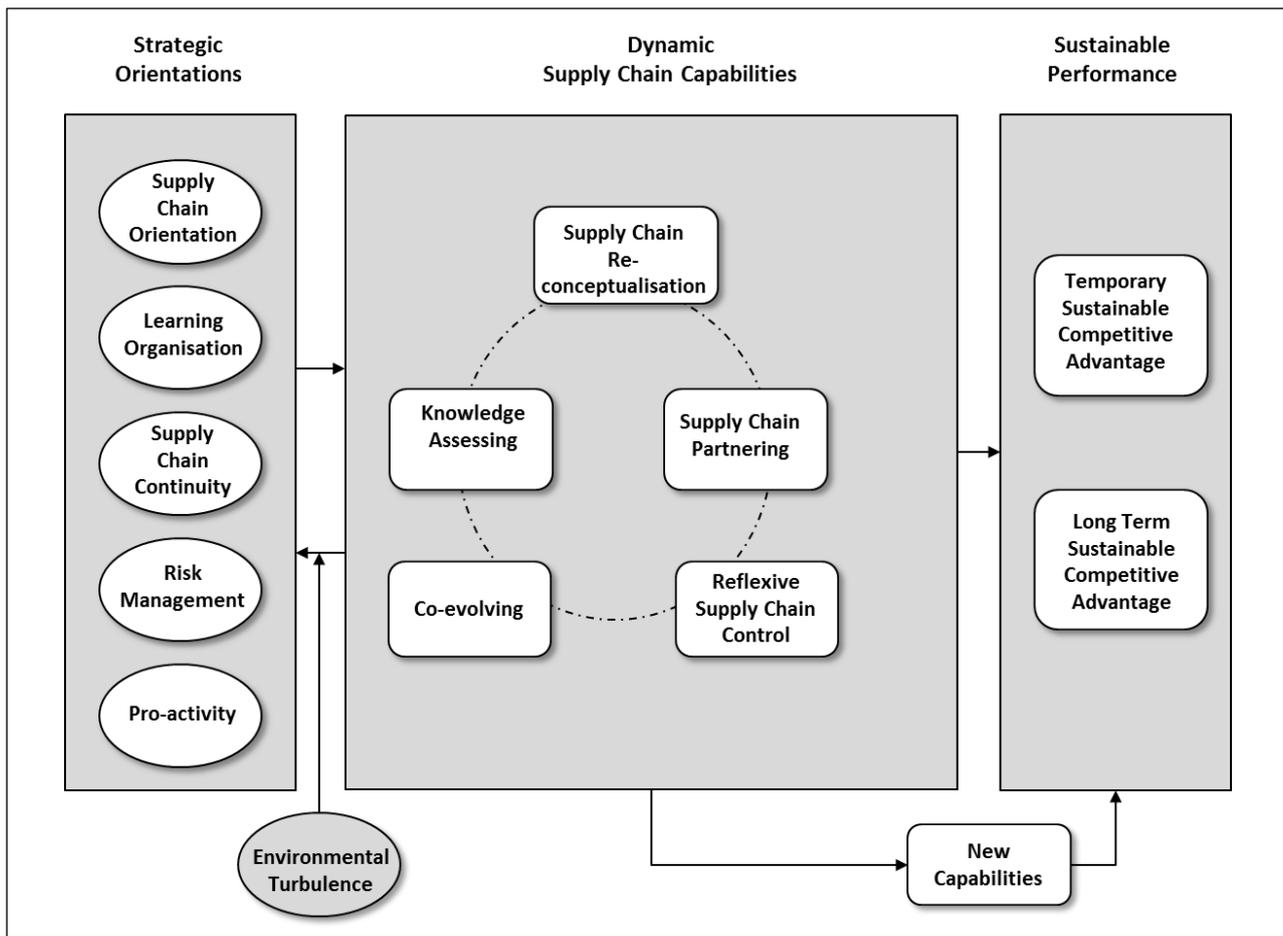
**Figure 4.17: A First Model of Dynamic Supply Chain Capabilities**

Source: Defee and Fugate, 2010.

The research of Beske (2012) added a new dimension to dynamic supply chain capabilities, by adding the concept of sustainable supply chain management. This is defined as "the management of material, information and capital flows as well as cooperation between companies along the supply chain while taking goals from all three dimensions of sustainable development, economic, environmental and social in account which are derived from customer and stakeholder requirements".

Integrating sustainability with the concept of dynamic supply chain capabilities creates a further challenge by introducing an additional set of environmental drivers that will determine supply chain performance. Organisations with the intent of pursuing a strategy of sustainability will be more prone to unpredictable changes (Beske, 2012). This placed even more emphasis on the requirement for dynamic capabilities as opposed to static capabilities.

The integration of supply chain sustainability provided the basis for a next framework for dynamic supply chain capabilities which is depicted in Figure 4.18.



**Figure 4.18: A Further Model of Dynamic Supply Chain Capabilities**

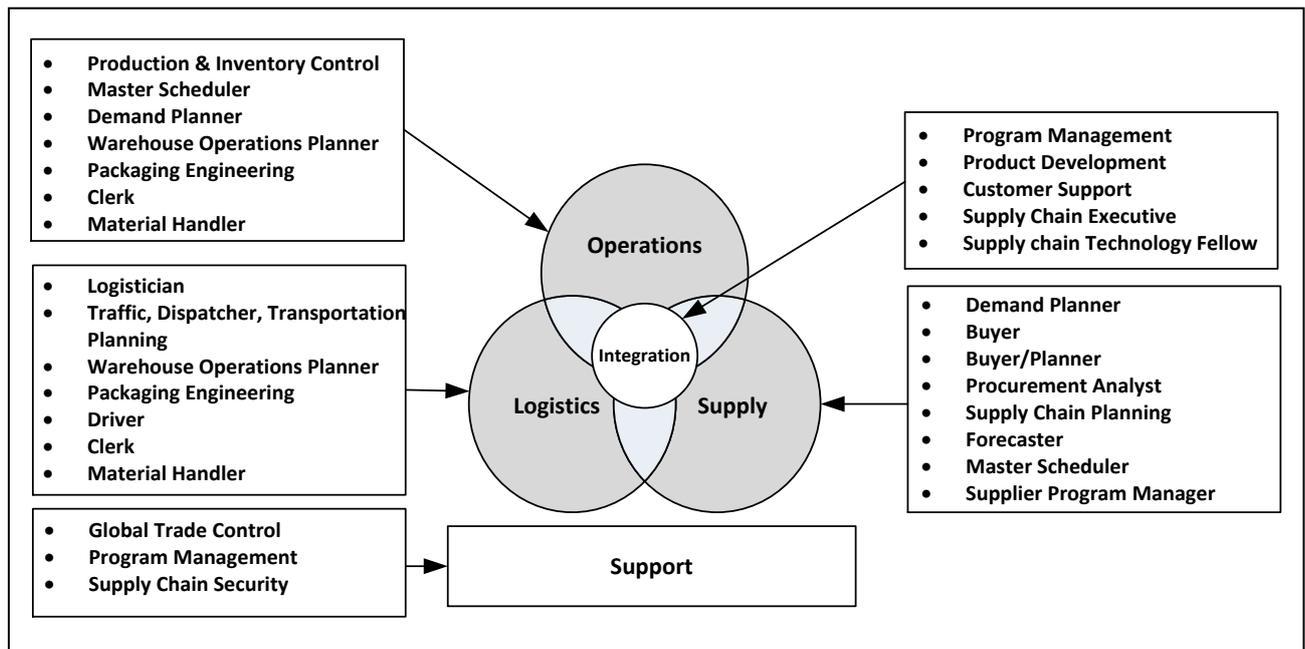
Source: Adapted from Beske, 2012.

From the research on sustainability the strategic orientations were expanded to include supply chain continuity, risk management and pro-activity. As pointed out, environmental turbulence is further exacerbated by the introduction of sustainability. Further dynamic capabilities such as supply chain re-conceptualisation, partner development and reflexive control were added to the model of Defee and Fugate (2010).

Dynamic supply capabilities are positioned at a more strategic level of the supply chain. In terms of the definitions in the classical competency work, these competencies are more like core competences of the supply chain at an organisational level. Although these core competences thus provide key guidance at the strategic level, they need to be broken down into process and work-related competencies for implementation at job level. The next section reviews the research of competencies at job level, which will be integrated with dynamic capabilities in Chapter 6.

#### 4.4.3. The Supply Chain Talent Academic Initiative

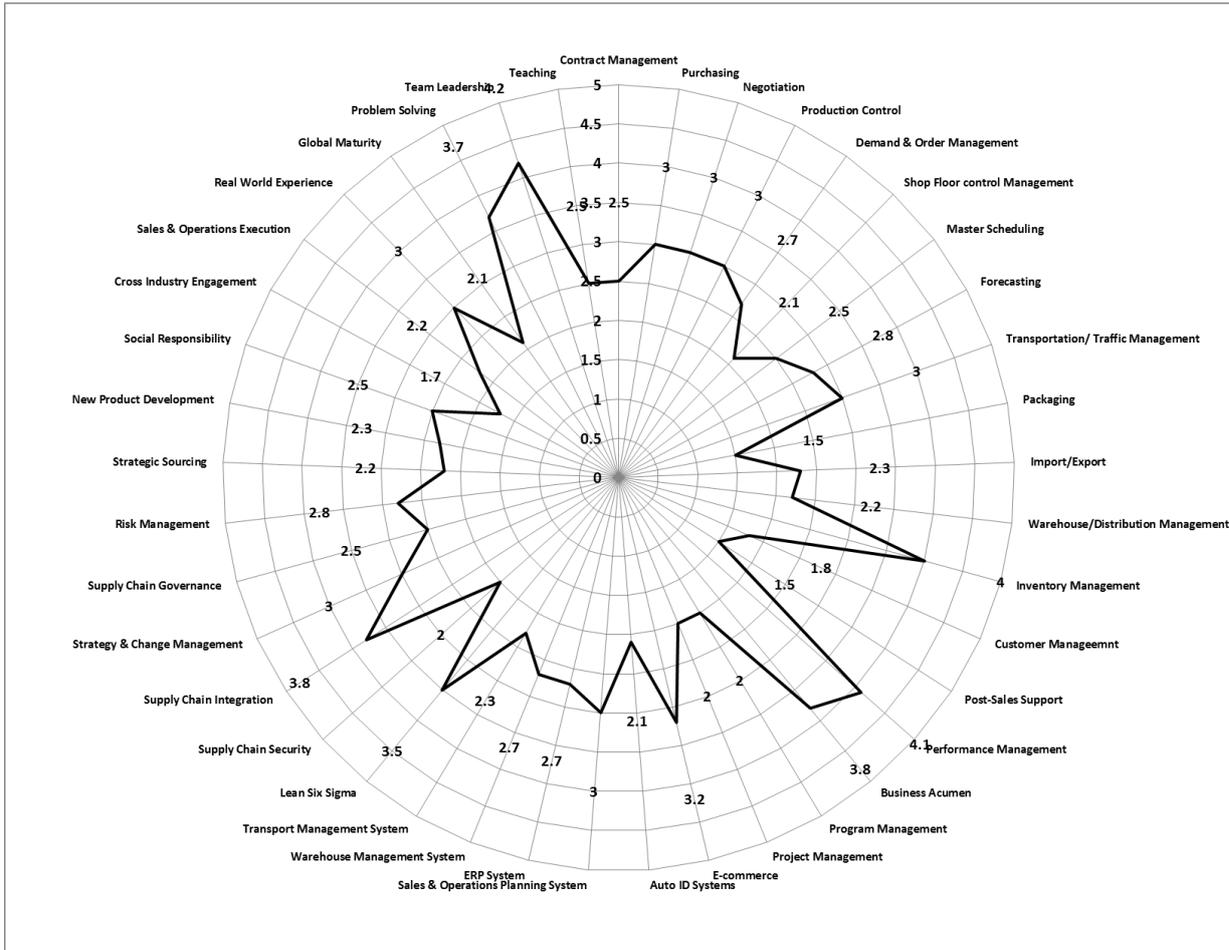
The Supply Chain Talent Academic Initiative (SCTAI) was formed to focus on the development of supply chain talent and the identification of supply chain competencies required by industry. Recent research amongst its members has identified the status of supply chain talent. The model developed by this initiative is to provide the basis for identification of different supply chain competencies and roles as outlined in Figure 4.19.



**Figure 4.19: The Supply Chain Talent Academic Initiative**

Source: Supply Chain Council, 2014.

This model provided the basis for identification of the major functional building blocks such as logistics, operations, supply and support. The potential supply chain positions which relate to each of the functional building blocks were also identified. Further research was done on the competencies required to fulfil the supply chain positions. The outcome of this research is depicted in Figure 4.20, which provides a rating for each of the competencies on a scale of 1 to 5.



**Figure 4.20: Supply chain talent initiative research**

Source: Supply Chain Council, 2014.

This study clearly indicated certain competencies that are required as part of supply chain management. The limitation of this research is that these competencies are not linked to a competency model that can provide a competency profile for each of the identified positions or jobs identified in the previous model. These competencies will be integrated into an integrated competency model, which is the subject of the next chapter.

**4.4.4. The competency model of APICS**

The American Production and Inventory Control Society (APICS) is one of the leading vocational societies in the supply chain industry. Figure 4.21 below provides an overview of the APICS competency model.

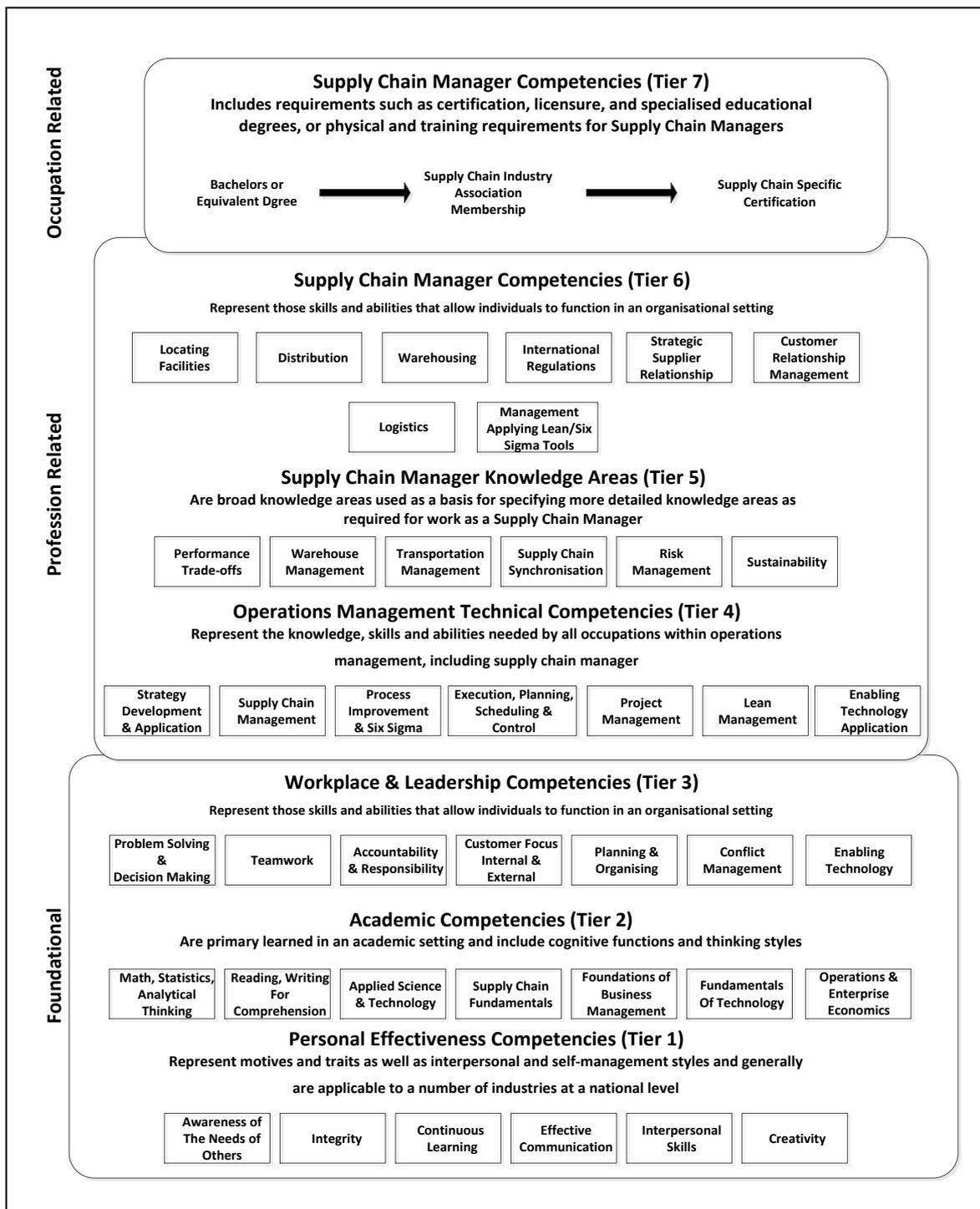


Figure 4.21: APICS competency model

Source: APICS, 2013.

The APICS model shows significant similarities with the model of Competency Clearinghouse discussed under section 3.5.2 in chapter 3. These models focus not only on functional competencies but also include other personal competencies. The APICS model identifies six tiers:

- Tier 1: Personal effectiveness competencies
- Tier 2: Academic competencies

- Tier 3: Workplace and leadership competencies
- Tier 4: Operations management technical competencies
- Tier 5: Supply chain manager knowledge areas
- Tier 6: Supply chain manager competencies.

The detail of the different competencies is included in Appendix A. The detail elements have been integrated into a single model which is discussed in Chapter 6.

#### **4.4.5. Developing a supply chain management program: A competency model**

The next research into supply chain competencies is positioned at a much more detailed level compared to the previous model. The competencies identified in this model were identified for developing a course in supply chain management at a university of the United States. The different functional areas and supporting subjects identified are as follows (Sauber, McSurely & Tummala, 2008):

##### **Procurement**

- Purchasing process
- Procurement cycle
- Purchasing research
- Relationships with suppliers
- Negotiation
- Commodity planning
- JIT (just-in-time) systems
- Expediting systems
- Cost, price and value analysis
- Life-cycle costing
- Cost reduction techniques
- Purchase/product specifications
- International procurement
- Sourcing strategies
- Theoretical models explaining procurement and sourcing strategy
- Supplier quality certification
- Statistical quality control
- Outsourcing
- Supplier selection
- Global sourcing
- Purchasing organisation.

## **Customer relationship management**

- Order management
- Customer relationship management
- Demand management
- Customer service
- Data mining
- Order fulfilment
- B2B (business-to-business) marketing
- B2C (business to customer) marketing
- Supply chain contracts.

## **Logistics and distribution**

- Channel management
- Transportation decisions
- Facility decisions
- Network design
- SCM information technology
- Inventory analysis
- Inventory control in SCM
- Multi-echelon inventory control models
- Interaction of government, carrier and user logistics
- Warehousing
- Materials handling
- Integrated performance measurement
- Managerial and statistical data techniques used for logistics analysis
- Logistical information systems
- Tools, procedures, and metrics for purchasing, manufacturing operations and logistics
- Distribution operations
- Logistics management
- Just-in-time systems
- Logistics
- Transportation
- Traffic management.

These functional areas can be compared to the functions and processes identified in the different supply chain models reviewed. Based on these functional areas and processes, the following competencies were identified.

### **Supply chain management**

- Be able to describe the major environmental factors affecting the entire supply chain.
- Understand key issues to be considered in designing or redesigning the supply chain.
- Describe different players and their roles in the entire supply chain.
- Be knowledgeable of the basic value- and non-value added activities/functions at each node of the supply chain.
- Be able to develop a complete framework for an entire supply chain.
- Understand the role of in-sourcing and outsourcing and the corresponding relationship development issues including collaborative product development.
- Comprehend the use of decision support systems and enterprise resource planning (ERP) in the management of supply chains.
- Understand requirement planning for materials, production, and distribution.

### **Information technology for supply chain management**

- Understand and apply information technology used in supply chain systems to achieve competitive advantage.
- Understand the role and function of various supply chain systems such as ERP, CRM, eProcurement, and ePayment.
- Understand the function and interrelation of eBusiness applications.
- Be able to use correct vocabulary of E-commerce technology.
- Understand the various technologies available for integrating systems.
- Understand various management techniques such as collaboration, strategic alliance, joint venture, and other methods to achieve strategic and sustainable competitive operations.
- Know the latest developments in B2B standards and applications that facilitate supply chain integration and creation of value systems.
- Gain hands-on knowledge and skill using ERP systems such as SAP.

**Logistics in the supply chain**

- Understand the strategic and operational issues pertaining to location, warehouses, inventory, and transportation decisions.
- Be able to link logistics with other SCM functions.
- Be knowledgeable about the operating and service characteristics of different motor, air, and water, inter-modal carriers and railroads and containerisation.
- Learn how to use optimisation models for warehousing and transportation.
- Be able to identify the transportation needs for different goods and services.
- Be familiar with the location and layout issues to resolve the establishment needs for supply chains.
- Understand the physical components and operation of transportation (e.g. infrastructure, fuel energy, equipment, labour, scheduling and dispatching).
- Understand the causes of uncertainty and variability in the transportation industry.
- Be aware of the major issues pertaining to logistics routes (e.g. air, water, pipelines, information technology, and rail lines).
- Be familiar with different types of material handling equipment.
- Be aware of the history behind the transportation industry.
- Be aware of the transportation environment and energy (e.g. air quality, safety, noise and congestion).

**Customer relationship management**

- Understand ways to identify and profile customers in the supply chain.
- Be able to find customer information on the internet and use it to drive the B2C and B2B marketing processes.
- Be able to analyse customers' purchase patterns and identify market opportunities in the supply chain.
- Be able to analyse the potential lifetime value of customers and how to develop the most appropriate level of service for different segments of customers.
- Know how business customers make decisions about developing and purchasing new products and services.

- Understand and design programmes to increase customer loyalty and retention across the supply chain, using both online and off-line media channels.
- Know how to design, develop and implement effective trade promotions including the use of trade shows.
- Know how customers make decisions and purchases to develop marketing campaigns that realise strategic objectives using both traditional and electronic means of promotion.
- Understand how to manage a multi-channel selling system that relies on a combination of field sales, retail, partners, call centres and electronic channels – to reach and serve customers effectively.

### **Operations planning and scheduling**

- Distinguish between the make-to-stock, standardised services, assemble- or finish-to-order, engineer- and make-to-order, and customised services strategies and how they relate to competitive priorities.
- Understand different manufacturing processes and assess the role of process technologies in enhancing process flexibility and product and service variety.
- Understand concepts related to master demand scheduling (MDS), master production scheduling (MPS), material requirements planning (MRP), and distribution requirements planning (DRP) and how they relate to supply chain planning.
- Be able to evaluate alternative capacity strategies in developing realistic plans.
- Understand actions related to the implementation of the planning recommendations (i.e. modifying the recommended due dates and quantities; adding firm planned orders for DRP, MRP or MPS; releasing planned purchase and production orders; implementing repetitive schedules; and rescheduling scheduled receipts).
- Know the differences between various inventory systems for independent and dependent demand items, and learn how to use them for managing inventory.
- Understand concepts related to demand management and how to forecast demand using qualitative and quantitative methods.
- Understand concepts related to production activity control and the theory of constraints (e.g. managing continuous and repetitive operations and synchronised scheduling; managing job and batch operations; backward and forward scheduling; operations overlapping and job splitting; and capacity control).

**Purchasing and outsourcing**

- Understand the criteria and techniques for selecting suppliers.
- Know how to assess and evaluate existing suppliers.
- Know how to build trust between participants across the supply chain.
- Know about the causes resulting in the types and degree of relationships between the different tier suppliers.
- Know how to establish cross-functional teams between suppliers and their customers.
- Understand purchasing practices in relation to product/market characteristics.
- Be able to identify global purchasing and logistics issues.
- Understand how to monitor process output using control charts and other QC tools.
- Know how to assess process capability and identify ways of meeting customer specifications.
- Know how to identify best practices to implement appropriate action plans and benchmarking.
- Be knowledgeable about quality systems and how they are used in assessing quality (e.g. ISO 9000, QS-9000, etc.) and awards (e.g. Deming Prize, Malcolm Baldrige Award).

**Integrated product and process design**

- Explain the need for the business to focus upon meeting customer needs and anticipations.
- Describe how the business vision, mission, and strategy of the organisation are developed and/or revised periodically to meet customer needs.
- Explain the linkage between market research and product development strategy.
- Describe and apply market research methods.
- Describe the development of product objectives and alternatives, the product selection process, and marketing mix strategies.
- Describe the concurrent/collaborative engineering (CCE) process for product and process design in a lean manufacturing environment.
- Describe CCE project planning methods and CCE team management issues.
- Apply CCE principles for product and process design, value stream mapping, and supply chain integration.
- Describe the benchmarking process and its role in performance measurement.

- Employ benchmarking techniques.
- Identify strategies for meeting product specifications.
- Carry out design improvement approaches such as quality function deployment (QFD) in product and process design, failure mode and effects analysis (FMEA), and design for manufacture and assembly (DFMA).
- Compute process capability indices and explain their use.
- Explain the use of corrective action plans.
- Describe the insourcing/outsourcing decision process in a CCE environment.
- Define widely held criteria and techniques for selecting suppliers.
- Explain the application of public and private systems, with and without electronic commerce, as they relate to integrated product and process design and supplier selection (Sauber *et al.*, 2008).

The competencies identified in this research project are positioned at the level of a specific skills development course. The value of the research is that the competencies were identified through an empirical process. This competency model can however not be used for the purpose of competency development in a supply chain organisation as it is not linked to specific jobs or positions. A further disadvantage is that these competencies are all identified at the same level of proficiency.

#### **4.4.6. Transportation, distribution, and logistics competency model of the Competency Clearinghouse**

The Transportation, Distribution, and Logistics Competency Model depicted in Figure 4.22 consists of nine tiers. The arrangement of the tiers in a pyramidal shape is not meant to be hierarchical, or to imply that competencies at the top are at a higher level of skill. The model's shape represents the increasing specialisation and specificity in the application of skills as you move up the tiers. Tiers 1-4 have been developed and are divided into blocks. The blocks represent competency areas, that is, the applied skills, knowledge, abilities essential to successful performance in the transportation, distribution and logistics industry. Tiers 1 through 3 contain foundation competencies, which form the foundation needed to be ready to enter the workplace.

**Tier 1 – Personal effectiveness competencies** are shown as hovering below the pyramid because these competencies are essential for all life roles. Often referred to as "soft skills", personal effectiveness competencies are generally learned in the home or community and reinforced and honed at school and in the workplace. They represent personal attributes that may present some challenges to teach or assess.

**Tier 2 – Academic competencies** are critical competencies primarily learned in a school setting. They include cognitive functions and thinking styles. Academic competencies are likely to apply to all industries and occupations.

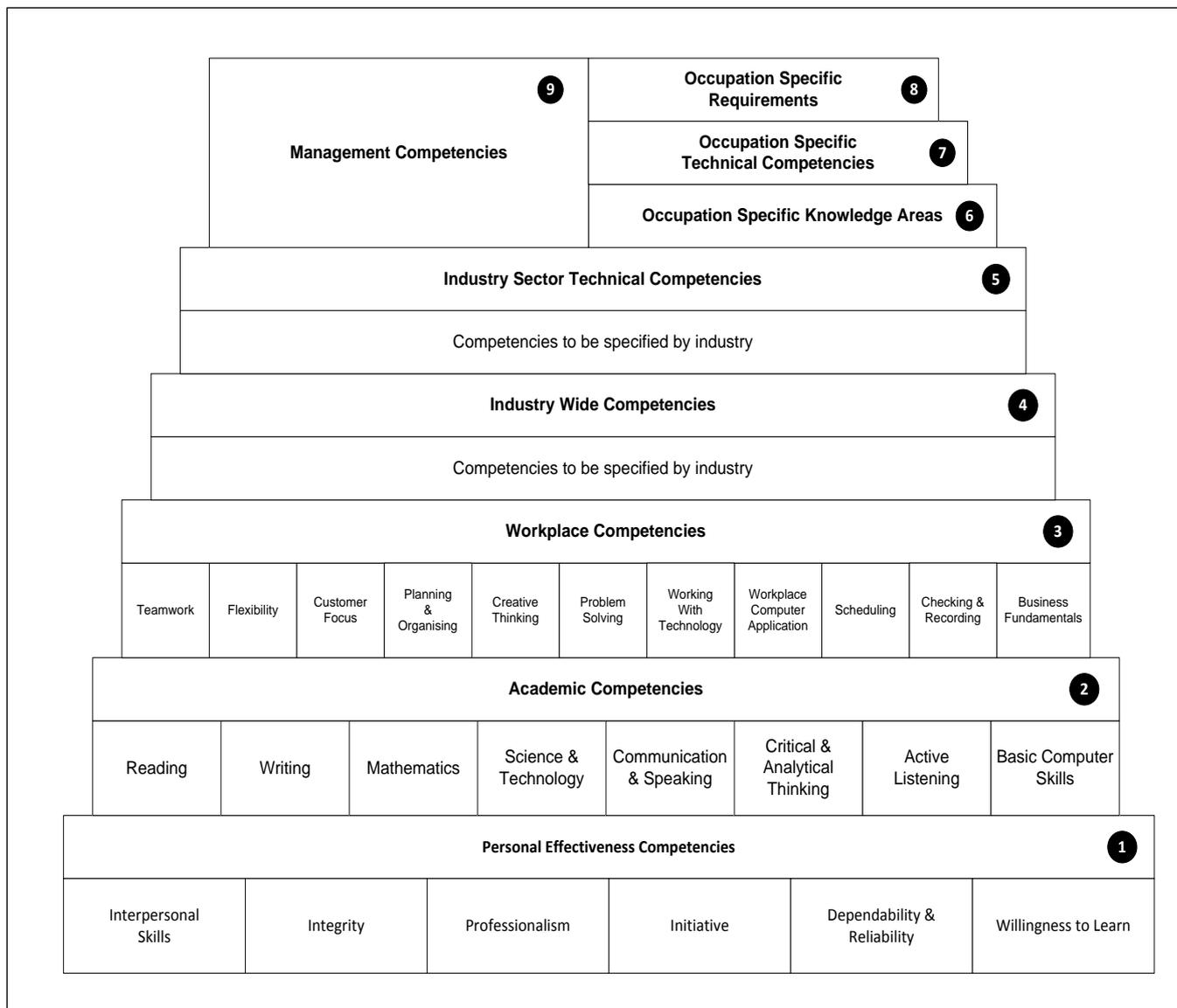
**Tier 3 – Workplace competencies** represent motives and traits, as well as interpersonal and self-management styles. They generally are applicable to a large number of occupations and industries.

**Tiers 4 and 5 contain industry competencies**, which are specific to an *industry or industry sector*. Cross-cutting, industry-wide technical competencies make it possible to create career lattices within an industry wherein a worker can easily move across industry sub-sectors. Rather than narrowly following a single occupational career ladder, this model supports the development of an agile workforce.

**Tier 4 – Industry-wide technical competencies** represent the knowledge and skills that are common across sectors within a broader industry. These technical competencies build on, but are more specific than, competencies represented on lower tiers.

**Tier 5 – Industry-sector technical competencies** represent a sub-set of industry technical competencies that are specific to an industry sector.

Tiers 6 through 9 represent the specialisation that occurs within specific *occupations* within an industry.



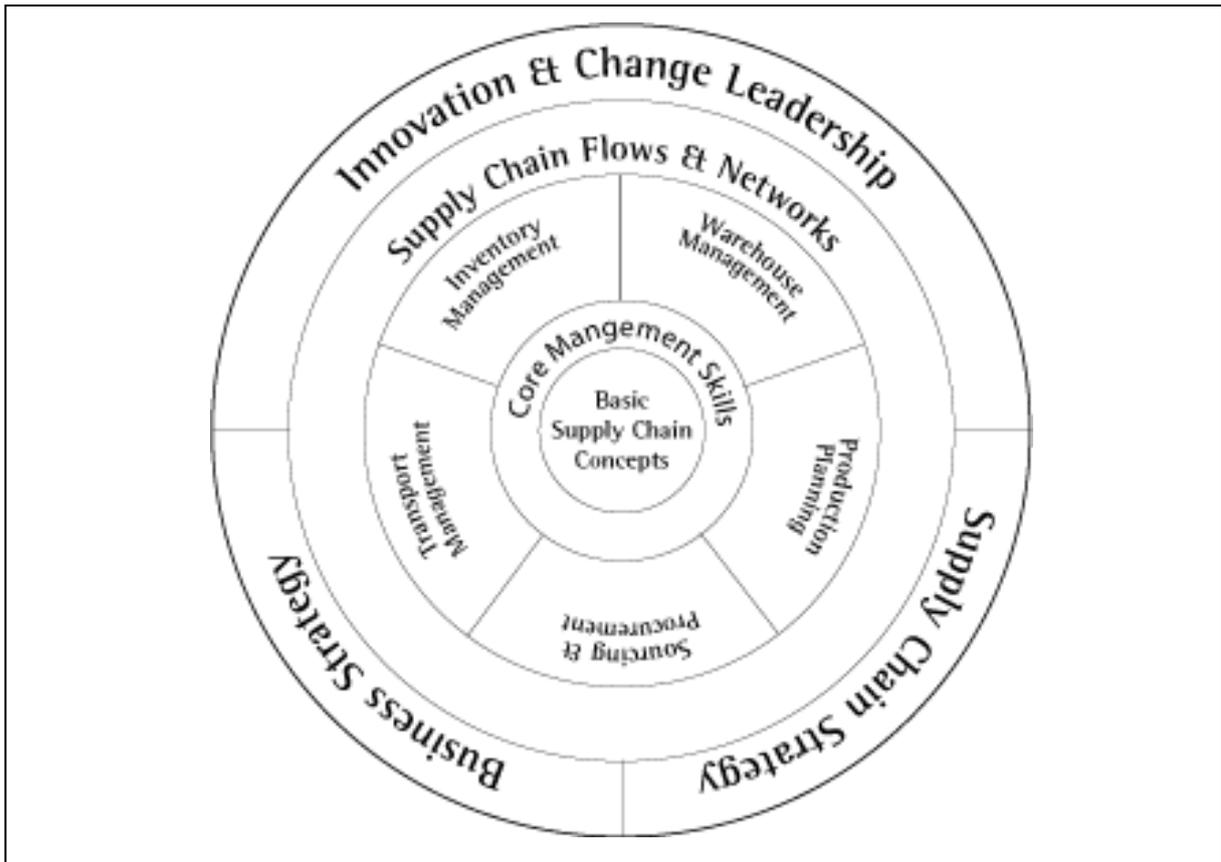
**Figure 4.22: Competency model of Clearinghouse**

Source: Career One Stop, 2013.

**4.4.7. Competence System from European Certification Board for Logistics**

The European Logistics Association (ELA) has created a Certification Board for Logistics for the purpose of training and development. This association is one of the major industry associations in Europe and as such represents a significant number of members and by implication companies.

A competency model was developed to provide the basis for developing further education and training. This model is outlined in Figure 4.23.



**Figure 4.23: European Board for Logistics Competence System**

Source: European Logistics Association, 2013.

The core elements identified from this system are:

#### **Core building blocks**

- Core management skills
- Basic supply chain concepts.

#### **The functional areas**

- Inventory management
- Production management
- Sourcing and procurement
- Warehouse management.

#### **The more integrative elements are**

- Supply chain flow and networks.

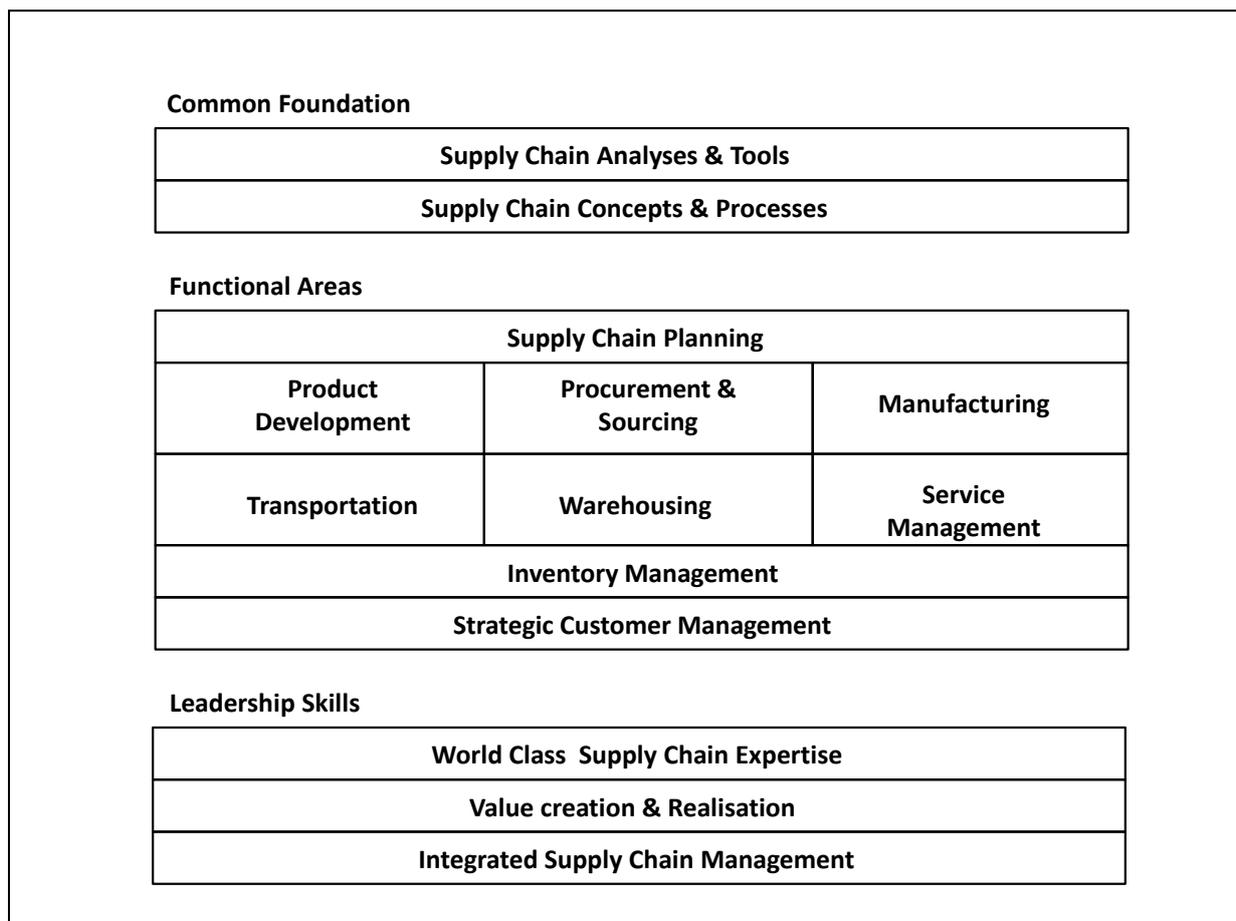
### Strategic elements

- Supply chain strategy
- Business strategy
- Innovation and change leadership.

This model can be compared with the competency model of APICS and the Supply Chain Council. These models have limited academic or research foundations, but play an important role in directing the further training and development of the members. This by implication contributes towards shaping supply chain competencies.

#### 4.4.8. Curriculum Model Accenture

Accenture is one of the leading consulting companies in the world. As part of its consulting practice, a supply chain academy was developed. The broad outline of the curriculum offered is outlined in Figure 4.24 below.



**Figure 4.24: Curriculum of the Accenture Supply Chain Academy**

Source: Accenture Supply Chain Academy, 2013.

The model is similar to some of the other models in that a common foundation is provided which consists of basic concepts, in this case analysis tools, techniques, basic concepts and processes.

The functional areas identified are:

- Supply chain planning
- Product development
- Procurement and sourcing
- Manufacturing
- Transport management
- Warehousing
- Service management
- Inventory management
- Strategic customer management.

There is a significant overlap between the functional elements and the other models. Product development and strategic customer management are unique to this model.

Leadership skills such as world-class supply chain expertise, value creation and realisation and integrated supply chain management form the basis for the more integrative building blocks.

#### **4.4.9. Supply chain talent: State of the discipline**

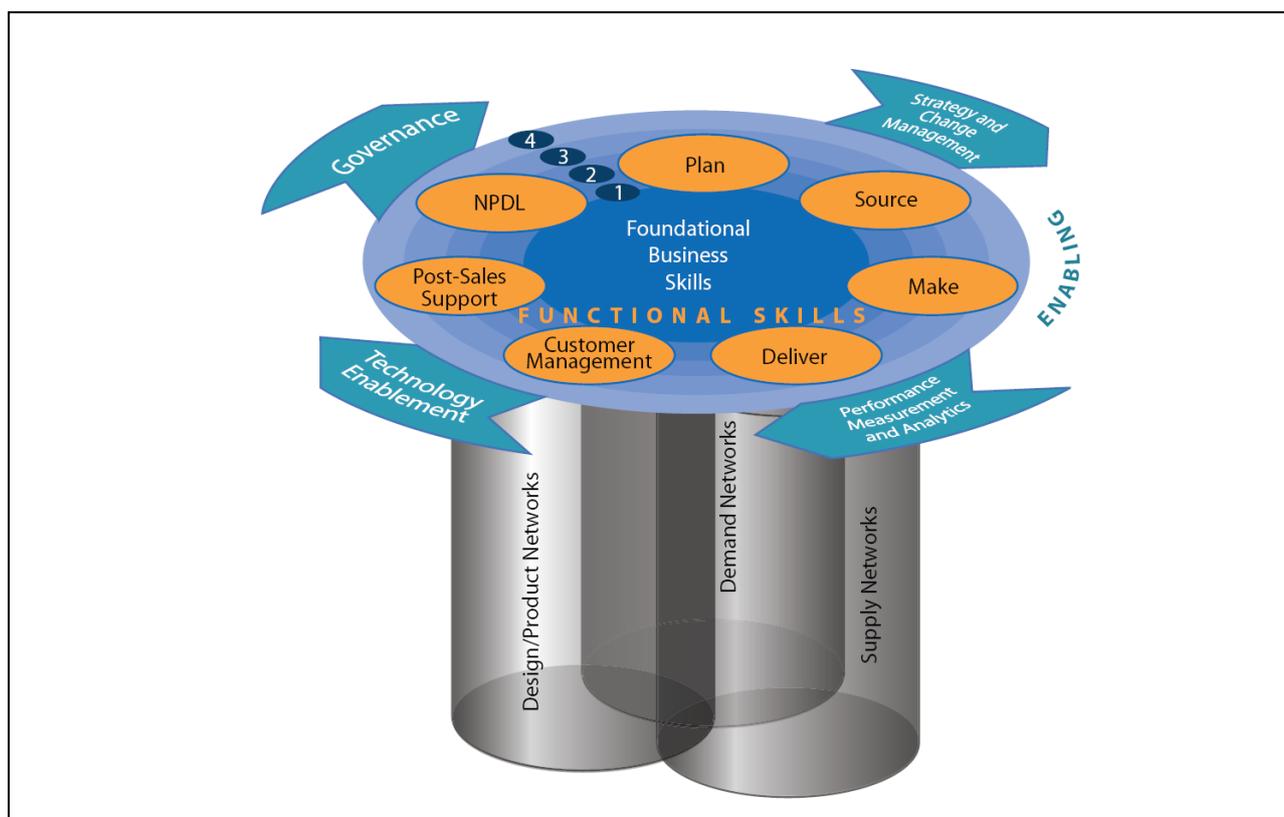
A research study to determine the state of supply chain talent in the United States was published in April 2008 (Aquino & Draper, 2008).

The following key conclusions were made:

- No two supply chains are alike. Very few companies define supply chain in the same way. Of the supply chain leaders involved in the study, almost all had different spans of control. This contributes significantly to a lack of clear priorities for standards and for consistent curriculum development at universities.
- Leaders view supply chain management as a business discipline. Overall supply chain management is still very engineering centric. Few companies include manufacturing and new product development within the definition and span of control of supply chain, which is a differentiator amongst leading companies.
- Globalisation has created urgency. A general flattening and global broadening of supply chain organisations have boosted the need for a more extensive set of complex skills and competencies within company ranks. In addition, a trend towards a more centralised supply chain structure has heightened the need for broader skill sets and faster ramp-up time.

- A common supply chain talent model is the foundation for improvement. For supply chain management professional development to evolve into a more universal body of capabilities, industries and academia need to adopt a shared, modern, comprehensive model that incorporates the growing depth and scope of the discipline.

These conclusions led to the development of common supply chain talent model. AMR stated that “The establishment of a supply chain talent model would simultaneously assist in identifying major functional areas of responsibility, highlighting the gaps that require review, and beginning the process of formulating an appropriate universal curriculum”(Aquino & Draper, 2008). This model is depicted in Figure 4.25.



**Figure 4.25: AMR supply chain talent attribute model**

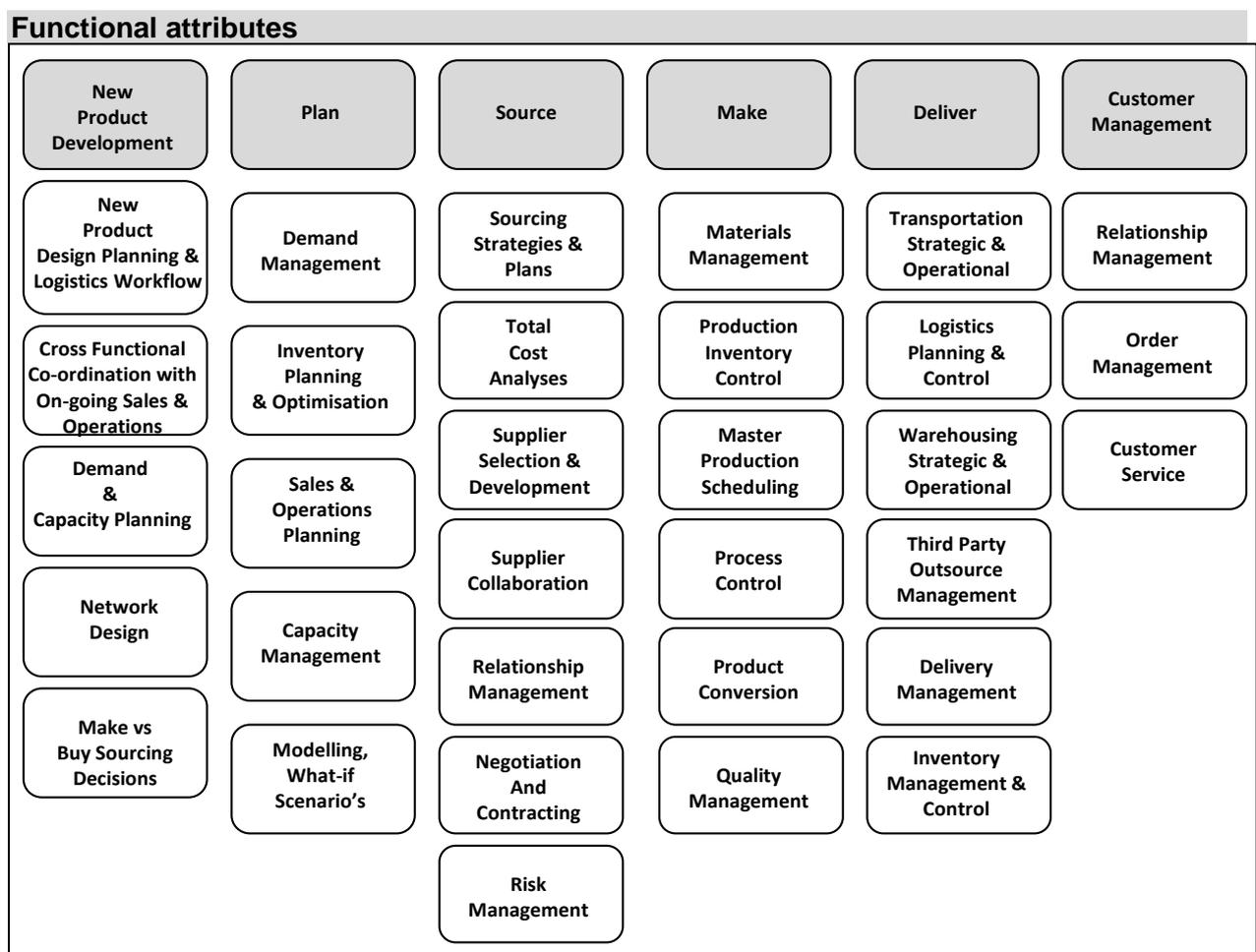
Source: Aquino and Draper, 2008.

This model is developed based on supply chain stations and attributes. A station can be compared to a functional area defined in the previous models. An attribute can be compared with knowledge or skills defined in previous models, this represents a section of learning necessary to become proficient within a station (Aquino and Draper, 2008).

The stations identified in this model are:

- Plan
- Source
- Make
- Deliver
- New product development
- Post-sales support
- Customer management
- Strategy and change management
- Performance management
- Technology enablement
- Governance.

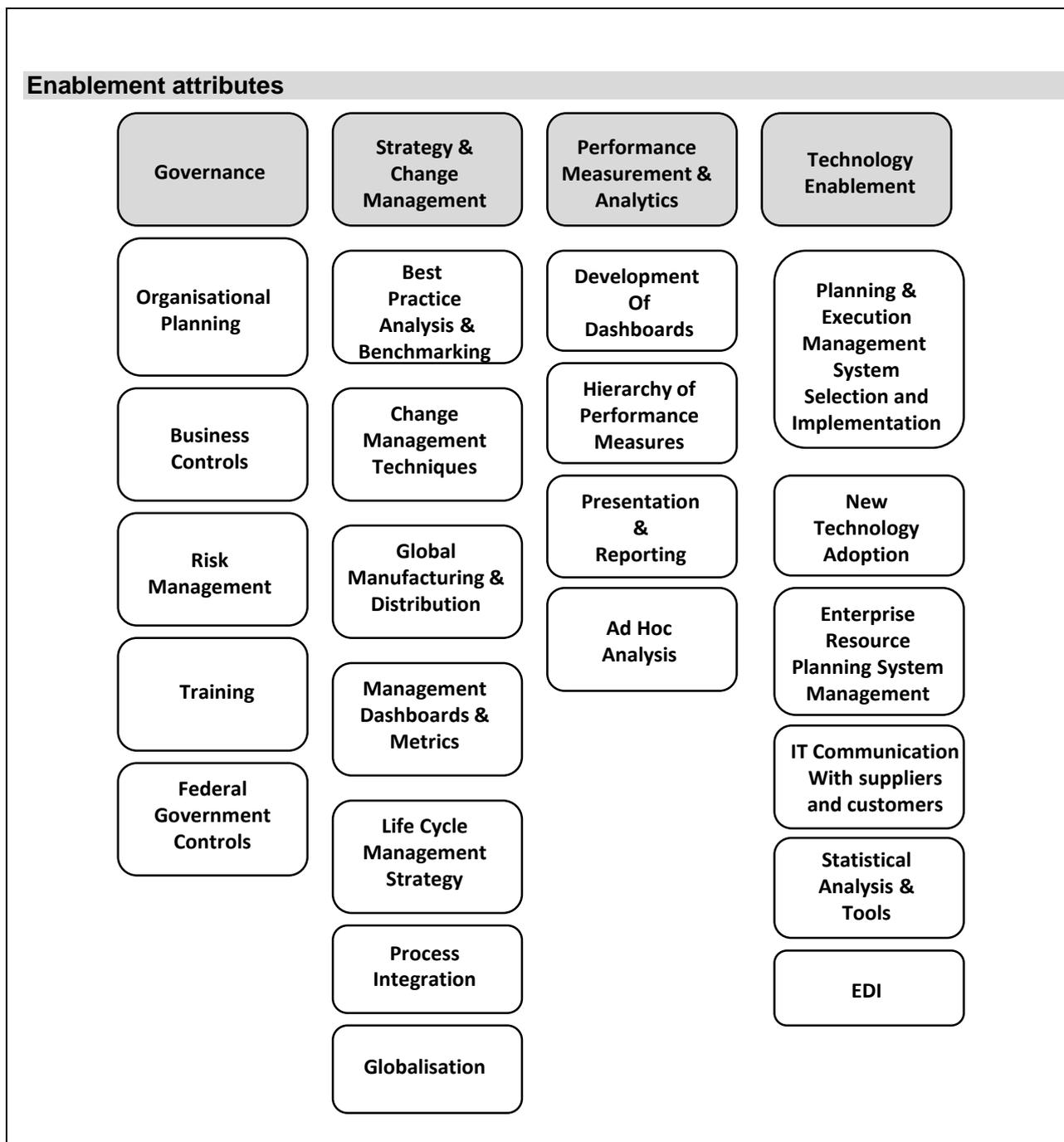
These stations are supported by the attributes listed in Figure 4.26 and Figure 4.27.



**Figure 4.26: Sub-attributes within talent stations – Functional**

Source: Aquino and Draper, 2008.

The sub-attributes identified to support supply chain enablement are outlined in the following diagram:

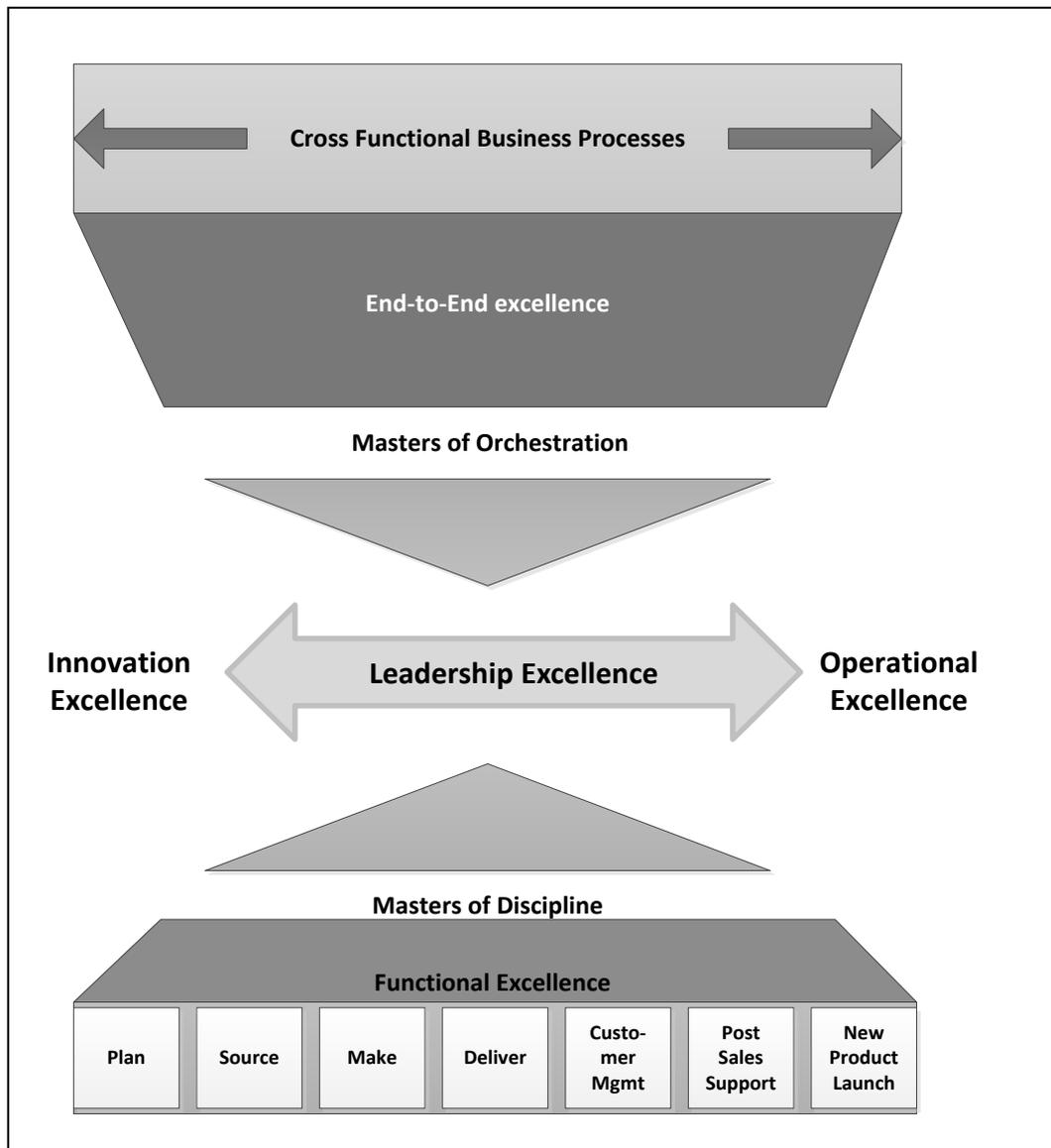


**Figure 4.27: Sub-attributes within talent stations - Enablement**

Source: Aquino and Draper, 2008.

This model provides valuable input to the development of a competency model as it defines the areas of competence, in this case called stations, and the more detailed building blocks or attributes. These elements need to be integrated with the other models already discussed and then

aligned and translated into competencies that can be used as the basis for a competency model. Gartner more recently updated its model to reflect a dual focus, as outlined in Figure 4.28.



**Figure 4.28: Gartner dual supply chain focus model**

Source: Gartner, 2014.

#### 4.5. CONCLUSION

For the purpose of reaching conclusions from the review of supply chain models and the previous research on supply chain competency, two tables which compare the different models were developed.

In Table 4.7, the different supply chain models are compared in terms of a set of criteria which is a combination of guidelines from Chapter 2 with the potential contribution of the model towards a conceptual supply chain competency model.

**Table 4.7: Supply chain models: A comparison based on competency requirements**

Evaluation Criteria	Model:						
	Lambert	Consortium	MIT 2020	Gattorna	DDSN	APQC/CSCMP	SCOR
Functional elements identified	√	√	×	√	√	√	√
Cross-functional processes identified	√	√	×	×	√	√	√
Strategic alignment defined	×	×	√	√	×	√	×
Process model & standards developed	√	×	×	×	√	√	√
Best practices identified	√	×	×	√	√	√	√
Competency model developed	×	×	×	×	×	×	√
Competency definitions in place	×	×	×	×	×	×	×
Proficiency levels developed	×	×	×	×	×	×	×
Competency measurement in place	×	×	×	×	×	×	×

The following observations can be made from this comparison:

- Most of the models define certain core elements or functional elements that are the basic building blocks of supply chain management. The exception is the MIT supply chain 2020 study.
- Cross-functional processes are defined by all the models except the MIT 2020 and Gattorna models.
- Strategic alignment is addressed by the MIT 2020 study, Gattorna and the APQC/CSCMP models.
- Process models are developed by Gartner's demand-driven supply chains, APQC/CSCMP and the Supply Chain Council. The process models are however fundamentally different from each other.
- All the models except the MIT 2020 study and the Supply Chain Consortium defined some form of best practices. The models of the Supply Chain Council and APQC/CSCMP are the most comprehensive with process definitions and best practices by process;
- Concerning competency models, only the SCOR models include a framework for a competency model. The model is however only in its infancy stage of development,

- None of the models reviewed includes any supply chain competency definitions; the focus is primarily on core activities and process models,
- Competency proficiency levels are not part of any of the models. The SCOR models have proficiency levels defined but not developed;
- Competency measurement does not form part of any of the models;
- The concept of dynamic supply chain capabilities is not clearly defined nor included in any of the supply chain models reviewed.

A comparison of the supply chain competency models or related research is provided in Table 4.8 at a summary level. The criteria for comparison are primarily based on the best practice framework developed in Chapter 2.

**Table 4.8: Supply chain competency models: A comparison based on competency requirements**

Evaluation Criteria	Model:						
	21 <sup>st</sup> century	Sauber <i>et al.</i>	Gartner	Talent Initiative	Competency Clearinghouse	APICS	ELA
Strategic alignment defined	√	×	×	×	×	×	×
Alignment with process model	×	×	×	×	×	×	×
Competency model developed	√	√	√	√	√	√	√
Anatomy of a competency	×	×	×	×	√	×	×
Competency libraries	×	×	×	×	×	×	×
Proficiency levels developed	×	×	×	×	×	×	×
Competency measurement in place	×	×	×	×	×	×	×
Using technology to enhance	×	×	×	×	×	×	×
Using competency analytics	×	×	×	×	×	×	×

The following observations can be made from this comparison:

- Strategic alignment is only addressed in the 21<sup>st</sup>-century work of Bowersox. None of the other models refer to strategic alignment;
- Limited alignment exists between the competency research and a process model. The implication is that competencies cannot be linked to specific supply chain jobs;
- A competency model in some form is part of the models and research reviewed. The format and completeness of the models vary significantly;
- None of the models includes a competency dictionary as defined in the best practice framework;
- Proficiency levels are not defined for any of the models;
- Competency measurement is not available for any of the models;
- Technology-based competency assessment is not available for any of the models;
- None of the models uses any form of competency analytics;
- Dynamic supply chain capabilities are not included in any of the competency models reviewed. The link between dynamic capabilities and supply chain competencies is thus neither defined nor integrated.

In summary, the following conclusions can be made from the comparison across 14 supply chain models or competency research:

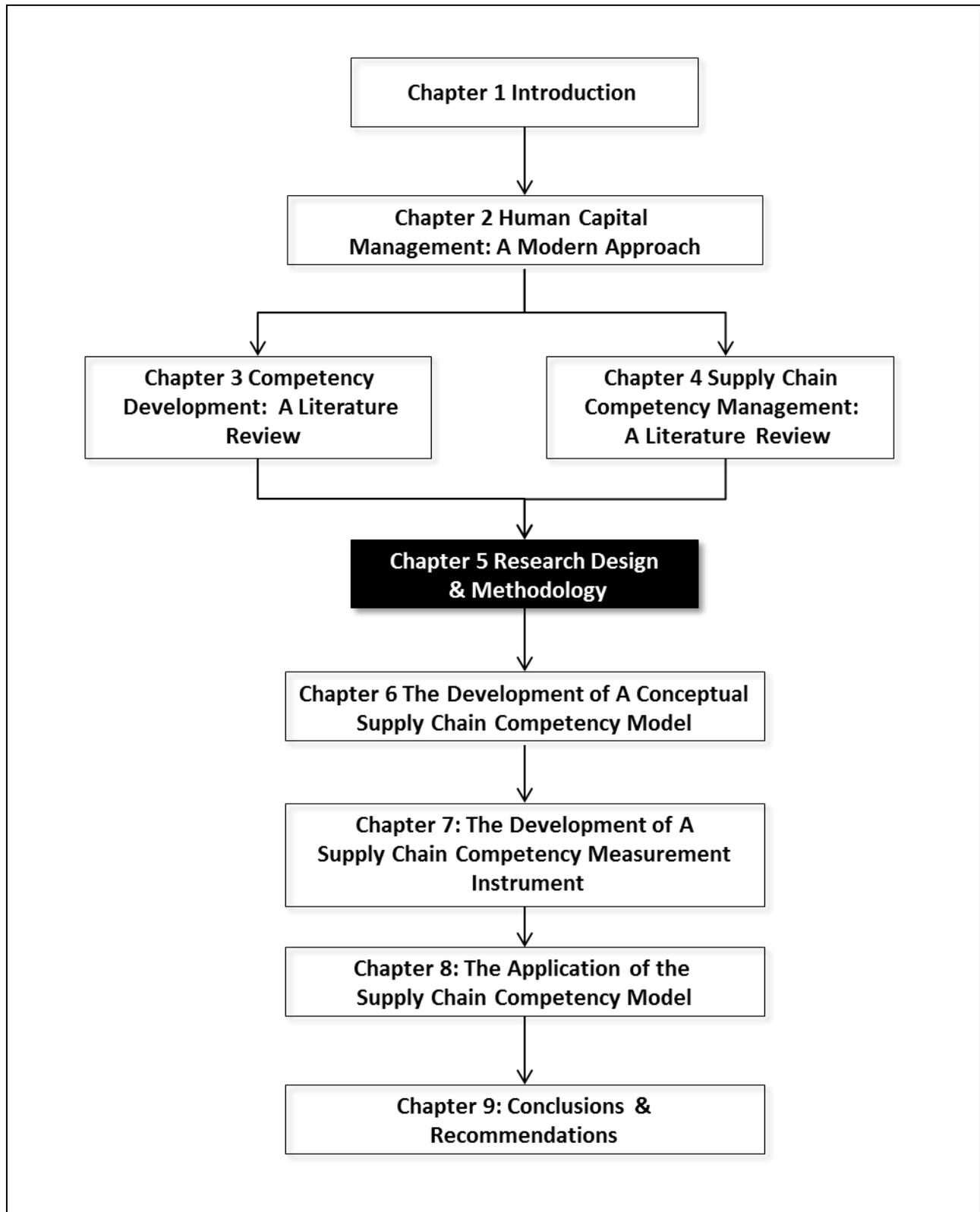
- The importance of a single competency model for supply chain management to advance was confirmed in previous research (Aquino & Draper, 2008);
- Various models of supply chain exist, which reflects that the field is still evolving without the models converging into a single generally accepted model.
- Although various forms of competency models do exist in supply chain, most are in their infancy stage of development. No single model exists which can be used for competency development;
- The inclusion of dynamic supply chain capabilities in a supply chain competency model is not essential, but integration between dynamic capabilities at an organisational level with competencies at job level is required for a fully integrated competency model;
- Measurement of supply chain competency is not available in any of the competency models and limited research on the topic is available. Without competency measurement in place,

competency development will continue to be faced with the challenge of the ineffectiveness of perception-based competency assessments.

The literature review that was described in the previous three chapters firstly identified the increased importance of a competency-based approach towards managing human capital. A model for competency-based human capital management was suggested at the end of Chapter 2. This was taken further in Chapter 3 with the development of guidelines for competency modelling, which is the implementation mechanism for competency-based human capital management. The supply chain literature and existing models were reviewed to confirm the current status and the knowledge gaps in the application of competency-based management in supply chain management. It was concluded that no single competency model exists and no measurement model could be found for measuring supply chain competency that is available in the public domain. These conclusions will form the basis for confirmation of the research problem and objectives which will be discussed in the next chapter.

## CHAPTER 5

### RESEARCH DESIGN AND METHODOLOGY



## 5.1. INTRODUCTION

The purpose of this chapter is to document the research objectives of the study and the methodology that was followed. The research methodology is based on the research objectives formulated in the introduction and the problem statement which was confirmed by the review of the literature and previous research. More specifically, the objectives of this chapter are to:

- Confirm the knowledge gap and the problem statement as a consequence of that.
- Formulate specific research objectives.
- Explain the research methodology that was followed.

## 5.2. PROBLEM STATEMENT

The problem statement is based on the conclusions from the literature review that was discussed in the previous three chapters. A short summary of the findings from the literature review thus provides verification of the problem statement or research requirement.

The following conclusions were reached from the review of the literature:

- The increased importance of human capital as a strategic resource to achieve business success and the challenge of managing global talent pools in an environment of severe skills shortage was confirmed.
- The transition from a traditional approach of managing human capital to a strategic competency-based approach was identified. The strategic importance of global competency development is evident from the research reviewed. Competency models as a core mechanism for competency development are central in the process of competency development.
- A best-practice model for competency modelling was developed in Chapter 2, which provided a framework for developing and evaluating competency models. This was used as the basis for evaluating existing supply chain competency models and competency research.
- The review of the supply theory indicated that a number of different models for supply chain management are being used. These models are not integrated however, and provide for a degree of fragmentation.
- A review of the previous research on the use of competency models in supply chain indicated that no integrated competency model currently exists. Various competency models exist, but every model has limitations if evaluated against the best practices for competency modelling. None of the current models includes the definition of proficiency levels, without which measurement of competency levels would not be possible;

- The measurement of supply chain competency is unexplored territory as indicated in Chapter 4. Limited research is available on the development of supply chain competency assessment instruments and it is not part of any of the existing supply chain competency models.
- Limited research is available regarding the challenges and experiences with the application of competency models in supply chain.

Based on these conclusions, the research problem formulated for this research study was twofold:

- No integrated competency model which is inclusive of the various models of supply chain is currently available in the public domain. This puts a constraint on the further development of supply chain competency management.
- Research on the challenges and complexities with the application of a supply chain competency model including competency assessment is limited, which adversely affects the progress of the field of supply chain competency management.

The research problem provided a basis for the formulation of the research objectives and a methodology to achieve those objectives.

### **5.3. OBJECTIVES OF THE RESEARCH**

The objectives of the research were:

- To develop a supply chain competency model that integrates various supply chain models into a single model, and complies with the best practices for competency modelling. The focus of the competency model is on functional supply chain competencies and not personal traits or characteristics;
- To develop a measurement instrument for measuring functional supply chain competency in line with the competency model;
- To implement the competency model and complete an exploratory assessment to better understand the challenges, complexities and possible solutions during the implementation of a competency model.

The following supporting objectives provide a more detailed view of the research objectives.

The development of a **supply chain competency model** further required the following supporting activities:

- Integrate the different models of supply chain management into a single model to provide the basis for a competency model.

- Apply the best-practice framework for competency modelling in the development of a supply chain competency model.

For the **development of a measurement instrument** for measuring supply chain competency the following supporting activities were relevant:

- Develop competency profiles to provide the basis for competency assessment.
- Develop a competency assessment instrument for the measurement of competency levels.

For the **application of the competency model and the measurement instrument**, the following supporting activities were relevant:

- Formulate an appropriate research approach for the application of the models.
- Apply the best practice guidelines for competency modelling to the application.
- Document the learnings, conclusions and recommendations for future research.

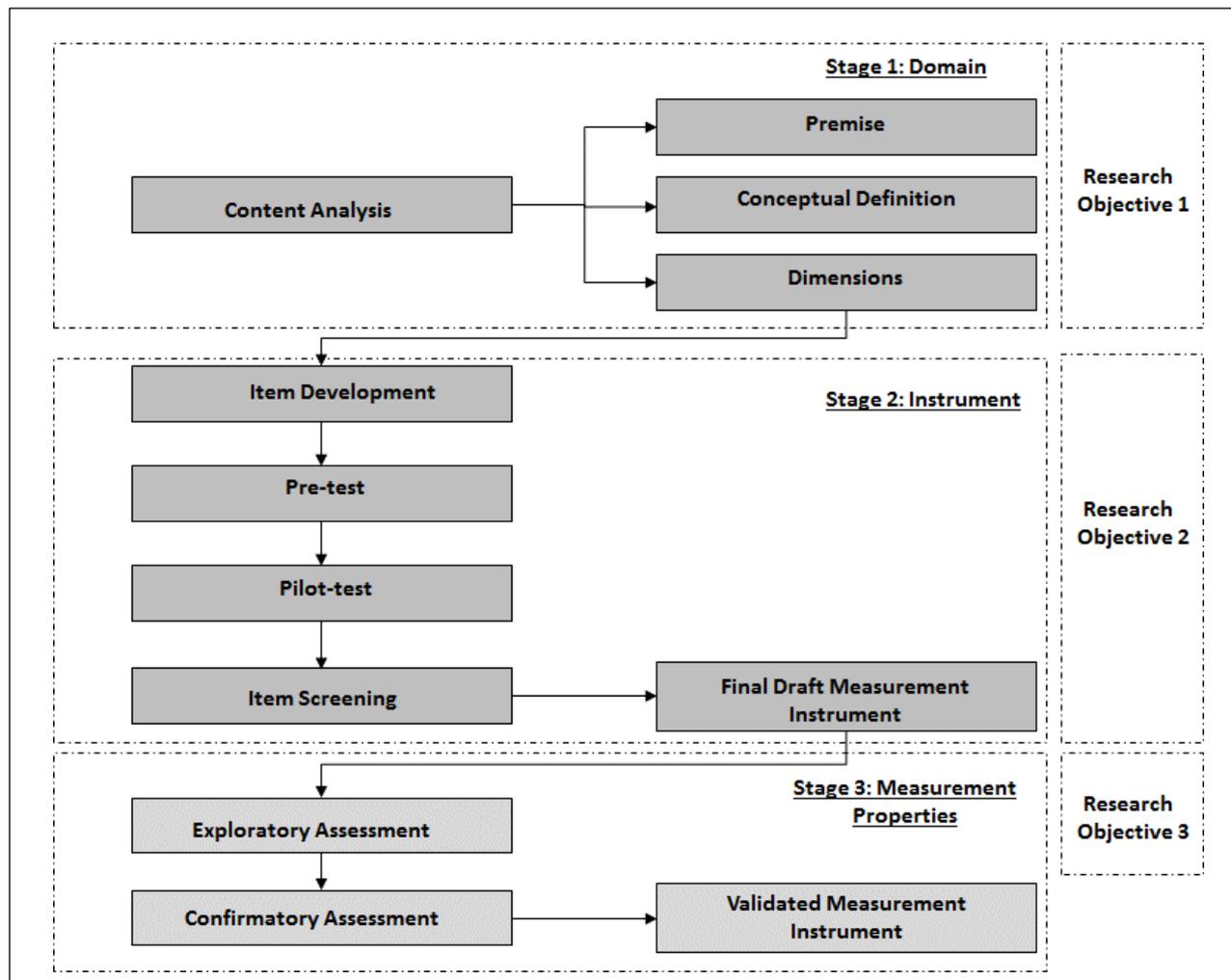
The research design focused on developing a research methodology for achieving these objectives.

#### **5.4. RESEARCH DESIGN & METHODOLOGY**

The research strategy is based on deductive research, where a known theory is explored and tested for validity in a given set of circumstances (Beiske, 2007). In this research conclusions will be based on a combination of literature review or secondary research combined with further deductions based on primary research. The research was completed in three phases:

- Phase 1: The development of a conceptual model for supply chain competency
- Phase 2: The development of a measurement instrument for measuring supply chain competency
- Phase 3: The application of measurement instrument

A construct development methodology is used as an overarching methodology which was combined with further guidelines and specific techniques for each phase of the research. The methodology is based on the research of Lewis, Templeton and Byrd (2005) which is outlined in Figure 5.1 was used for this purpose.



**Figure 5.1: Construct development methodology**

Source: Lewis *et al.*, 2005.

The methodology is proposed for use by researchers who are creating new measurement instruments from scratch. The methodology is organised into three stages. First, the domain of the construct or concept is established. Next, based on that domain, a set of statement items is generated and a field survey instrument is designed, evaluated, and refined through multiple steps. In the final stage, data is collected through administration of the instrument and its measurement properties are examined and iteratively optimised using multiple techniques. This methodology evolved from the basic approach to construct development established by Churchill in 1979. In the methodology described here, four steps originating from Churchill are employed using techniques that have been added and refined over years of practice. Each phase in the Churchill approach focuses on satisfying one of four key measurement considerations: (1) construct domain specification, (2) construction of items, (3) data collection, and (4) measure purification. In the proposed methodology, particular attention is paid to managing data collection and iterative purification (Lewis *et al.*, 2005).

This methodology will be adapted by adding further research recommendations and procedures from other references. The positioning of the research objectives on the right-hand side of the methodology in Figure 5.1 indicates the application of the methodology to the different research objectives. Each phase and the application to the different research objectives will now be discussed in more detail.

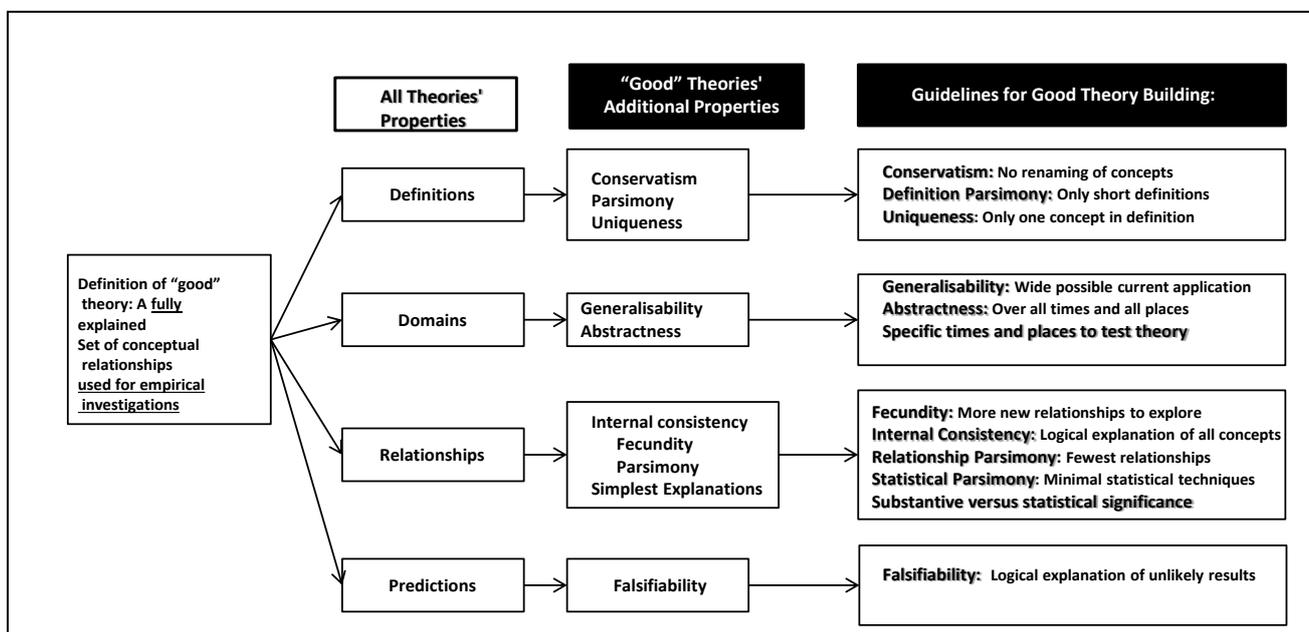
### 5.4.1. Phase 1: The development of a supply chain competency model

#### 5.4.1.1. Guidelines followed

A set of guidelines was followed during phase one of the research. These were a combination of research guidelines for developing conceptual models combined with guidelines for competency modelling which was developed in Chapter 3, section 3.7.

- Guidelines for Model Development:

The construct development methodology of Lewis *et al.* (2005) was expanded by adding the framework of Wacker (2008), which offers a set of guidelines for model development. This is discussed in the next section. A set of guidelines for the model development from the research of Wacker (2008) is explained in this section and outlined in Figure 5.2.



**Figure 5.2: The derivation of the guidelines for good theory**

Source: Wacker, 2008.

The framework outlined in Figure 5.2 is translated to a more detailed set of guidelines in Table 5.1.

**Table 5.1: A summary of the guidelines for evaluating empirical theory building**

1. Is the proposed theory really a theory? Does the theory explicitly state all four properties (definitions, domain, relationships and predictions)?
2. If the proposed theory is actually a theory, how good a theory is it? Where are its weaknesses? What is the precision in definitions, specified domains, logically consistent relationships, falsifiable predictions?
3. How "good" are the definitions? <ol style="list-style-type: none"> <li>a. Does the author define all concepts or present definitions to clearly understand what is being proposed?</li> <li>b. Does the author refrain from renaming an existing concept without clearly differentiating why it is necessary?</li> <li>c. Are the definitions concise (as short as possible)?</li> <li>d. Do the definitions lead to a unique concept or are they ambiguous or vague?</li> <li>e. Do the definitions pass the guidelines for "good" definitions?</li> </ol>
4. How carefully is the theory's domain specified? <ol style="list-style-type: none"> <li>a. Does the study use the literature to indicate where the previous studies' domains were gathered: (1) countries, (2) industries, (3) respondent's position, and (4) relevant respondents' demographics?</li> <li>b. Does the study specify "when" and "where" the theory can be applied and tested?</li> </ol>
5. For empirical tests of the theory's relationships: <ol style="list-style-type: none"> <li>a. Does the theory offer new areas to explore (fecundity)?</li> <li>b. Are the relationships graphically/mathematically examined and explained to be internally consistent?</li> <li>c. Are all the relationships from the extant literature included in the explanation?</li> <li>d. Does the author use the simplest statistics possible to develop the tests and refrain from presenting statistics that are not germane to the discussion suggestions (Wilkinson <i>et. al.</i>, 1999 task force)?</li> <li>e. Does the author differentiate between substantive significance and statistical significance (McCloskey &amp; Ziliak, 1996)?           <ol style="list-style-type: none"> <li>i. Does the author drop variables due to statistical insignificance?</li> <li>ii. Does the author include variables due to statistical significance rather than substantive significance?</li> <li>ii. Are the relationships conceptually explained versus statistically explained?</li> </ol> </li> </ol>
6. For predictions: <ol style="list-style-type: none"> <li>a. Do the conclusions offer new insights and explanations for the theory?</li> <li>b. Are the conclusions predicted from the extant literature avoiding "calling in the conventional stratagem"?</li> </ol>

Source: Wacker, 2008.

These guidelines, which were applied to the development of a conceptual model of supply chain competency, provided additional research quality criteria. The application will be discussed in Chapter 6.

- Guidelines for competency modelling

The guidelines for competency modelling from Chapter 3 (Table 3.10) were also applied in the development of the competency model, specifically the format of the model and the information that should be included in the model. The development of proficiency levels was guided by the same set of guidelines that was applied in the development of the competency model and the application of the model, thus across different stages of the research.

#### 5.4.1.2. Process Followed

Construct development endeavours ultimately intend to create more relevant and precise tools for measurement. In cases where constructs of interest are believed to be of great significance in practice, the unavailability of sound data collection instruments constrains further development of knowledge in research streams and compromises the ability to accurately assess phenomena in practice. As such, two issues must be addressed by any construct development methodology: level of analysis and philosophy of knowledge (Lewis *et al.*, 2005).

- Level of analysis

One of the most important ways to differentiate between instruments is by level of analysis, of which there are two primary categories: organisation and individual. Organisation-level instruments use human proxy respondents to assess aspects about organisational properties, such as its size, form, or performance. Individual-level instruments assess human-level perceptions through direct questioning and typically often focus on the interactions between humans and technology. The focus of this research was individual-level assessments of supply chain competency.

- Philosophy of knowledge

In instrumentation, knowledge exists at four abstraction levels that form the whole of the concept of interest. First, the **domain definition** is a brief yet holistic description that is a reasonable and supportable representation of the concept of interest. The domain definition is a general guide to what the instrument is designed to assess. A good domain definition includes four attributes. First, it expresses general components of meaning that should be easily accessible from the literature, practice, or logic. Second, it should include level of analysis to avoid confusion in the resulting question pool. Third, the purpose should be included to inform the researchers and research community about what the construct generally leads to. Finally, it is important to address the constraints (what it is not) of the definition in order to provide a limit to project scope (Lewis *et al.*, 2005).

Second, the **dimensions** abstraction level contains the theoretical parts of the domain definition. Just as any assertion by researchers, dimensions are justified by observations from practice, reviews of the literature and logic. The complete set of dimensions forms a more precise depiction of the domain definition it intends to represent. Third, **item stems** are the theoretical sub-parts of dimensions and are often extracted from a combination of literature review and experience surveys. This is the first abstraction level where the elements represent units of knowledge about the concept at hand and are therefore more tightly bound to its true meaning. The name of an item stem is a one- to three-word phrase that describes a part of a dimension. Fourth, **statement items** derive from the item stem set. Each item stem is used to generate multiple alternative statements

that will be deliberated and refined before a subjective choice is made of the single most fitting statement for that item stem. Generating and selecting among alternative statements for each item is called “domain sampling”, a process that traditionally depends upon the researcher rather than external judgment. Thus, statement items should represent a single stem, which represents a single dimension, which represents the overall domain definition. Researchers should take care that the meanings of statement items are adequately (1) unitary (have a single meaning) and (2) independent of other statement items (Lewis *et al.*, 2005).

These deliverables may be derived from numerous sources, such as a review of the literature, case studies, open-ended questionnaires, interviews, or some combination of these sources. However, in all situations, the material resulting from these efforts will need to be synthesised to produce the information necessary for the specification of the construct domain. Content analysis, a common technique employed in the social sciences to draw inferences from text (Weber, 1985), is an appropriate method to address the domain specification task and can be used on any of the sources (i.e. literature, interview transcripts, and case studies).

The philosophical elements described here represent a hierarchy that decomposes in succession, beginning with the domain definition and ending with statement items. The deliberation and design of philosophical elements can have profound effects on both project efficiency and the rate of scientific advancement in the field. During the initial creation of elements, a researcher may coordinate design efforts by eliciting the input of either (1) other members on the research team or (2) experts. The latter is preferred, although potentially more costly and less convenient. In cases where used, it is suggested to use two different expert pools from which to select question reviewers. First, practitioner and academic subject matter experts can be used to evaluate the fit between each item and associated construct. This can be an important early determinant of internal validity (Lewis *et al.*, 2005). The Delphi technique was used to collect the inputs from the expert pools, an approach that is explained in more detail in the next section.

#### 5.4.1.3. *Techniques applied*

The following techniques were applied during phase 1 of the research:

- Literature review

A comprehensive review of the literature was done to provide a basis for the development of the conceptual model. The literature review covered three aspects, reviewing key developments in managing human capital, developing a best practice framework for competency modelling and a review of previous research on supply chain models and competency modelling. The guidelines for competency modelling developed from the competency modelling literature was used to evaluate the supply chain models and supply chain competency models.

From the review of supply chain competency literature a conceptual model was developed through the integration of the various models.

- Delphi research

The Delphi research methodology was used to test the conceptual model with a panel of experts. The Delphi method can be characterised “as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem” (Linstone & Turoff, 1975). The Delphi method provides a structured process to solicit expert opinion on a particular subject and enables group interaction without needing a face-to-face meeting (Taylor-Powell, 2002). This method is particularly suited as a research methodology for this type of research as “the Delphi technique lends itself especially well to exploratory theory building on complex, interdisciplinary issues” (Akkermans, Bogerd, Yucesan & Van Wassenhove, 2003; Okoli & Pawlowski, 2004). The problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis (Linstone & Turoff, 1975).

Delphi panellists are typically selected, not for demographic representativeness, but for the perceived subject matter expertise that they can contribute to the topic. In order to obtain the desired valid results, Scheele (1975) suggested the panel must be selected from stakeholders who will be directly affected, experts with relevant knowledge and experience, and facilitators in the field under study. Spencer-Cooke (1989) suggested that the composition of the panel relate to the validity of the results of the research. Criticisms of the use of experts include difficulties in identifying expert criteria and deciding whether responses from experts are significantly different from those of non-experts (Mullen, 2003).

The literature suggests that Delphi panel sizes range from a few to 50 or more participants. In Brockhoff's (1975) study of Delphi performance, he suggested that for forecasting questions, groups with eleven participants were more accurate in their predictions than larger groups. For fact-finding questions, groups with seven participants had a higher performance in his controlled study. Other studies have found that error decreases with larger Delphi panels (Linstone & Turoff, 1975); however, large panels have more difficulty achieving agreement and are more difficult to administer. Linstone and Turoff (1975) remarked that accuracy improved very slowly with large numbers and that a suitable size is seven. Based on this research, an expert panel of between seven and 15 is acceptable for research of this kind.

A two-phased process was used where two groups of experts were asked to review the theoretical model. The first group was a team of experts selected from a company with global supply chain operations representing all the major functional areas of supply chain management. Selection

criteria of the experts were based on seniority in the company, level of expertise in supply chain management and area of responsibility. A first draft of the competency model was provided to the first team of experts for review. The review was done in a focus group format where the experts were all present and reviewed the model by discussion their comments. The list of competencies was then updated based on feedback from the first experts.

In the second phase, a different team of 11 experts, selected from various industries was requested to evaluate the competency model. The selection criteria for these experts were based on:

- representation from different industries;
- expertise and experience in supply chain management;
- expertise with managing people in supply chain.

The evaluation was based on a questionnaire where each competency was evaluated in terms of its relevance by means of a Likert scale. The questionnaire was mailed to each expert who completed the response independently from other experts. Results were analysed and items were deleted based on the results. The results were analysed and the degree of consensus between the experts was measured using Kendall's *W* coefficient as this test measure performs well with small samples (Schmidt, 1997; Siegel, 1988).

#### *5.4.1.4. Quality of results*

A key requirement for evaluating the conceptual model is content validity, which is one form of validity applicable to psychological, educational and social science measurement. It is also critical when developing valid measures for workplace tests, other personnel and training assessments. Content validity is the extent that a measure or item in a survey or other instrument represents a specific concept. A survey that is intended to measure worker attitudes toward training may not be content valid if it measures only a portion of the concept that is being measured. For example, if developers wanted to achieve an attitude measure that includes both affect and behaviour, and the attitude survey measures only the affective dimension of attitude but ignores the behavioural dimension, then the overall measure would not be considered valid. It is important to understand that "validation must consider the appropriateness of test content in relation to the purpose of the testing" (Sireci, 1998). In developing a valid measure, the American Educational Research Association's (1999) Standards for Educational and Psychological Testing standard 1.6 suggested that it be "justified in reference to the construct the test [or measurement] is intended to measure or the domain it is intended to represent" (Sireci, 1998). Content validity is the degree to which the test measures the content domain it purports to measure (Sireci, 1998). While some researchers insist that validity must be developed through statistical procedures, the large majority of test

developers believe that there is no easy way to determine content validity aside from expert opinion. The concept of validity applies to all measures used in the social sciences (Sireci, 1998).

Content validity based on the opinion of experts has been a part of instrument development since as early as the 1950s, when scholars indicated that content should be validated through assessment of expert judgment, and is still an accepted procedure for content validity in training and development and supply chain research. Content validity is determined at least in part by the judgment of subject matter experts (Gay, Mills & Airasian, 2005; Aiken, 2003). Karoulis and Pombortsis (2006) also found that expert evaluations were as valid as empirical methods.

Content validity was further improved through a literature study of both competency modelling and supply chain research. A best practices model in competency modelling that was developed in Chapter 3 section 3.7 was applied in the development of the conceptual model. A review of supply chain models and competency research was also completed.

Content validity was also improved through the application of the construct development methodology of Lewis *et al.* (2005) combined with application of the principles for model development from Wacker (2008).

#### **5.4.2. Phase 2: The development of a supply chain competency measurement instrument**

##### *5.4.2.1. Research approach*

Phase 2 of the research, the development of a measurement instrument based on the conceptual model developed in the previous phase, is a combination of primary and secondary research. The conceptual model provided the framework or model for competency definition. The objective of this phase is to develop a measurement instrument that can measure competency levels based on the conceptual model.

The development of levels of proficiency and the definition of proficiency statements for each level of proficiency was done using a combination of the best practice for competency modelling, the model developed in Chapter 3. This was combined with using supply chain literature to confirm the definition of the different levels of competency.

Developing the measurement instrument itself was based on primary research where an item pool of potential assessment questions was developed through primary research. As it is challenging to test and confirm the development of levels of proficiency through statistical research, it can only be regarded as exploratory research. The measurement instrument for measuring competency levels will only be applied in the next phase of the research and is thus also an exploratory instrument.

#### 5.4.2.2. Data collection approach

The development of the levels of competency proficiency, the first step towards a measurement instrument, was based on the application of the competency modelling best practice model combined with the supply chain theory. The data collection for the first step was thus secondary data being used, supply chain theory converted into a competency model framework.

The development of a supply chain competency measurement instrument is a subject with limited previous research and thus a limited framework of reference. A key issue for consideration in formulating the research design is what data collection approach should be followed, survey or case study research. Some guidance was offered by the research of Aquino *et al.* (2008), which found that company-specific competency models are more appropriate. This was further supported by the work of Champion *et al.* (2011), where the integration of competency models with business strategy and other business applications was strongly recommended. Riege (2003) also supports the use of case study research as an appropriate approach towards theory development. Dooley (2002) points out that case study research enables all phases of theory development. Eisenhardt & Graebner (2007) further motivates the use of case study research because of linking qualitative data with quantitative data, enabling further deductive research. These recommendations indicated that a case-study approach would be more appropriate for the development of the measurement instrument than survey research. This is further supported by:

- Alignment with business objectives identified as a key requirement for success (Shippmann *et al.*, 2000);
- Integration with business processes and the organisational structure of the business as indicated by Hofman *et al.* (2013);
- Job and competency profiles which are unique to a specific company (Champion *et al.*, 2011).

The construct development methodology of Lewis *et al.* (2005) was combined with the case-study approach for the development of the measurement instrument. The construct development methodology provided the process of development required and the techniques that should be applied, and the case-study methodology provided the guidelines for the unit of analysis. As the case-study methodology provided the contextual framework, it will be discussed first in the next section.

##### 5.4.2.2.1. Different types of case studies

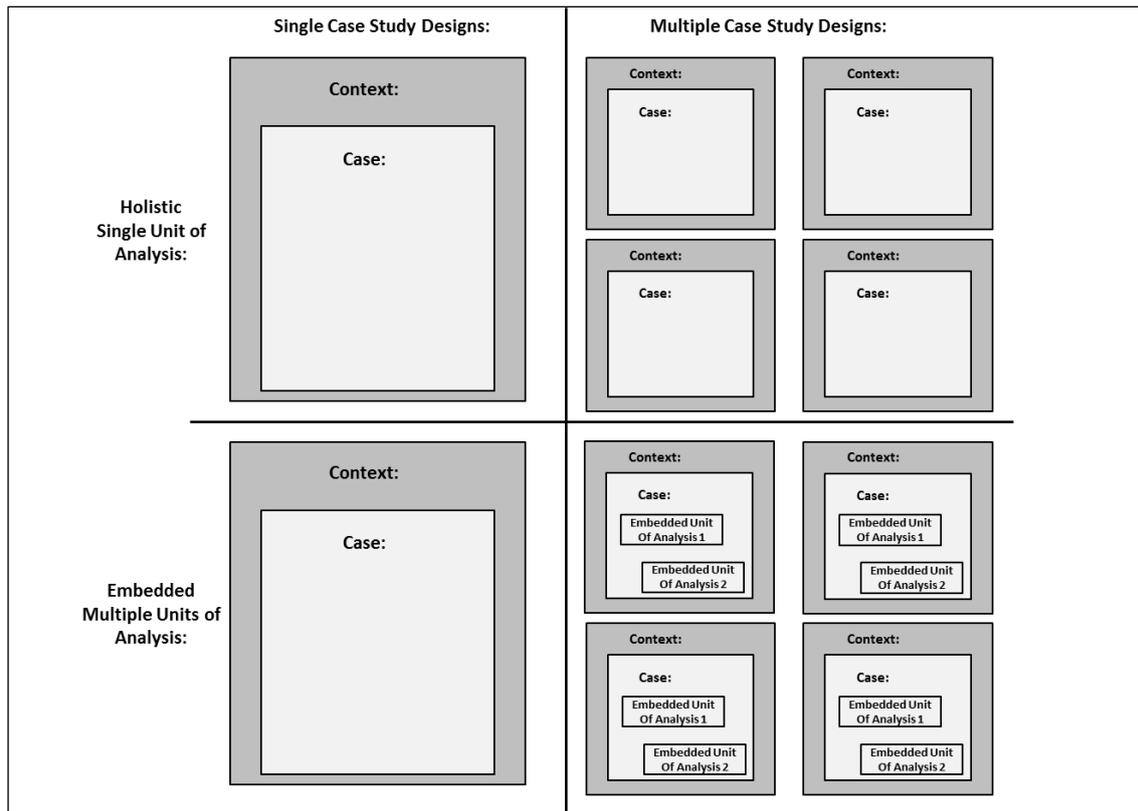
The different types of case studies need to be considered when making a decision about the type of case study that will be used for the research. The options to be evaluated are: (These alternatives are illustrated in Figure 5.3.)

- Type 1 single-case (holistic) designs;
- Type 2 single-case (embedded) designs;
- Type 3 multiple-case (holistic) designs;
- Type 4 multiple-case (embedded) designs (Yin, 2008).

A primary distinction in designing case studies is between single- and multiple-case designs.

- One rationale for a single case exists when it represents the critical case in testing a well-formulated theory (again, note the analogy to the critical experiment).
- A second rationale for a single case is where the case represents an extreme case or a unique case.
- Conversely, a third rationale for a single case is the representative or typical case.
- A fourth rationale for a single-case study is the revelatory case. This situation exists when an investigator has an opportunity to observe and analyse a phenomenon previously inaccessible to social science inquiry.
- A fifth rationale for a single-case study is the longitudinal case: studying the same single case at two or more different points in time.

The same single-case study may involve more than one unit of analysis. This occurs when, within a single case, attention is also given to a sub-unit or sub-units. For instance, even though a case study might be about a single organisation, such as a hospital, the analysis might include outcomes about the clinical services and staff employed by the hospital and possibly even some quantitative analyses based on the employee records of the staff (Yin, 2008)



**Figure 5.3: Different case-study designs**

Source: Yin, 2008 & Remenyi, 2012

Remenyi (2012) warns about using multiple case studies as a research approach based on the amount of work required for completing case study based research. In this particular case the single case study approach was used with multiple units of analysis embedded. The motivation for this approach is based on achieving a certain depth in the case study analysis combined with the requirements of including multiple units of analysis. The risk of using multiple case studies with a detailed analysis of multiple units, is the fact that significant differences between the cases can extend the scope of the study beyond practical feasibility. A single case with a holistics design including multiple units of analysis was used.

#### 5.4.2.2.2. Guidelines for designing case studies

Given that a case study was appropriate research methodology for this application, the focus needed to be placed on the design requirements for case-study research.

The following components of a research design are especially important:

- A study's questions;
- Its proposition, if any;
- Its unit(s) of analysis;

- The logic linking the data to the propositions; and
- The criteria for interpreting the findings (Yin, 2008, & Dooley, 2002).

Although these elements will be addressed in detail in the following sections, the quality tests for case study research will be used as a guideline for the discussing the design principles.

#### 5.4.2.2.3. Quality tests for case studies

In order to achieve high quality research output from case studies, the basic tests for validity and reliability need to be applied.

- *Construct validity*: identifying correct operational measures for the concepts being studied;
- *Internal validity* (for explanatory or causal studies only and not for descriptive or exploratory studies): seeking to establish a causal relationship, whereby certain conditions are believed to lead to other conditions, as distinguished from spurious relationships;
- *External validity*: defining the domain to which a study's findings can be generalised;
- *Reliability*: demonstrating that the operations of a study — such as the data collection procedures — can be repeated, with the same results (Yin, 2008).

The application of these scientific measures to case-study research needs further exploration, specifically the potential concerns.

- Construct validity

People who have been critical of case studies often point to the fact that a case-study investigator fails to develop a sufficiently operational set of measures and that “subjective” judgments are used to collect the data (Yin, 2008). To meet the test of construct validity, an investigator must be sure to cover two steps, firstly define the subject of analysis in terms of specific concepts (and relate them to the original objectives of the study); and secondly identify operational measures that match the concepts (preferably citing published studies that make the same matches).

- Internal validity

The main concerns with internal validity in case studies are, firstly that internal validity is mainly a concern for explanatory case studies, when an investigator is trying to explain how and why event x led to event y. If the investigator incorrectly concludes that there is a causal relationship between x and y without knowing that some third factor— z— may actually have caused y, the research design has failed to deal with some threat to internal validity. Secondly, the concern over internal validity, for case-study research, extends to the broader problem of making inferences. Basically, a case-study involves an inference every time an event cannot be directly observed. An investigator

will “infer” that a particular event resulted from some earlier occurrence, based on interview and documentary evidence collected as part of the case study. The challenge is how to ensure that this inference is correct.

- External validity

The third test deals with the problem of knowing whether a study’s findings can be generalised beyond the immediate case study. A key question is thus: can the conclusions from one case study be applicable to other cases? The problem of external validity has been a major barrier in doing case studies. Critics typically state that single cases offer a poor basis for generalising. However, such critics are implicitly contrasting the situation to survey research, in which a sample is intended to generalise to a larger universe. This analogy to samples and universes is incorrect when dealing with case studies. Survey research relies on statistical generalisation, whereas case studies (as with experiments) rely on analytic generalisation. In analytical generalisation, the investigator is striving to generalise a particular set of results to some broader theory.

- Reliability

The objective is to be sure that, if a later investigator followed the same procedures as described by an earlier investigator and conducted the same case study all over again, the later investigator should arrive at the same findings and conclusions. The goal of reliability is to minimise the errors and biases in a study.

A key focus of the research design was thus on strategies and procedures to address these concerns and ensure the scientific soundness of the case-study analysis. A summary of these procedures is provided in Table 5.2.

**Table 5.2: Test for scientific research**

Tests	Case study tactic	Phase of research on which tactic occurs
<b>Construct validity</b>	1. Use multiple sources of evidence 2. Establish a chain of evidence 3. Have key informants review draft case-study report	4. Data collection 5. Data collection composition
<b>Internal validity</b>	6. Do pattern matching 7. Do explanation building 8. Address rival explanations 9. Use logic models	10. Data analysis 11. Data analysis 12. Data analysis
<b>External validity</b>	13. Use theory in single-case studies 14. Use replication logic in multiple-case studies	15. Data collection 16. Data collection

Tests	Case study tactic	Phase of research on which tactic occurs
<b>Reliability</b>	17. Use case-study protocol 18. Develop case-study database 19. Give full account of theories and ideas 20. Ensure congruence between research issues and case study design	21. Data collection 22. Data collection 23. Research design 24. Research design

Source: Yin, 2008 & Riege, 2003

These procedures and the supporting techniques needed further exploration which is provided in the following section.

#### 5.4.2.2.4. Case-study design guidelines

The guidelines for designing and executing case studies to achieve the above-mentioned measures of scientific research are discussed to create a framework for the actual design which was done and which will be explained in the next section: The following principles are relevant:

- Specific research questions or objectives should be formulated.
- Develop a case-study protocol.
- Specific principles need to be followed for the collection of evidence.
- Specific analytic techniques need to be followed.
- The case study must be significant.
- The case study must be complete.
- The case study must display sufficient evidence.
- The case study must be composed in an engaging manner (Yin, 2008, Riege, 2003, & Dooley, 2002).

These principles are now explained in more detail.

#### 5.4.2.2.5. Developing a case-study protocol

The objective with a case protocol is similar to that of designing a questionnaire. It serves as a mechanism for collecting data, ensuring consistency in the collection process, and provides the basis for data analysis (Remenyi, 2012). The case-study protocol should typically be structured as described in Table 5.3.

**Table 5.3: Typical case-study protocol**

<p>1. Introduction to the case study and purpose of the protocol:</p> <p>1.1. Case-study questions, hypotheses and propositions</p> <p>1.2. Theoretical framework for the case study</p> <p>1.3. Role of the protocol in guiding the case-study investigator</p>
<p>2. Data collection procedures:</p> <p>2.1. Names of sites to be visited, including contact persons</p> <p>2.2. Data collection plan</p> <p>2.3. Expected preparation prior to site visits</p>
<p>3. Outline of case report:</p> <p>3.1. The law enforcement practice in operation</p> <p>3.2. Innovativeness of the practice</p> <p>3.3. Outcomes from the practice to date</p> <p>3.4. Law enforcement agency and history pertaining to the practice</p> <p>3.5. Exhibits to be developed: chronology of events covering the implementation and outcomes of the practice at this site; logic model for the practice, arrays of presenting outcome or other data, references to relevant documents, lists of people to be interviewed</p>
<p>4. Case-study questions:</p> <p>4.1. The practice in operation and its innovativeness.</p> <p>4.1.1. Describe the practice in detail, including the deployment of personnel and technologies, if any.</p> <p>4.1.2. What is the nature, if any, of collaborative efforts across communities or jurisdictions that have been needed to put the practice into place?</p> <p>4.1.3. How did the idea for the practice start?</p> <p>4.1.4. Was there a planning process, and how did it work? What were the original goals and target populations or areas for the practice?</p> <p>4.1.5. In what way is the practice innovative compared to other practices of the same kind or in the same jurisdiction?</p> <p>4.1.6. Describe whether the practice has been supported from the jurisdiction's regular budget or as a result of funding from an external source.</p>
<p>5. Evaluation:</p> <p>5.1. What is the design for evaluating the practice, and who is doing the evaluation?</p> <p>5.2. What part of the evaluation has been implemented?</p> <p>5.3. What outcome measures are being used, and what outcomes have been identified to date?</p> <p>5.4. What logical explanations have been identified and explored for attributing the outcomes to the investment of the federal funds?</p>

Source: Yin, 2008.

The protocol although from a legal practice case study, provides an example which clearly illustrates that it is vital for the researcher to plan, structure and execute the study based on specific agreed objectives and procedures.

#### 5.4.2.2.6. Principles for collecting evidence

The principles and procedures for collecting data in case of survey research are well documented and provide researchers with a procedure to follow for achieving the scientific outcomes desired. In the case of case-study research, these procedures are not as well documented; as such, more attention is focused in this chapter on providing clear guidelines that were required to contribute towards the scientific outcome of this research. The following principles apply to the collection of evidence in case studies.

The first aspect that needs clarification is what the sources of “data” or evidence are when case studies are being used. Riege (2003) stresses the importance of using multiple sources of evidence. These sources of evidence are outlined in the Table 5.4 below.

**Table 5.4: Sources of evidence**

Source of evidence	Strengths	Weaknesses
<b>Documentation</b>	<ul style="list-style-type: none"> <li>• Stable – can be reviewed repeatedly</li> <li>• Independent – not created as a result of the case study</li> <li>• Exact – contains exact names, references and details of an event</li> <li>• Broad coverage – long span of time, many events and many settings</li> </ul>	<ul style="list-style-type: none"> <li>• Retrievability – can be difficult to find</li> <li>• Biased selectivity, if collection is incomplete</li> <li>• Reporting bias, reflects bias of the author</li> <li>• Access – may be deliberately withheld</li> </ul>
<b>Archival records</b>	<ul style="list-style-type: none"> <li>• Stable – can be reviewed repeatedly</li> <li>• Independent – not created as a result of the case study</li> <li>• Exact – contains exact names, references and details of an event</li> <li>• Broad coverage – long span of time, many events and many settings</li> <li>• Precise and usually quantitative</li> </ul>	<ul style="list-style-type: none"> <li>• Retrievability – can be difficult to find</li> <li>• Biased selectivity, if collection is incomplete</li> <li>• Reporting bias, reflects bias of the author</li> <li>• Access – may be deliberately withheld</li> <li>• Accessibility due to privacy reasons</li> </ul>
<b>Interviews</b>	<ul style="list-style-type: none"> <li>• Targeted – focuses directly on case-study topics</li> <li>• Insightful – provides perceived causal inferences and explanations</li> </ul>	<ul style="list-style-type: none"> <li>• Bias due to poorly articulated questions</li> <li>• Response bias</li> <li>• Inaccuracy due to poor recall</li> <li>• Reflexivity – interviews give what interviewer wants to hear</li> </ul>
<b>Direct observations</b>	<ul style="list-style-type: none"> <li>• Reality – covers events in real time</li> <li>• Contextual – covers context of case</li> </ul>	<ul style="list-style-type: none"> <li>• Time-consuming</li> <li>• Selectivity – broad coverage difficult without a team of observers</li> <li>• Reflexivity – event may proceed differently because it is being observed</li> <li>• Cost – hours needed by human observers</li> </ul>

**Table 5.4: Sources of evidence (continued)**

Source of evidence	Strengths	Weaknesses
<b>Participant observation</b>	<ul style="list-style-type: none"> <li>• Reality – covers events in real time</li> <li>• Contextual – covers context of case</li> <li>• Insightful into interpersonal behaviour and motives</li> </ul>	<ul style="list-style-type: none"> <li>• Time consuming</li> <li>• Selectivity – broad coverage difficult without a team of observers</li> <li>• Reflexivity – event may proceed differently because it is being observed</li> <li>• Cost – hours needed by human observers</li> <li>• Bias due to participant observers' manipulation of events</li> </ul>
<b>Physical artefacts</b>	<ul style="list-style-type: none"> <li>• Insightful into cultural features</li> <li>• Insightful into technical features</li> </ul>	<ul style="list-style-type: none"> <li>• Selectivity</li> <li>• Availability</li> </ul>

Source: Yin, 2008.

The evidence collected from these sources can be further enhanced by textbooks, models and principles from other research and published works. The soundness of data can be further enhanced by the application of the following principles in the data collection process:

- Use multiple sources of evidence

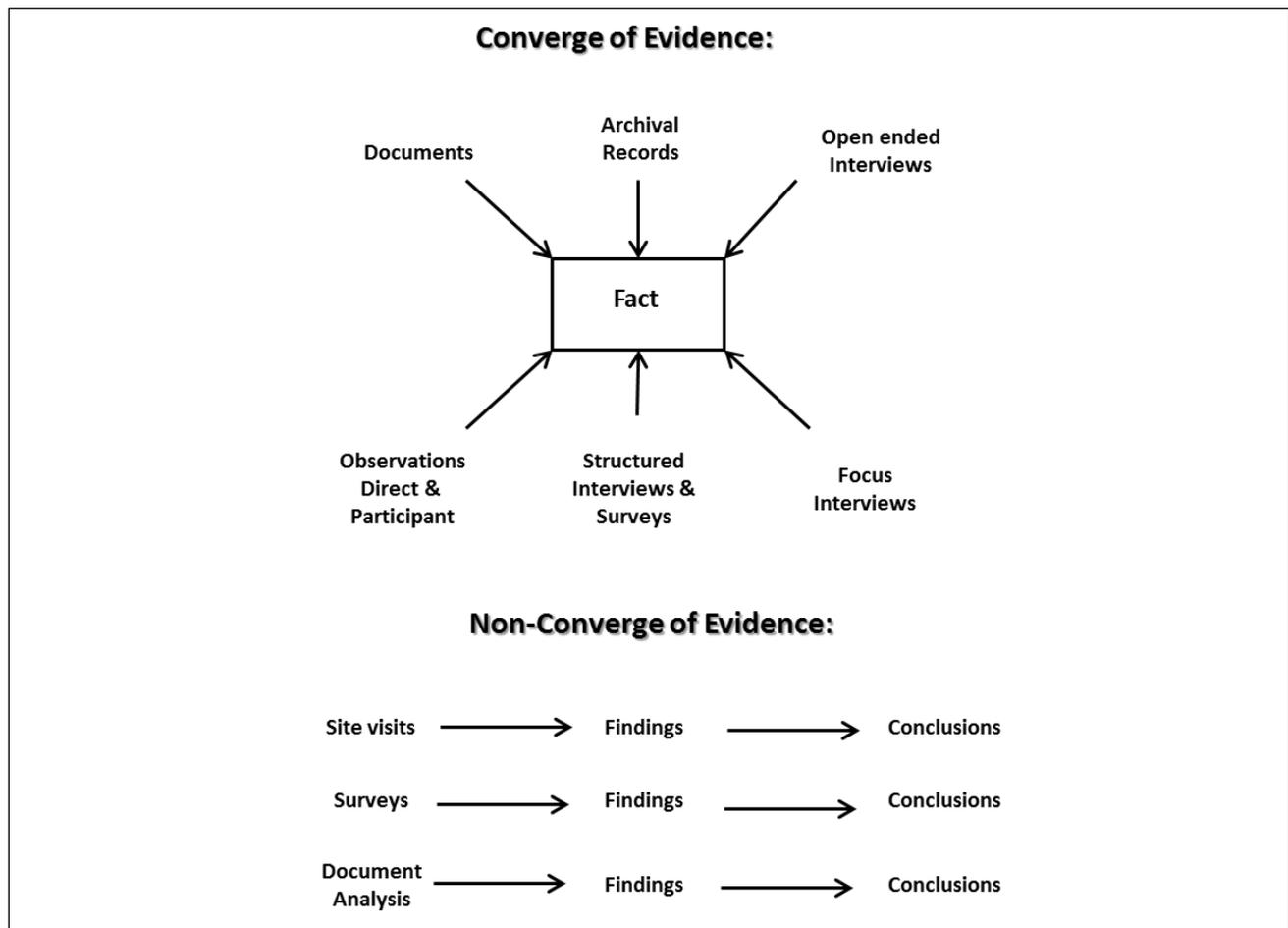
The more different sources of evidence can be combined, the better the likely scientific outcome of the data. Dooley (2002) points out that this is one of the advantages of case study research, it can use multiple sources of evidence and different techniques at the same time. A key benefit of using multiple sources of evidence is the development of converging lines of inquiry, enabling the process of triangulation. Eisenhardt (1989) emphasises the synergistic effect of using both qualitative and quantitative data in case study research.

Patton (2002) discussed four types of triangulation in doing evaluations, namely the triangulation

- of data sources (data triangulation);
- among different evaluators (investigator triangulation);
- of perspectives to the same data set (theory triangulation); and
- of methods (methodological triangulation).

When the data has really been triangulated, the events or facts of the case study have been supported by more than a single source of evidence; when multiple sources have been used but the data has not actually been triangulated, then typically each source of evidence has been analysed separately and the conclusions have been compared with the different analyses – but the data has not been triangulated. With data triangulation, the potential problems of construct validity

can also be addressed because the multiple sources of evidence essentially provide multiple measures of the same phenomenon. Not surprisingly, one analysis of case-study methods found that those case studies using multiple sources of evidence were rated more highly, in terms of their overall quality, than those that relied on only single sources of information (COSMOS Corporation, cited in Yin, 2008). This concept is illustrated in Figure 5.4 below.



**Figure 5.4: Convergence of evidence**

Source: Yin, 2008.

- Create a case-study database

The practice is very important and every case-study project should strive to develop a formal, presentable database so that, in principle, other investigators can review the evidence directly and not be limited to the written case-study reports. (Yin, 2008, Riege 2003, & Remenyi, 2012). In this manner, a case-study database markedly increases the reliability of the entire case study.

This should contain:

- Case study notes
- Tabular materials

- Narratives (Riege, 2003).

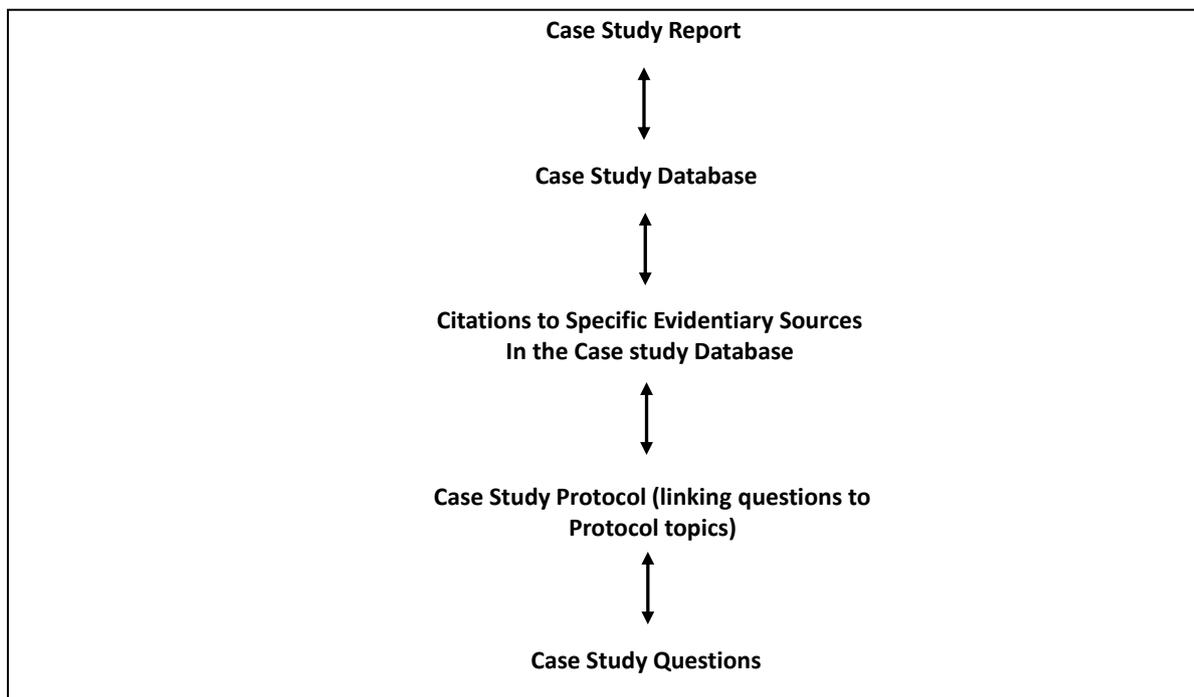
With the collection of evidence covered, the next issue that becomes relevant is the analysis of the evidence and data.

#### 5.4.2.2.7. Analysis of evidence

The techniques for the analysis of evidence and data in a case study need further explanation. The key principles and techniques are discussed below.

- **Maintain a chain of evidence**

To increase the reliability of the information in a case study is to maintain a chain of evidence. Such a principle is based on a notion similar to that used in forensic investigations. The principle is to allow an external observer, in this situation the reader of the case study to follow the derivation of any evidence from initial research questions to ultimate case-study conclusions. This is an extension of using multiple sources of evidence, a consistent chain of evidence needs to be created across different sources of information Riege (2003). Moreover, this external observer should be able to trace the steps in either direction. This is illustrated in Figure 5.5.



**Figure 5.5: Maintaining a chain of evidence**

Source: Yin, 2008.

- **Rely on theoretical propositions**

The first and most preferred strategy is to follow the theoretical propositions that led to the researcher's case study. The original objectives and design of the case study presumably were based on such propositions, which in turn reflected a set of research questions, reviews of the literature, and new hypotheses or propositions. The propositions would have shaped the data collection plan and therefore would have given priorities to the relevant analytic strategies (Yin, 2008). Riege (2003) also emphasise the constant cross referencing to the theoretical propositions during analysis of case data.

- **Develop a case description**

A second general analytic strategy is to develop a descriptive framework for organising the case study. This strategy is less preferable than relying on theoretical propositions but serves as an alternative when the researcher is having difficulty making the first strategy work (Yin, 2008). Dooley (2002) emphasises that the case description should be well integrated with the research objectives.

- **Use both qualitative and quantitative data**

This third strategy may be more attractive to advanced students and scholars and can yield appreciable benefits. Certain case studies can include substantial amounts of quantitative data. If this data is subjected to statistical analyses at the same time that qualitative data nevertheless remain central to the entire case study, the researcher will have successfully followed a strong analytic strategy. Combining qualitative and quantitative data is not only an advantage of the case study method, but also a mechanism to ensure the quality of the research (Eisenhardt, 1989).

#### 5.4.2.2.8. Analytic techniques

The techniques are especially intended to deal with the previously noted problems of developing internal validity and external validity in doing case studies. These techniques are:

- **Pattern matching**

For case-study analysis, one of the most desirable techniques is to use a pattern-matching logic. Such logic compares an empirically based pattern with a predicted one (or with several alternative predictions). If the patterns coincide, the results can help a case study to strengthen its internal validity (Yin, 2008). In case analysis is approach towards pattern matching across different units of analysis in the same case. Comparing patterns from different regions before a final conclusion is made is an example of this (Eisenhardt, 1989).

- **Explanation Building**

To “explain” a phenomenon is to stipulate a presumed set of causal links about it, or “how” or “why” something happened. The causal links may be complex and difficult to measure in any precise manner. In most existing case studies, explanation building has occurred in narrative form. Because such narratives cannot be precise, the better case studies are the ones in which the explanations have reflected some theoretically significant propositions (Yin, 2008).

- **Final quality criteria**

- The case study must be significant
- The case study must be complete
- The case study must display sufficient evidence
- The case study must be composed in an engaging manner.

#### 5.4.2.3. *Application of the research design: The case study design*

The objective of this section is to discuss how the researcher applied the principles discussed in the previous section to the design of the case-study research. This is done in the format of Table 5.5, outlining all the major aspects based on the guidelines for scientific research.

**Table 5.5: The application of the case-study protocol**

Research aspect	Application
<b>Study questions:</b>	<ul style="list-style-type: none"> <li>• How can best practice competency modelling be applied?</li> <li>• What challenges would be faced with the implementation?</li> <li>• Who would be involved in the process?</li> <li>• How should the process be enabled through technology?</li> <li>• How should the process be linked to the company strategy?</li> <li>• How can supply chain competency be assessed?</li> <li>• What would be the practical requirements for a competency assessment?</li> <li>• How can the competency assessment be integrated with other human capital processes?</li> </ul>
<b>Study propositions:</b>	<ul style="list-style-type: none"> <li>• The implementation of a competency model would be less successful if the best practices of competency modelling are not applied</li> <li>• The implementation of a competency model would be impractical if the level of individual competency cannot be measured</li> </ul>
<b>Rival propositions:</b>	<ul style="list-style-type: none"> <li>• The best practice competency modelling framework is not required for the implementation of a supply chain competency model</li> <li>• Competency assessment is not required as part of the implementation of competency modelling</li> </ul>

**Table 5.5: The application of the case-study protocol (continued)**

<b>Unit of analysis:</b>	<p>The unit of analysis was a company in the supply chain industry. The unit of analysis was segmented into further sub-units of analysis:</p> <ul style="list-style-type: none"> <li>• The company as a unit in terms of the implementation of competency modelling best practises</li> <li>• Operational staff for the completion of a perception-based competency assessment</li> <li>• A selection of job positions selected in terms of supply chain relevance</li> </ul>
<b>Type of case study:</b>	<p>Embedded single case study with multiple sub-units was selected as the type of case study to be used. This will allow an in depth analysis of multiple aspects of the case where different units of analysis will represent different aspects to be evaluated. Using multiple cases in the same study, would have been too risky due to the broad scope and volumes of work required.</p>
<b>Sources of evidence and data:</b>	<ul style="list-style-type: none"> <li>• <b>Documentation:</b> Company documentation was reviewed. This included strategy documentation, job profiles, performance assessments and skills development plans</li> <li>• <b>Interviews &amp; expert participation:</b> This was achieved through the constant involvement throughout the process of three teams of people, which include: <ul style="list-style-type: none"> <li>• <b>Steering committee:</b> consisting of senior management who provided input into the development of models and the implementation process</li> <li>• <b>An expert team</b> consisting of internal experts who assisted with the development of the competency assessment questions</li> <li>• <b>Line managers</b> who participated in the improvement of the job profiles and the development of the competency profiles</li> </ul> </li> <li>• <b>Participant observation</b> consisting of the competency assessment of a selected sample of staff based on the relevant job profiles</li> <li>• <b>Theoretical supply chain frameworks</b> published in various journals serving as a framework for cross reference</li> <li>• <b>Competency modelling best practices</b> published in various journals serving as a framework for testing the application using for triangulation purposes</li> </ul>
<b>Principles for data collection to be applied:</b>	<ul style="list-style-type: none"> <li>• <b>Multiple sources of data</b> were used as outlined in the section above on data sources. The different types of data from various sources were analysed</li> <li>• <b>A case-study database</b> was created where all documentation, process designs, competency definitions and assessment questions are available for review. All of these are available on-line</li> <li>• <b>The chain of evidence</b> was maintained throughout the process. This was achieved through creation of checklists and review frameworks</li> </ul>

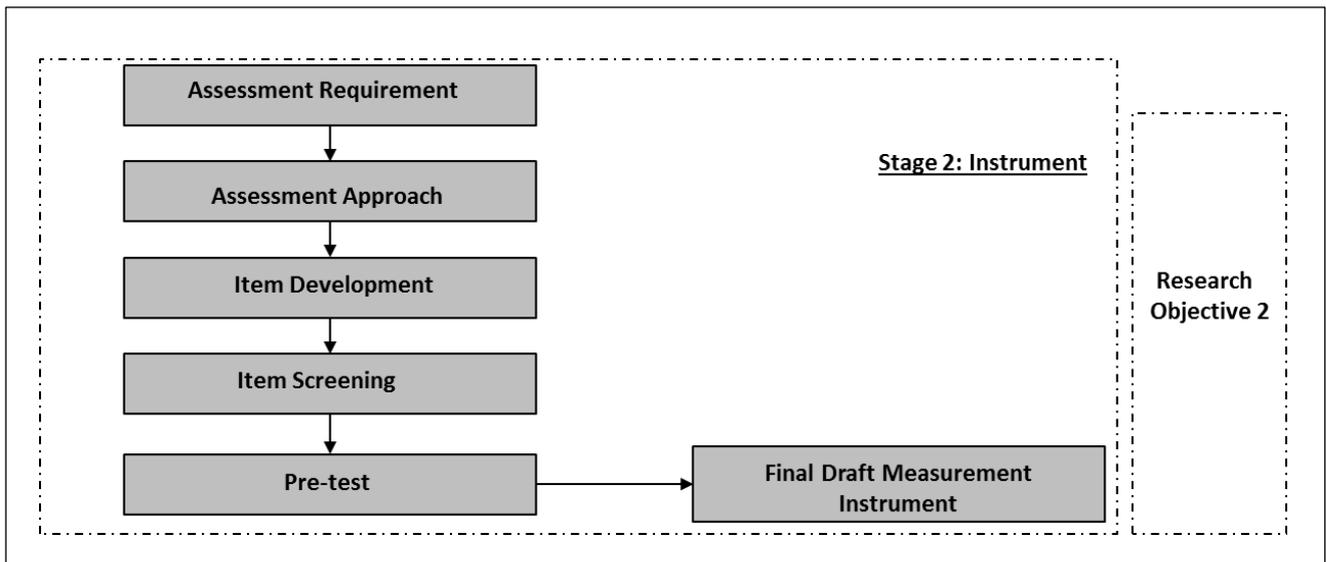
**Table 5.5: The application of the case-study protocol (continued)**

<p><b>Analysis of evidence &amp; data:</b></p>	<ul style="list-style-type: none"> <li>• <b>Theoretical propositions</b> as a framework were used to guide the implementation</li> <li>• <b>A case description</b> was developed that outlined the key attributes and processes</li> <li>• <b>Both qualitative and quantitative data</b> was analysed in combination, qualitative data in the form of job descriptions and assessment questions combined with the quantitative data from the competency assessments</li> <li>• <b>Analytical techniques</b> were applied: <ul style="list-style-type: none"> <li><b>Pattern matching</b> where best practice frameworks were used as a reference pattern</li> <li><b>Explanation building</b> was used to explore the complexities in developing competency assessment tools</li> <li><b>Logic models</b> were used to explain the chain of events as the case study progressed</li> </ul> </li> </ul>
<p><b>Types of compositional structures to be applied to the case-study report</b></p>	<ul style="list-style-type: none"> <li>• <b>Linear-analytic:</b> The standard research sequence to the report was followed</li> <li>• <b>Theory-building:</b> The sequence of the report and explanation of the findings also focused on theory building</li> </ul>
<p><b>Justification of the case study:</b></p>	<p>The selection of the case study provided the basis for the justification:</p> <ul style="list-style-type: none"> <li>• A supply chain company operating globally</li> <li>• The company is providing service across multiple functional areas of supply chain management</li> <li>• The case included all the units of analysis targeted as part of the research objectives</li> <li>• The executive team was committed to the research and made resources available</li> <li>• The company had a team of experts that could contribute towards the research</li> <li>• Multiple sources of data was available to enable the research to achieve the quality standards defined</li> <li>• The staff compliment for assessment was ad equate to be able to draw a big enough sample for the assessment</li> </ul>

The construct development methodology which was used in addition to the case-study research will be discussed in the next section.

#### 5.4.2.4. *The development of a competency measurement instrument*

With the case-study methodology as contextual framework, the process of developing the measurement instrument will be discussed in more detail in this section. The methodology of Lewis *et al.* (2005) will be combined with a set of guidelines for competency assessment from the research of Baartman, Bastiaaens, Kitschner, Van Der Vleuten and Cees (2006). Stage II of the Lewis methodology is outlined in Figure 5.6.



**Figure 5.6: Construct development methodology stage II**

Source: Lewis *et al.*, 2005.

#### 5.4.2.4.1. Assessment requirement

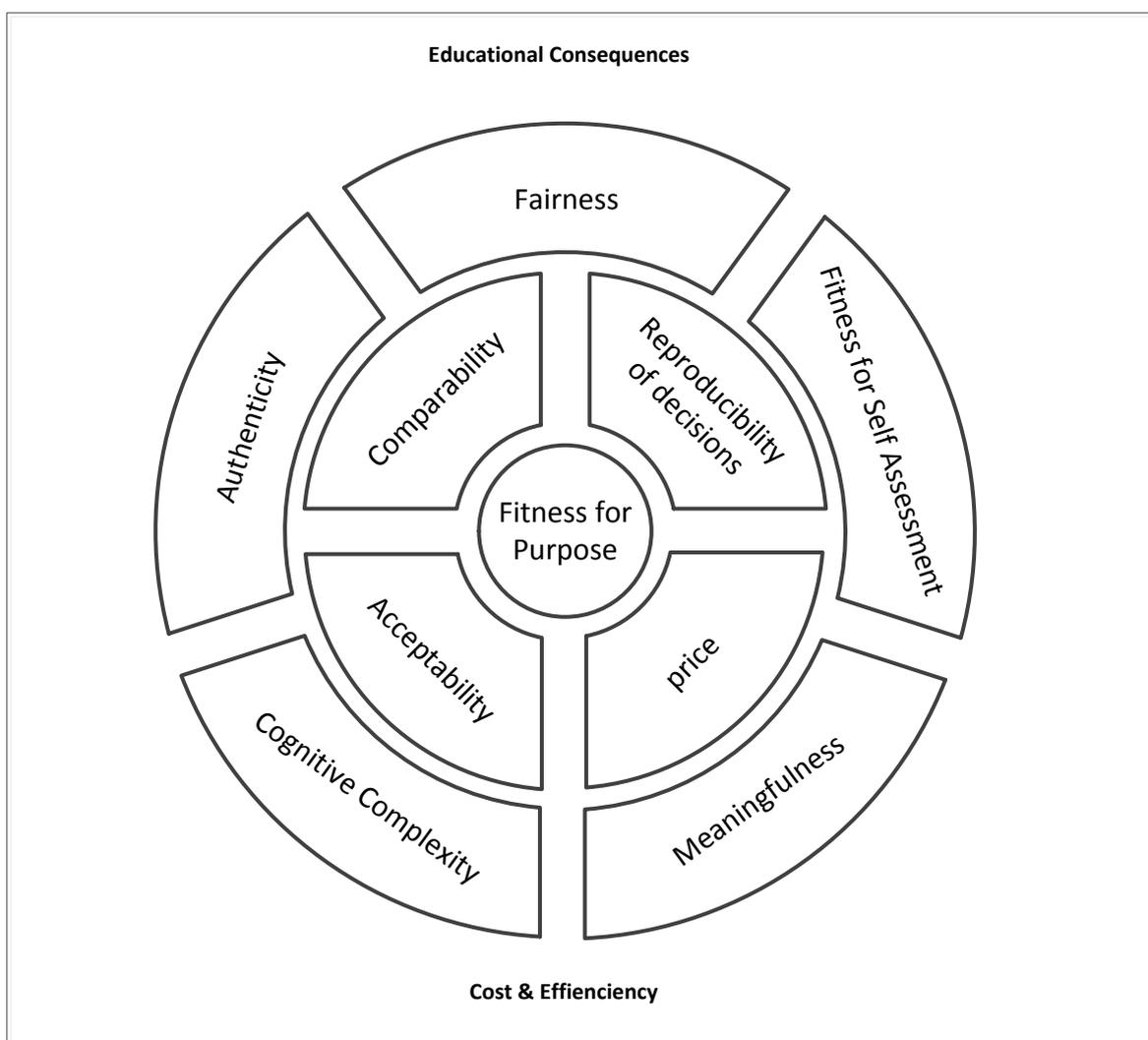
The assessment requirement is a translation of the proficiency levels developed for each competency, where the specific requirements by job are defined. This was done through the formulation of job profiles which define roles, responsibilities and requirements for each supply chain job. The job profiles were developed through the involvement of a team of job incumbents combined with a team of experts. The team of job incumbents participated in the process of developing the job profiles. The draft version of the job profiles was then evaluated by a team of company experts to provide final approval. A similar process was followed with the development of competency profiles which specify the competency requirements for each job profile. Content validity was achieved through the involvement of two teams of experts, which is acceptable in terms of research guidelines (Gay *et al.*, 2005; Aiken, 2003). Multiple sources of evidence were also used for this development, which provides further content validity based on the case-study research methodology (Yin, 2008).

#### 5.4.2.4.2. Assessment approach:

The development of adequate assessment methods is of utmost importance because of the strong relationship that exists between development and assessment. Alderson and Wall (1993) and Prodromou (1995) have described this as the "washback effect" or "backwash effect": what is assessed strongly influences what is developed. If assessment only measures factual knowledge, then job incumbents will concentrate primarily on learning facts (Bartman *et al.*, 2006).

Some authors (e.g. Biggs, 1996; Dochy, Moerkerke & Martens, 1996; Tillema, Kessels & Meijers, 2000) see the linking of assessment to instruction as the cornerstone of success for the implementation of competency-based development (Bartman *et al.*, 2006). Biggs (1996, 1999) calls this constructive alignment, which does not prescribe a specific type of instruction, development and assessment, but only prescribes that the three must be well aligned. If instruction and learning are based on acquiring competencies, then constructive alignment implies that assessment must also be competency based (Bartman *et al.*, 2006).

The scientific criteria for the development of a competency assessment instrument are summarised in Figure 5.7.



**Figure 5.7: The wheel of competency testing**

Source: Bartman, Bastiaaens, Kitschner and Van Der Vleuten, 2006.

In terms of this framework the key requirements for the development of high quality assessment instruments are:

- **Fitness for purpose:** Fitness for purpose was shown to be comparable to the idea of constructive alignment (Biggs, 1996, 1999), which prescribes that all competency assessment practices must be aligned with the goal of the learning process (i.e. the acquisition of competencies), and with the instruction given.
- **Comparability:** Comparability addresses the fact that competency assessment practices should be conducted in a consistent and responsible way. The conditions under which the assessment is carried out should be, as much as possible, the same for all incumbents and scoring should occur in a consistent way, using the same criteria for all incumbents (Uhlenbeck, 2002). Possibilities to increase comparability include careful sampling across conditions and using a large sample across the content and situations of the competency at stake (Van der Vleuten & Schuwirth, 2005).
- **Reproducibility:** Reproducibility of decisions relates to whether the decisions made based on the results of a competency assessment are accurate and constant over time and assessors. This does not mean that a competency assessment must be objective (Schuwirth & Van der Vleuten, 2004; Van der Vleuten & Schuwirth, 2005). Using performance assessments, assessors subjectively judge the performance of learners. Important is that the decisions about the learner are made accurately and do not depend on the assessor or the specific assessment situation.
- **Transparency:** Transparency relates to whether a competency assessment is clear and understandable to all participants. Learners should know the scoring criteria, who the assessors are, and what the purpose of the assessment is. As a possible indication of the transparency of an assessment, Hambleton (1996) suggests to check whether learners can judge themselves and other learners as accurately as trained assessors.
- **Authenticity:** Authenticity relates to the degree of resemblance of a competency assessment to the future professional life. A competency assessment should assess those competencies needed in the future workplace (Gulikers, Bastiaens & Kirschner, 2004). The authors distinguish five dimensions that can vary in authenticity: the assessment task, the physical context, the social context, the assessment result or form, and the assessment criteria.
- **Cognitive complexity:** Cognitive complexity resembles authenticity in the sense that it also relates to the processes applied in future professional life, but it focuses more directly on the fact that assessment tasks should also reflect the presence of higher cognitive skills (Hambleton, 1996; Linn, Bakker & Dunbar, 1991). An assessment task, depending on the

phase of education, should elicit the thinking processes used by experts to solve complex problems in their occupational field. In this respect, Hambleton remarks that the use of performance assessments is no guarantee that higher cognitive skills are indeed being measured. This should thus always be thoroughly investigated.

- **Meaningfulness:** Meaningfulness implies the fact that a competency assessment should have a significant value for both teachers and learners (Hambleton, 1996; Messick, 1994), to which the importance in the eyes of future employers could be added. A possible way to increase meaningfulness is to involve job incumbents in the (development of the) assessment process. McDowell (1995) stressed that for incumbents to perceive an assessment as meaningful, they need to perceive a link between the assessment task and their personal interests. An assessment might also become more valuable to incumbents when they themselves can determine when they are ready to take the assessment and can thus gain most profit from it.
- **Fairness:** Fairness specifies that a competency assessment should not show bias to certain groups of learners and reflect the knowledge, skills and attitudes of the competency at stake, excluding irrelevant variance (Hambleton, 1996; Linn *et al.*, 1991). Possible causes of bias are improper adjustment to the educational level of the incumbents or tasks containing cultural aspects that not all learners are familiar with.
- **Educational consequences:** Educational consequences are mentioned by various authors as a criterion for competency assessment by (Dierick & Dochy, 2001; Linn *et al.*, 1991; Messick, 1994; Schuwirth & Van der Vleuten, 2004) and pertain to the effects a competency assessment has on development and instruction. A collection of evidence is needed about the intended and unintended, positive and negative effects of the assessment on how developers and learners view the goals of education and adjust their learning activities accordingly (Linn *et al.*, 1991). This criterion is also related to effects like washback (Alderson & Wall, 1993; Prodromou, 1995).
- **Directness:** Directness considers the degree to which teachers or assessors can immediately interpret the assessment results, without translating them from theory into practice (Dierick & Dochy, 2001). A theoretical test does not immediately show if an incumbent is competent in a job situation, whereas a performance assessment does. Some evidence can be found that direct methods of assessment predict success at work better than more indirect methods do (Uhlenbeck, 2002).
- **Costs and efficiency:** Costs and efficiency are especially important because competency assessments are generally more complex than classical tests and more difficult to carry out (Linn *et al.*, 1991; Uhlenbeck, 2002). This criterion relates to the time and resources needed

to develop and carry out the competency assessment, compared to the benefits. Evidence needs to be found that the additional investments in time and resources are justified by the positive effects, such as improvements in learning and teaching (Hambleton, 1996).

Although the criteria discussed above originated from an educational context it was used as guidelines for the development of the supply chain competency assessment instrument. The next section will discuss item generation.

#### 5.4.2.4.3. Item development

The item development was completed within the framework of the approach that was followed for the development of the measurement instrument. These items were developed based on the following criteria:

- Competency to be assessed; and
- Level of proficiency to be assessed.

Items were developed with a team of experts made up of subject-matter experts and operational experts. The subject-matter experts provided input into the item design for specialised competencies, while operational experts provided input on the operational requirements. An item pool was developed for each competency at the different levels specified in the proficiency statements. Each item was linked to a scenario which could range from a single line to 20 lines of text. Construct and content validity was achieved through the expert opinion and the use of multiple sources of evidence (Yin, 2008).

#### 5.4.2.4.4. Item screening

The purpose of this step is to empirically screen the items on the instrument to determine whether each item on the instrument adequately represents the content domain of the construct. This procedure begins with the selection of a content evaluation panel composed of a group of experts knowledgeable about the concept. The panellists are presented with the list of questions or items and requested to evaluate each item. The evaluation focuses on both the content of the question and the relevance, given the overall competency model. Only items that were rated acceptable will be included in the item pool. Construct and content validity will be achieved through the expert opinion and the use of multiple sources of evidence (Yin, 2008).

#### 5.4.2.4.5. Pre-test

Following revisions by the panellists, a pilot test should be undertaken to further appraise and purify the instrument. The pilot test is a “dress-rehearsal” of the instrument with a small sample. Respondents chosen for the pilot test should be selected based on the pre-defined unit of analysis, as well as being similar to the population that will be the target of the administrations of the

instrument in Stage III. Pilot test respondents should be asked to fill out the instrument, and then comment on difficulties in completing the instrument and offer suggestions for improvement, including specifying any additional item statements they felt were missing or items that should be deleted. Again, results of the pilot test should be examined and appropriate adjustments made to the instrument based on the observations of the respondents (Lewis *et al.*, 2005).

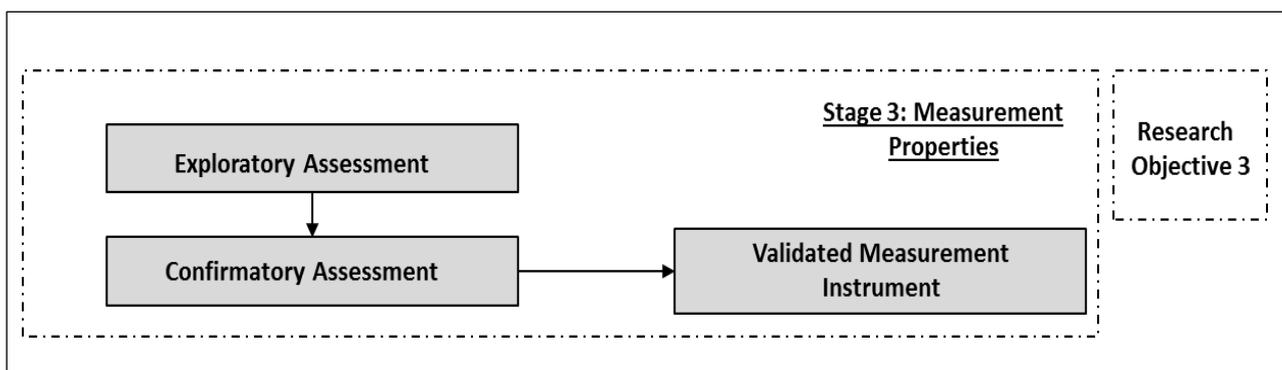
#### 5.4.2.4.6. Quality of results:

The quality of results from phase two of the research will be ensured through following the procedures defined in Lewis *et al.* (2005) to achieve construct validity of the items generated for the item pool. The techniques outlined by Yin (2008) for case study research such as multiple sources of evidence, cross referencing and a chain of evidence will contribute towards the quality of the results from the case study. The development of proficiency levels will be governed through a combination the guidelines for competency modelling and a foundation from the literature.

### 5.4.3. Phase 3: The application of the measurement instrument

#### 5.4.3.1. Methodology

The focus in this section of the research is on the application of the measurement instrument. After the pre-test that was completed in the previous stage of the research, stage III of the construct development methodology is the application of the instrument. The reference to the staged model presented earlier in the chapter is provided in Figure 5.8.



**Figure 5.8: Stage III of construct development**

Source: Lewis *et al.*, 2005.

Although the methodology of Lewis *et al.* (2005) includes confirmatory assessment as well, the objective of this research was only development up to the exploratory assessment. A number of challenges that need to be addressed in the exploratory assessment are the following:

- The measurement instrument measures a level of competence which is not based on a perception or a response on a scale such as a Likert scale. The type of data is ordinal in nature, where answers to assessment questions have a single answer which can be either text, such as true or false, or a choice from a multiple-choice question;
- The scope of confirmatory analysis that is possible with ordinal data is limited. Techniques such as factor analysis and classical reliability analysis cannot be applied to ordinal data;
- A next challenge is that the data set is not going to be complete. This is the result of an item pool where not all the questions will be selected during a single round of assessment;
- Certain questions can potentially not be selected as the software that is administering the assessment might not select a specific question;
- The data set across respondents will not be uniform, thus not all respondents will answer the same questions. Using techniques such as factor analysis to determine the underlying structure of the construct and provide more detail testing of validity, would thus not be possible.

#### *5.4.3.2. Sample*

Selection of the sample was firstly based on the selection of jobs that were relevant to the supply chain management. Forty-two positions were selected to participate in the application of the measurement instrument. The second aspect was the selection of individual respondents to participate in the study. A total sample of 650 people was selected which included all job incumbents from the 23 selected positions. These people were based across four geographical regions of South Africa. Representation of the sample was not an issue as the selected respondents were actually the population and not a sample from the population.

#### *5.4.3.3. Data collection*

Data collection was done with a software-based electronic assessment. Respondents logged in to the software and presented their personal details which included job position. The software then selected a competency profile which was allocated to the selected job profile. Based on the competency profile, a set of questions was selected where each question was linked to a specific competency and the level of proficiency required.

Once the assessment was generated, the questions were presented to the respondents. As the questions are answered, the associated data is entered into a database where the answers are compared to the correct answer. A score is then calculated for each question and the overall score is presented to the respondent at the end of the assessment.

#### 5.4.3.4. *Data analysis*

Data analysis of the competency assessment offered some unique challenges. For the purpose of continual use of the assessment instrument as part of competency development, not all items in item pool will be used during the assessment. Items will be selected on a random basis for each assessment to be able to repeat the assessment for the same candidate multiple times without repeating the same questions. During a single iteration of assessment, it is thus unlikely that all questions will be used unless a very big sample is being used.

The second challenge relates to the type of data that is generated during a competency assessment. Although quantitative data is generated, it is multivariate data in which the variables are binary where the respondent can only select of one or two possible options such as yes/no or true/false (Cox, 1972).

The first objective of analysis was thus to eliminate all questions which do not have at least 5 responses from the analysis. The balance of the items was analysed for its discriminative value, thus the quality of the item to differentiate between correct and incorrect answers. This was done by calculating an overall score of correct items and then calculating the correlation between each item and the total score. This technique is similar to Cronbach Alpha correlation coefficients. Because not all items were similar between assessments, Cronbach Alpha coefficients could not be used in the analysis. All items with a poor correlation or low discriminative value were deleted from further analysis.

Only items with an acceptable level of discrimination, thus with an effect size of above 0.4 was accepted was further analysis. Once only items with an acceptable quality were selected, the competency results were calculated. The segmentation of individual results into subgroups will be a function of the size of the sample when segmented into a subgroup. Competency results were primarily calculated at competency level consistent with the conceptual competency model.

#### 5.4.3.5. *Quality of results:*

Although the reliability of the use of the items that scored at acceptable levels could be established, construct validity could not be confirmed through statistical analysis. The results of this study can thus only be used in an exploratory application for further research which is one of the limitations of the study. With regards to the potential quality of the assessment approach, the design of the measurement instrument is likely to meet the quality criteria defined by Baartman *et al.* (2006).

## **5.5. ANTICIPATED VALUE OF THE RESEARCH**

It was anticipated that this research would provide a generic supply chain competency model incorporating different supply chain models and thinking and integrated with the concept of core supply chain competence. This model will provide a basis for further research and development of the supply chain competency. Other areas of potential value can be summarised as follows:

- A contribution can be made towards the establishment of a competency management model which can form the basis for supply chain talent management.
- The competency model can form the basis for aligning training and development initiatives to progress towards the implementation of a unified model for competency development.
- The model can enable supply chain organisations to determine competency development requirements more effectively.
- It can provide global supply chain organisations with a basis for competency development and transfer during the process of global expansion.
- It can improve processes for managing supply chain talent.

## **5.6. LIMITATIONS OF THE RESEARCH**

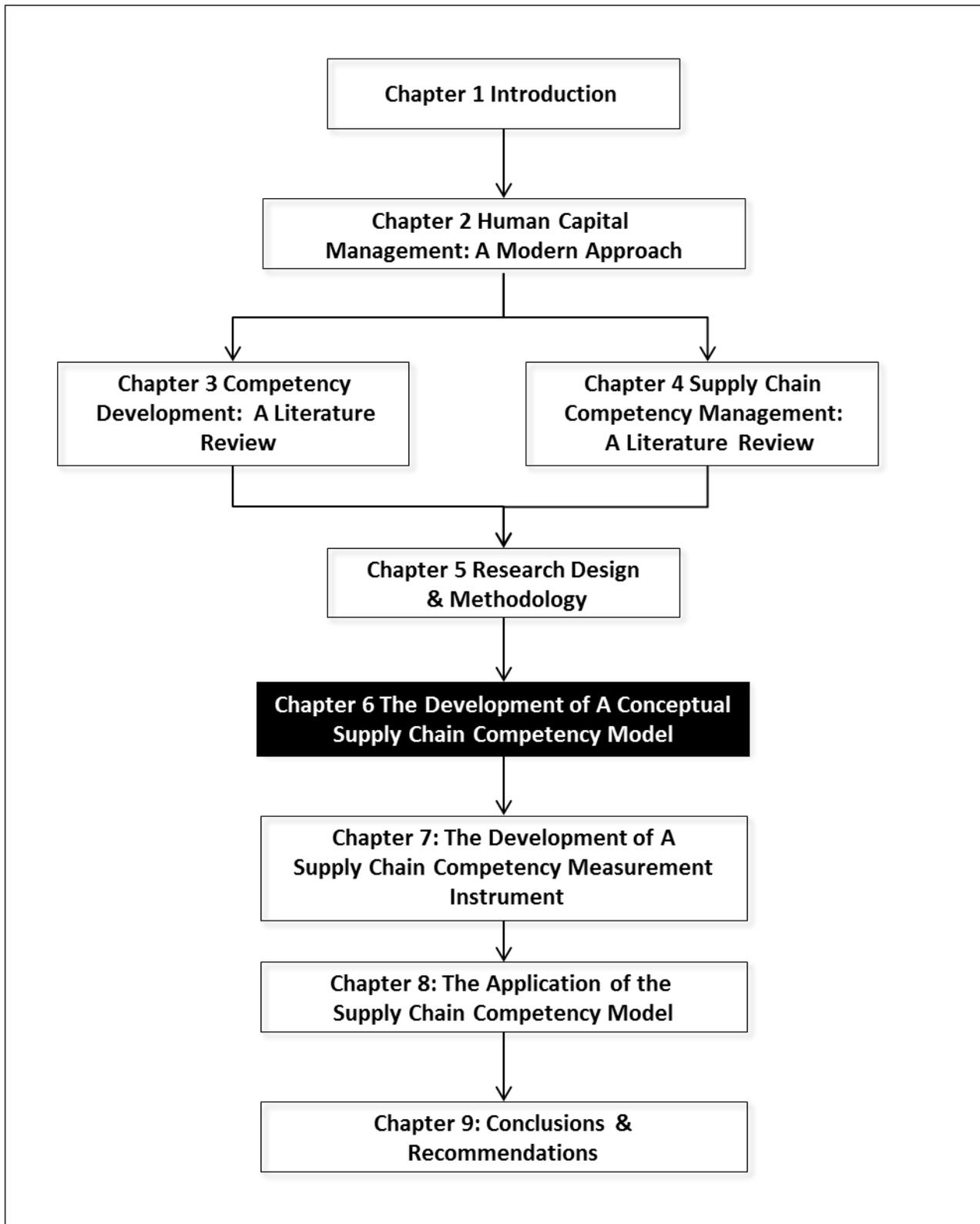
Although it is anticipated that this study will contribute towards the development of supply chain competency development, it is accepted that further development will be required for the general application of the competency model. The study limitations are as follows:

- The best practice framework for competency modelling developed in Chapter 3 of the study is only based on literature and exploratory research done by the authors. Although the construct validity of the work can be confirmed by the techniques used both the quoted research and this research, the validity was not confirmed using advanced statistical analysis such as confirmatory factor analysis;
- The conceptual supply chain competency model that was developed in this research could only be regarded as an exploratory model. Although construct validity could be confirmed through the use of content analysis and the Delphi techniques, no confirmatory analysis was performed;
- The measurement instrument for measuring supply chain competency is also exploratory research because not all items in the item pool could be used and as such construct validity could not be confirmed through statistical techniques such as confirmatory factor analysis or Lisrel analysis;

- A last limitation of the study is that the competency model does not provide for the application of the model in different types of supply chains and possible differences between different global regions.

## CHAPTER 6

### THE DEVELOPMENT OF A CONCEPTUAL SUPPLY CHAIN COMPETENCY MODEL



## **6.1. INTRODUCTION**

The research design outlined in the previous chapter identified the research objectives. The first objective was to develop a supply chain competency model based on the literature review and to test the model through a Delphi study. This chapter is the first of three chapters dealing with the research results. The objectives of this chapter are more specifically to:

- Apply the best practices framework for developing competencies models from Chapter 3 to the development of a supply chain competency model;
- Consolidate and integrate the supply chain theory and research to date as the key building blocks into a conceptual supply chain competency model;
- Test the conceptual model through a Delphi study before the model is developed further.

## **6.2. THE PROCESS OF CREATING A CONSOLIDATED SUPPLY CHAIN COMPETENCY MODEL**

A structured process of creating a consolidated supply chain competency model was followed. This process firstly applied the best practices for competency models outlined in Chapter 3 and secondly followed the principles of model development through the consolidation of the literature and previous research on supply chain theory and supply chain competency models.

The challenge with the integration of different supply chain models and previous research into a single competency model was that different dimensions exist across different models with the result that the process of consolidation would require a hierarchy of the different dimensions which could provide the basis for consolidation by categorising previous literature into the identified dimensions and then consolidating per dimension.

For this purpose, the following dimensions could be identified:

- Supply chain core or strategic capabilities;
- Supply chain functions or processes;
- Sub-functions or sub-processes;
- Best practices;
- Supply chain competencies;
- Skills requirements.

The process that was followed to achieve this integration is outlined in Figure 6.1.

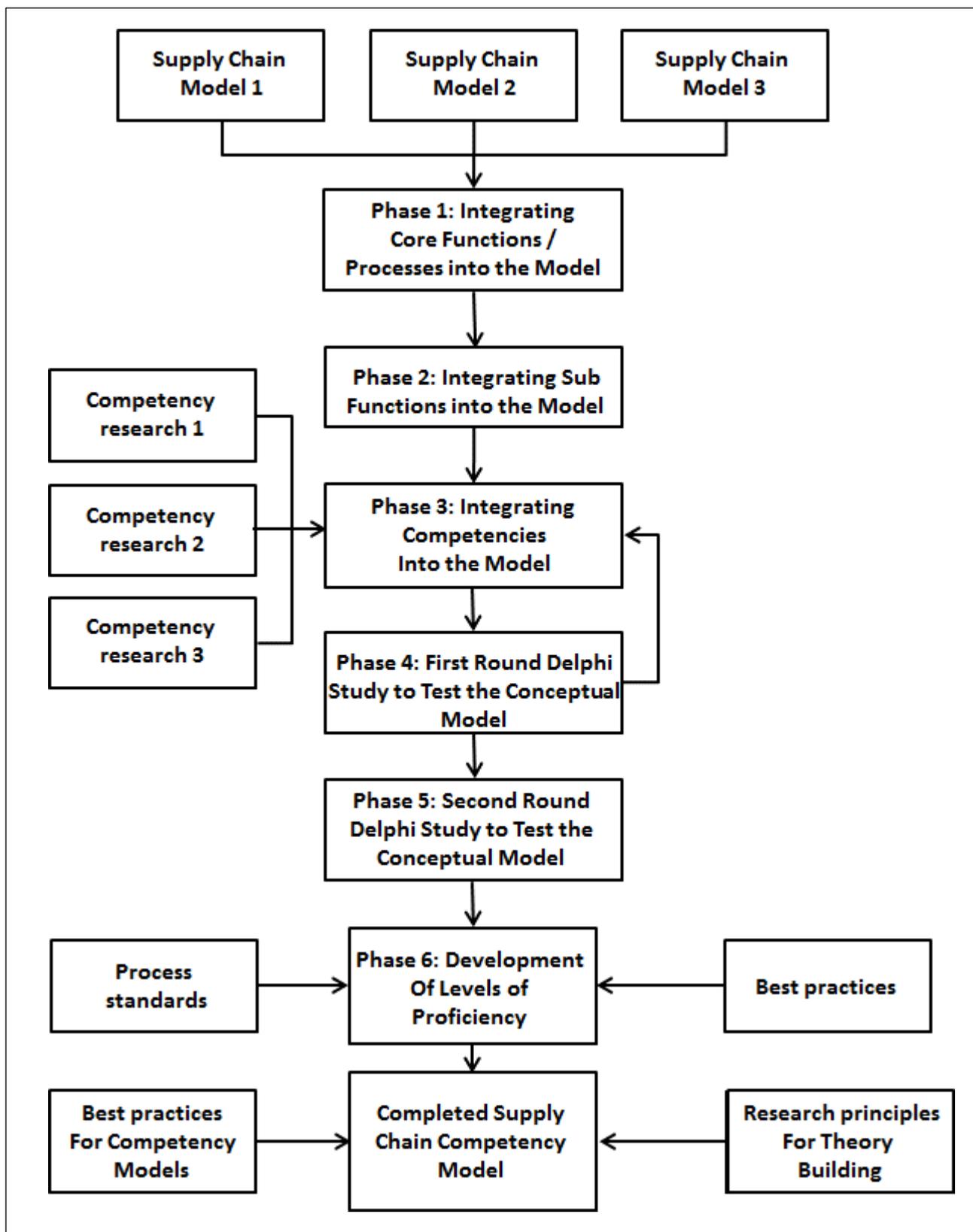


Figure 6.1: The process of integrating the different elements into an integrated model

Phase 1 of the process was to integrate the core elements from the different supply chain models into a consolidated model. This was done by comparing the different core elements and eliminating the overlap between the different models to get a consolidated list. Where there was an overlap, definitions were compared to provide the basis for consolidation.

Phase 2 consolidated the sub-elements at the next level. This led to a consolidated model with main elements supported by sub-elements. Phase 3 consolidated the different competencies identified from previous research. Where gaps existed in competencies, these were developed through an exploration of the literature. The first draft competency model was completed after phase 3. Phase 4 of the process involved the first round of Delphi research with an internal team of supply chain experts. Phase 5 of the process was round two of the Delphi study with an external team of experts to finally confirm the conceptual model. Phase 6 further developed the conceptual model by adding competency assessment capability to the model. The model was finally tested against two sets of criteria: firstly the competency best practices identified in Chapter 3, and secondly the criteria for developing conceptual models outlined in Chapter 5.

### **6.3. PHASE 1: INTEGRATING THE CORE ELEMENTS INTO A SINGLE SUPPLY CHAIN MODEL**

Table 6.1 provides the basis for phase 1 integration and consolidation of the core elements from different supply chain models. The reference to the relevant supply chain model is included in the first column, the key elements in the second column and the consolidated elements and processes in the third column.

**Table 6.1: A consolidation of the different supply chain models**

<b>Supply chain model</b>	<b>Key processes</b>	<b>Consolidated processes</b>
<b>Lambert Model</b>	Customer relationship management Customer service management Demand management Order fulfilment Manufacturing flow management Supplier relationship management Product development & commercialisation Returns management	Customer relationship management Customer service management Demand management Order fulfilment Manufacturing flow management Supplier relationship management Product development & commercialisation Returns management

**Table 6.1: A consolidation of the different supply chain models (continued)**

<b>Supply chain model</b>	<b>Key processes</b>	<b>Consolidated processes</b>
<b>Supply Chain Consortium</b>	Source Make Store/Sort Deliver Return Control Profile	Source Store/Sort Control Profile
<b>Supply Chain Council &amp; American Quality &amp; Productivity Institute</b>	Develop vision and strategy Develop and manage products and services Deliver products and services Manage customer service Develop and manage human capital Manage information technology Manage financial resources Acquire, construct and manage property Manage environmental health and safety (EHS) Manage external relationships Manage knowledge, improvement and change	Develop vision and strategy Develop and manage products and services Develop and manage human capital Manage information technology Manage financial resources Acquire, construct and manage property Manage environmental health and safety (EHS) Manage knowledge, improvement and change
<b>SCOR Version11</b>	Plan Source Make Deliver Return Design Product Management Sales & Support	Plan Source Make Deliver Return Design Product Management Sales & Support
<b>Demand Driven Supply Network Management from AMR</b>	Demand sensing Demand shaping Profitable demand response	Demand sensing Demand shaping Profitable demand response
<b>AMR Supply Chain Talent Model Functional &amp; Enablement Attributes</b>	New product development Plan Source Make Deliver Customer management Governance Strategy & change management Performance measurement & analytics Technology enablement	Governance Performance measurement & analytics Technology enablement

**Table 6.1: A consolidation of the different supply chain models (continued)**

<b>Supply chain model</b>	<b>Key processes</b>	<b>Consolidated processes</b>
<b>Gattorna</b>	Supply chain alignment Enablement Culture Channel strategy Demand response	Supply chain alignment Culture Channel strategy
<b>Latest research on supply chain trends</b>	Green supply chain management Supply chain sustainability (resilience)	Green supply chain management Supply chain sustainability
<b>Apics Model</b>	Strategy development & application Supply chain management Process improvement & six sigma Execution planning, scheduling & control Project management Lean management Enabling technology Performance trade-offs Warehouse management Transport management Supply chain synchronisation Risk management Sustainability Locating facilities Distribution Warehousing International regulations Strategic supplier relationships Customer relationship management	Process improvement & six sigma Project management Lean management Supply chain synchronisation Risk management Sustainability International regulations
<b>MIT Supply Chain Best Practices</b>	Business strategy Operational model Operational performance objectives Tailored business practices	
<b>European Logistics Association</b>	Basic supply chain concepts Core management skills Warehouse management Production planning Transport management Inventory management Supply chain flows & networks Innovation & change leadership Supply chain strategy Business strategy	Production planning Innovation & change leadership

**Table 6.1: A consolidation of the different supply chain models (continued)**

Supply chain model	Key processes	Consolidated processes
<b>Accenture Model</b>	World-class supply chain expertise Value creation & realisation Integrated supply chain management Strategic customer management Inventory management Transportation Warehousing Service management Product development Procurement & sourcing Manufacturing Supply chain planning Supply chain concepts & processes Supply chain analyses & tools	
<b>Gartner Model</b>	Plan Source Make Deliver Customer management Post-sales support New product launch Innovation excellence Operational excellence Cross-functional processes	Cross-functional process integration
<b>21<sup>st</sup>-century Logistics Framework</b>	Product/Service value flow Market accommodation flow Behavioural process Relationship management Planning & control process Material & service supplier management Technology & planning Operational process Information flow Cash flow	
<b>Supply Chain Academic Talent Initiative</b>	Operations Logistics Supply Support	

From the consolidation that was done in Table 6.1, the following consolidated list of core supply chain elements was identified:

- Customer relationship management
- Customer service management

- Demand management
- Order fulfilment
- Manufacturing flow management
- Supplier relationship management
- Product development and commercialisation
- Returns management
- Source
- Store/Sort
- Control
- Profile
- Develop vision and strategy
- Develop and manage products and services
- Develop and manage human capital
- Manage information technology
- Manage financial resources
- Acquire, construct and manage property
- Manage environmental health and safety
- Manage knowledge, improvement and change
- Move
- Sales and operations planning
- Make
- Demand sensing
- Demand shaping
- Profitable demand response
- Governance
- Performance measurement and analytics
- Technology enablement
- Supply chain alignment
- Culture
- Channel strategy
- Green supply chain management
- Supply chain sustainability
- Process improvement and six sigma
- Project management
- Lean management
- Supply chain synchronisation

- Risk management
- Sustainability
- International regulations
- Production planning
- Innovation and change leadership
- Cross-functional processes.

This consolidated list still represents aspects or dimensions across different levels of the hierarchy. It was thus required to consolidate this list further. A further consolidated list is as follows:

- **Supply chain strategy**
  - Develop vision and strategy
  - Profitable demand response
  - Strategic alignment
  - Channel strategy
  - Profile
  - Order fulfilment.
- **Products**
  - Product development
  - Develop and manage products
  - Products/service value flow
  - New product launch
  - Product portfolio management.
- **Customers**
  - Customer relationship management
  - Customer service management
  - Demand management
  - Demand sensing
  - Demand shaping
  - Strategic customer management.
- **Make /Manufacturing**
  - Order fulfilment
  - Manufacturing flow
  - Make.
- **Planning**
  - Plan
  - Sales and operations planning
  - Production planning.

- **Source /Supply**
  - Source product
  - Supplier relationships management
  - Strategic sourcing.
  
- **Performance Improvement**
  - Innovation excellence
  - Operational excellence
  - Process improvement
  - Six sigma
  - Project management
  - Lean management
  - Supply chain synchronisation
  - Supply chain concepts and processes
  - Supply chain analyses and tools
  - Information flow
  - Performance measurement and analytics.
  
- **Technology**
  - Technology enablement.
  
- **Human resources**
  - Managing human capital
  - Develop and manage human capital
  - Culture management
  - Behavioural process.
  
- **Store/Warehousing**
  - Store
  - Warehousing
  - Inventory management.
  
- **Move**
  - Deliver products
  - Logistics
  - Transport management.
  
- **Control/Compliance**
  - Governance
  - Risk management
  - Health and safety management.
  
- **Green supply chain**
  - Environment
  - Sustainability.

- **Financial resources**
  - Manage financial resources
  - Cash flow.
- **Property**
  - Acquire, construct and manage property
- **International**
  - International regulations
  - Global trade.

These core functions provided the basis for developing an integrated model. The output was the result of phase 1 of model building. The second phase of model building was to take the different competencies identified from the competency research and consolidate those into a single model.

#### 6.4. PHASE 3: INTEGRATING THE DIFFERENT COMPETENCY MODELS AND RESEARCH

Phase 3 integrated the different competencies that were identified from previous research. Table 6.2 provides the basis for integration with column one indicating the model or research reference, column two the competencies identified and column three providing the consolidation.

**Table 6.2: A consolidation of supply chain competencies**

Competency model or research	Competencies identified	Consolidation of competencies
<b>Supply Chain 2000 Framework</b> <b>(Bowersox <i>et al.</i>, 1999)</b>	<b>Customer integration:</b> <ul style="list-style-type: none"> <li>• Segmental focus</li> <li>• Relevancy</li> <li>• Responsiveness</li> <li>• Flexibility</li> </ul> <b>Internal integration:</b> <ul style="list-style-type: none"> <li>• Cross-functional unification</li> <li>• Standardisation</li> <li>• Simplification</li> <li>• Compliance</li> <li>• Structural adaption</li> </ul> <b>Material/Service supplier integration:</b> <ul style="list-style-type: none"> <li>• Strategic alignment</li> <li>• Operational fusion</li> <li>• Financial linkage</li> <li>• Supplier management</li> </ul>	<b>Customer integration:</b> <ul style="list-style-type: none"> <li>• Segmental focus</li> <li>• Relevancy</li> <li>• Responsiveness</li> <li>• Flexibility</li> </ul> <b>Internal integration:</b> <ul style="list-style-type: none"> <li>• Cross-functional unification</li> <li>• Standardisation</li> <li>• Simplification</li> <li>• Compliance</li> <li>• Structural adaption</li> </ul> <b>Material/Service supplier integration:</b> <ul style="list-style-type: none"> <li>• Strategic alignment</li> <li>• Operational fusion</li> <li>• Financial linkage</li> <li>• Supplier management</li> </ul>

**Table 6.2: A consolidation of supply chain competencies (continued)**

Competency model or research	Competencies identified	Consolidation of competencies
	<p><b>Technology &amp; planning integration:</b></p> <ul style="list-style-type: none"> <li>• Information management</li> <li>• Internal communication</li> <li>• Connectivity</li> <li>• Collaborative forecasting and planning</li> </ul> <p><b>Measurement integration:</b></p> <ul style="list-style-type: none"> <li>• Functional assessment</li> <li>• Activity-based and total cost methodology</li> <li>• Comprehensive metrics</li> <li>• Financial impact</li> </ul> <p><b>Relationship integration:</b></p> <ul style="list-style-type: none"> <li>• Role specific</li> <li>• Guidelines</li> <li>• Information sharing</li> </ul> <p>Gain/risk sharing</p>	<p><b>Technology &amp; planning integration:</b></p> <ul style="list-style-type: none"> <li>• Information management</li> <li>• Internal communication</li> <li>• Connectivity</li> <li>• Collaborative forecasting and planning</li> </ul> <p><b>Measurement integration:</b></p> <ul style="list-style-type: none"> <li>• Functional assessment</li> <li>• Activity-based and total cost methodology</li> <li>• Comprehensive metrics</li> <li>• Financial impact</li> </ul> <p><b>Relationship integration:</b></p> <ul style="list-style-type: none"> <li>• Role specific</li> <li>• Guidelines</li> <li>• Information sharing</li> </ul> <p>Gain/risk sharing</p>
<b>Competency Clearinghouse</b>	<p><b>Personal effectiveness:</b></p> <ul style="list-style-type: none"> <li>• Interpersonal skills</li> <li>• Integrity</li> <li>• Professionalism</li> <li>• Initiative</li> <li>• Dependability &amp; reliability</li> <li>• Adaptability &amp; flexibility</li> <li>• Willingness to learn</li> </ul> <p><b>Academic competencies:</b></p> <ul style="list-style-type: none"> <li>• Reading</li> <li>• Writing</li> <li>• Science, technology, engineering &amp; math</li> <li>• Communication</li> <li>• Critical &amp; analytical thinking</li> <li>• Basic computer skills</li> </ul> <p><b>Workplace competencies:</b></p> <ul style="list-style-type: none"> <li>• Teamwork</li> <li>• Customer focus</li> <li>• Planning &amp; organising</li> <li>• Problem solving</li> <li>• Working with tools &amp; technology</li> <li>• Scheduling &amp; co-ordinating</li> <li>• Checking, examining and recording</li> <li>• Business fundamentals</li> </ul>	<p><b>Personal effectiveness:</b></p> <ul style="list-style-type: none"> <li>• Interpersonal skills</li> <li>• Integrity</li> <li>• Professionalism</li> <li>• Initiative</li> <li>• Dependability &amp; reliability</li> <li>• Adaptability &amp; flexibility</li> <li>• Willingness to learn</li> </ul> <p><b>Academic competencies:</b></p> <ul style="list-style-type: none"> <li>• Reading</li> <li>• Writing</li> <li>• Science, technology, engineering &amp; math</li> <li>• Communication</li> <li>• Critical &amp; analytical thinking</li> <li>• Basic computer skills</li> </ul> <p><b>Workplace competencies:</b></p> <ul style="list-style-type: none"> <li>• Teamwork</li> <li>• Customer focus</li> <li>• Planning &amp; organising</li> <li>• Problem solving</li> <li>• Working with tools &amp; technology</li> <li>• Scheduling &amp; co-ordinating</li> <li>• Checking, examining and recording</li> <li>• Business fundamentals</li> </ul>

**Table 6.2: A consolidation of supply chain competencies (continued)**

Competency model or research	Competencies identified	Consolidation of competencies
	<p><b>Industry-wide technical competence:</b></p> <ul style="list-style-type: none"> <li>• Logistics planning and management</li> <li>• Warehousing &amp; distribution</li> <li>• Transport operations and maintenance</li> <li>• Technology applications</li> <li>• Customer relationship management</li> </ul> <p>Health, safety &amp; environment</p>	<p><b>Industry-wide technical competence:</b></p> <ul style="list-style-type: none"> <li>• Logistics planning and management</li> <li>• Warehousing &amp; distribution</li> <li>• Transport operations and maintenance</li> <li>• Technology applications</li> <li>• Customer relationship management</li> </ul> <p>Health, safety &amp; environment</p>
<p><b>APICS Competency Model</b></p>	<p><b>Personal effectiveness (Tier 1):</b></p> <ul style="list-style-type: none"> <li>• Awareness of the needs of others</li> <li>• Integrity</li> <li>• Continuous learning</li> <li>• Effective communication</li> <li>• Interpersonal skills</li> <li>• Creativity</li> </ul> <p><b>Academic competencies (Tier 2):</b></p> <ul style="list-style-type: none"> <li>• Math, statistics, analytical thinking</li> <li>• Reading and writing for comprehension</li> <li>• Applied science and technology</li> <li>• Supply chain fundamentals</li> <li>• Foundations of business management</li> <li>• Fundamentals of technology</li> <li>• Operations and enterprise economics</li> </ul> <p><b>Workplace &amp; leadership competencies (Tier 3):</b></p> <ul style="list-style-type: none"> <li>• Strategy development &amp; application</li> <li>• Supply chain management</li> <li>• Execution planning, scheduling &amp; control</li> <li>• Project management</li> <li>• Lean management</li> <li>• Enabling technology management</li> </ul> <p><b>Supply chain manager knowledge areas (Tier 5):</b></p> <ul style="list-style-type: none"> <li>• Performance trade-offs</li> <li>• Warehouse management</li> <li>• Transportation management</li> <li>• Supply chain synchronisation</li> <li>• Risk management</li> <li>• Sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness of the needs of others</li> </ul> <ul style="list-style-type: none"> <li>• Supply chain fundamentals</li> </ul> <ul style="list-style-type: none"> <li>• Strategy development &amp; application</li> <li>• Supply chain management</li> <li>• Execution planning, scheduling &amp; control</li> <li>• Project management</li> <li>• Lean management</li> </ul> <ul style="list-style-type: none"> <li>• Performance trade-offs</li> <li>• Warehouse management</li> <li>• Transportation management</li> <li>• Supply chain synchronisation</li> <li>• Risk management</li> <li>• Sustainability</li> </ul>

**Table 6.2: A consolidation of supply chain competencies (continued)**

Competency model or research	Competencies identified	Consolidation of competencies
	<p><b>Supply chain manager technical competencies (Tier 6):</b></p> <ul style="list-style-type: none"> <li>• Locating facilities</li> <li>• Distribution</li> <li>• Warehousing</li> <li>• Logistics</li> <li>• International regulations</li> <li>• Strategic sourcing / supplier management</li> <li>• Customer relationship Management</li> </ul> <p>Applying lean &amp; six sigma tools</p>	<ul style="list-style-type: none"> <li>• Locating facilities</li> <li>• Distribution</li> <li>• Warehousing</li> </ul>
<p><b>Research by Sauber, McSurely &amp; Tumala (2008)</b></p>	<p><b>Procurement:</b></p> <ul style="list-style-type: none"> <li>• Purchasing process</li> <li>• Procurement cycle</li> <li>• Purchasing research</li> <li>• Relationships with suppliers</li> <li>• Negotiation</li> <li>• Commodity planning</li> <li>• JIT systems</li> <li>• Expediting systems</li> <li>• Cost, price and value analysis</li> <li>• Life-cycle costing</li> <li>• Cost reduction techniques</li> <li>• Purchase/product specifications</li> <li>• International procurement</li> <li>• Sourcing strategies</li> <li>• Theoretical models explaining procurement and sourcing strategy</li> <li>• Supplier quality certification</li> <li>• Statistical quality control</li> <li>• Outsourcing</li> <li>• Supplier selection</li> <li>• Global sourcing</li> <li>• Purchasing organisation</li> </ul> <p><b>Customer relationship management</b></p> <ul style="list-style-type: none"> <li>• Order management</li> <li>• Customer relationship management</li> <li>• Demand management</li> <li>• Customer service</li> <li>• Data mining</li> <li>• Order fulfilment</li> <li>• B2B marketing</li> </ul>	<ul style="list-style-type: none"> <li>• Purchasing process</li> <li>• Procurement cycle</li> <li>• Purchasing research</li> </ul> <ul style="list-style-type: none"> <li>• Commodity planning</li> <li>• JIT systems</li> <li>• Expediting systems</li> </ul> <ul style="list-style-type: none"> <li>• Life-cycle costing</li> <li>• Cost reduction techniques</li> <li>• Purchase/product specifications</li> <li>• International procurement</li> <li>• Sourcing strategies</li> <li>• Theoretical models explaining procurement and sourcing strategy</li> <li>• Supplier quality certification</li> <li>• Statistical quality control</li> <li>• Outsourcing</li> <li>• Supplier selection</li> <li>• Global sourcing</li> <li>• Purchasing organisation</li> </ul> <ul style="list-style-type: none"> <li>• Order management</li> </ul> <ul style="list-style-type: none"> <li>• Demand management</li> </ul> <ul style="list-style-type: none"> <li>• Order fulfilment</li> </ul>

**Table 6.2: A consolidation of supply chain competencies (continued)**

Competency model or research	Competencies identified	Consolidation of competencies
	<ul style="list-style-type: none"> <li>• B2C marketing</li> <li>• Supply chain contracts</li> <li><b>Logistics and distribution</b></li> <li>• Channel management</li> <li>• Transportation decisions</li> <li>• Facility decisions</li> <li>• Network design</li> <li>• SCM information technology</li> <li>• Inventory analysis</li> <li>• Inventory control in SCM</li> <li>• Multi-echelon inventory control models</li> <li>• Interaction of government, carrier and user logistics</li> <li>• Warehousing</li> <li>• Materials handling</li> <li>• Integrated performance measurement</li> <li>• Managerial and statistical data techniques used for logistics analysis</li> <li>• Logistical information systems</li> <li>• Tools, procedures, and metrics for purchasing, manufacturing operations and logistics</li> <li>• Distribution operations</li> <li>• Logistics management</li> <li>• JIT systems</li> <li>• Logistics</li> <li>• Transportation</li> <li>Traffic management</li> </ul>	<ul style="list-style-type: none"> <li>• Channel management</li> <li>• Transportation decisions</li> <li>• Facility decisions</li> <li>• Network design</li>   <li>• Inventory analysis</li> <li>• Inventory control in SCM</li> <li>• Multi-echelon inventory control models</li> <li>• Interaction of government, carrier and user logistics</li>   <li>• Materials handling</li> </ul>

The consolidated list of competencies from the table above is the following:

**Customer integration:**

- Segmental focus
- Relevancy
- Responsiveness
- Flexibility.

**Internal integration:**

- Cross-functional unification
- Standardisation
- Simplification

- Compliance
- Structural adaption.

**Material/Service supplier integration:**

- Strategic alignment
- Operational fusion
- Financial linkage
- Supplier management.

**Technology and planning integration:**

- Information management
- Internal communication
- Connectivity
- Collaborative forecasting and planning.

**Measurement integration:**

- Functional assessment
- Activity-based and total cost methodology
- Comprehensive metrics
- Financial impact.

**Relationship integration:**

- Role specific
- Guidelines
- Information sharing
- Gain/risk sharing.

**Personal effectiveness:**

- Interpersonal skills
- Integrity
- Professionalism
- Initiative
- Dependability and reliability
- Adaptability and flexibility
- Willingness to learn.

**Academic competencies:**

- Reading
- Writing
- Science, technology, engineering and math
- Communication
- Critical and analytical thinking
- Basic computer skills.

**Workplace competencies:**

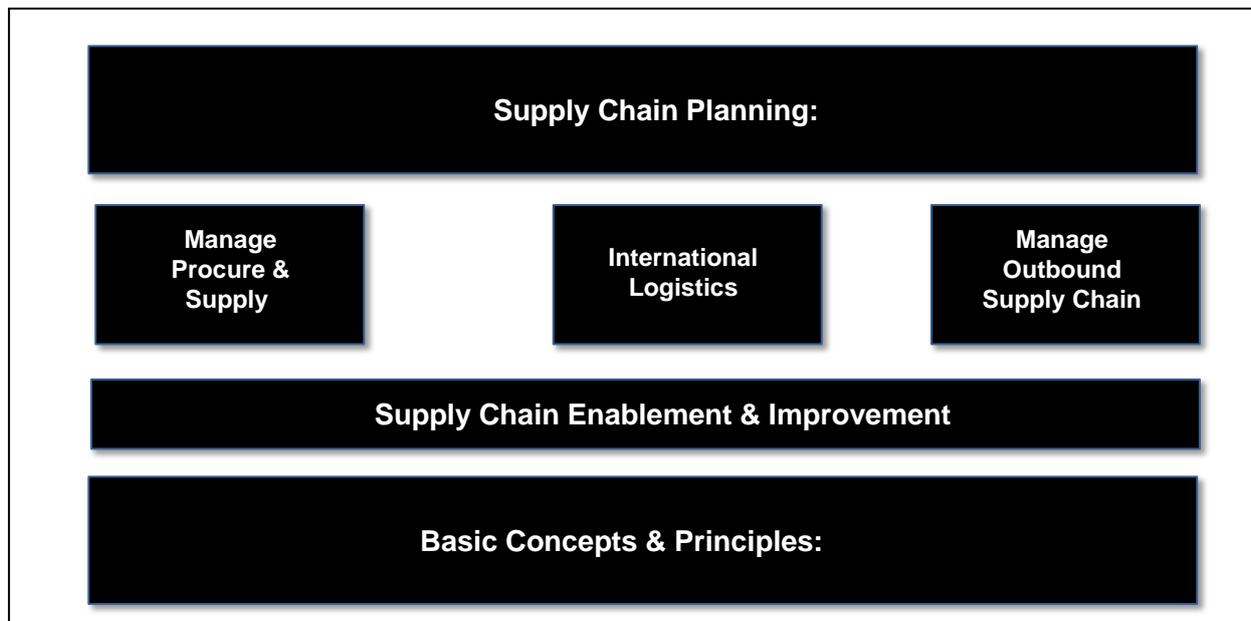
- Teamwork
- Customer focus
- Planning and organising
- Problem solving
- Working with tools and technology
- Scheduling and co-ordinating
- Checking, examining and recording
- Business fundamentals.

**Industry-wide technical competence:**

- Logistics planning and management
- Warehousing and distribution
- Transport operations and maintenance
- Technology applications
- Customer relationship management
- Health, safety and environment.
- Logistics planning and management
- Warehousing and distribution
- Transport operations and maintenance
- Awareness of the needs of others
- Supply chain fundamentals
- Strategy development and application
- Supply chain management
- Execution planning, scheduling and control
- Project management
- Lean management
- Performance trade-offs
- Warehouse management
- Transportation management
- Supply chain synchronisation
- Risk management
- Sustainability
- Locating facilities
- Distribution
- Warehousing
- Purchasing process

- Procurement cycle
- Purchasing research
- Commodity planning
- JIT systems
- Expediting systems
- Life-cycle costing
- Cost reduction techniques
- Purchase/product specifications
- International procurement
- Sourcing strategies
- Theoretical models explaining procurement and sourcing strategy
- Supplier quality certification
- Statistical quality control
- Outsourcing
- Supplier selection
- Global sourcing
- Purchasing organisation
- Order management
- Demand management
- Order fulfilment
- Channel management
- Transportation decisions
- Facility decisions
- Network design
- Inventory analysis
- Inventory control in SCM
- Multi-echelon inventory control models
- Interaction of government, carrier and user logistics
- Materials handling.

The two lists of core functions and supply chain competencies were consolidated into a first version conceptual model. This model is depicted in Figure 6.2.



**Figure 6.2: First version supply chain competency model**

The first draft competency model had six meta-competencies which included the following:

- Supply Chain Planning
- Managing the Outbound Supply
- International Logistics
- Manage, Procure & Pay
- Supply Chain Enablement & Improvement
- Basic Concepts & Principles.

The sub-competencies under each of the meta-competencies are summarised in Table 6.3.

**Table 6.3: The supply chain competency model version 1**

Meta-Competency	Sub-Competency
<b>Supply Chain Planning</b>	<p><b><u>Supply Chain Design (Strategic)</u></b></p> <ul style="list-style-type: none"> <li>Industry &amp; Market Analysis</li> <li>Understanding Different Types of Supply Chains</li> <li>Market Segmentation</li> <li>Developing Demand Fulfilment Strategy</li> <li>Customer Relationship Management</li> <li>Developing Innovative Customer Solutions</li> <li>Developing Supply Chain Strategy</li> <li>Network Design &amp; Optimisation</li> <li>Supply Chain Process Design &amp; Optimisation</li> </ul>

**Table 6.3: The supply chain competency model version 1 (continued)**

Meta-Competency	Sub-Competency
	<p><b><u>Sales &amp; Operations Planning (Tactical)</u></b>  Demand Sensing &amp; Shaping  Demand Planning  Supply Planning  Inventory Planning  Distribution Requirements Planning  Production Planning  Source Planning  Materials Requirements Planning  Demand &amp; Supply Balancing</p> <p><b><u>Supply Chain Operations Planning &amp; Scheduling (Operational)</u></b>  Customer Order Management  Operational Inventory Allocation Planning  Detail Production Scheduling  Inventory Deployment &amp; Replenishment Scheduling  Facility Operations Scheduling  Transport Operations Scheduling</p>
<b>Managing the Outbound Supply</b>	<p><b><u>Customer Order Management:</u></b>  Order Execution Management &amp; Customer Service</p> <p><b><u>Facilities Management</u></b> (Warehousing &amp; Distribution Centres)  Facility Design &amp; Layout  Implementation of Facilities Outsourcing  Facilities Operational Management</p> <p><b><u>Transport Management</u></b>  Bulk Logistics Management  Break Bulk Logistics Management  Dangerous Goods  Perishable Cargo  High Value Cargo  Marine Logistics  Pipeline Logistics  Out of Gauge or Abnormal Logistics  Rail Logistics  Road Logistics  Reverse Logistics Management  Import and Export Logistics  Developing Multi-Modal Solutions  Implementation of Transport Outsourcing  Fleet Management  Transport Operational Management  Logistics SHERQ (Safety, Health, Environmental, Risk and Quality)</p>

**Table 6.3: The supply chain competency model version 1 (continued)**

<b>Meta-Competency</b>	<b>Sub-Competency</b>
<b>Manage the Inbound Supply Chain</b>	<p><b><u>Procurement and Strategic Sourcing</u></b>  Strategic Sourcing  Spend &amp; Supply Demand Analysis  Reducing Total Cost of Ownership  Supplier Identification &amp; Qualification  RFX Process  Contract Management  Master Data Management  Supplier Performance Management</p> <p><b><u>Supply Demand Management</u></b>  Supply Demand Segmentation  Developing Supply Demand Fulfilment Strategy  Supply Demand Planning  Requirements Planning  Supply Order Execution Management</p> <p><b><u>Warehousing and Materials Management</u></b>  Network Design and Optimisation  Facility Design, Layout and Optimisation  Optimising Total Cost of Ownership  Implementation of Facilities Outsourcing  Facilities Operational Management  Reverse Logistics  Inventory Management</p>
<b>International Logistics</b>	International Trade Forwarding Airfreight Sea Freight Customs Insurance (Incoterms)
<b>Supply Chain Enablement &amp; Improvement</b>	Understanding Different Supply Chain Models Developing Supply Chain Management Strategies Business Process Optimisation in Supply Chain Management Compliance & Risk Management in Supply Chain Management Supply Chain Intelligence & Reporting Facilitate Organisational Learning and Development in Supply Chain Management Manage Own Learning and Development in Supply Chain Management Change Management Systems Technology Deployment Green Supply Chain Management

**Table 6.3: The supply chain competency model version 1 (continued)**

Meta-Competency	Sub-Competency
<b>Basic Concepts and Principles</b>	Introducing Supply Chain Management Understanding Supply Chain Processes Supply Chain Performance Management and Intelligence Risk Management in Supply Chain Management Supply Chain Collaboration and Partnerships Structuring Organisations for Supply Chain Management

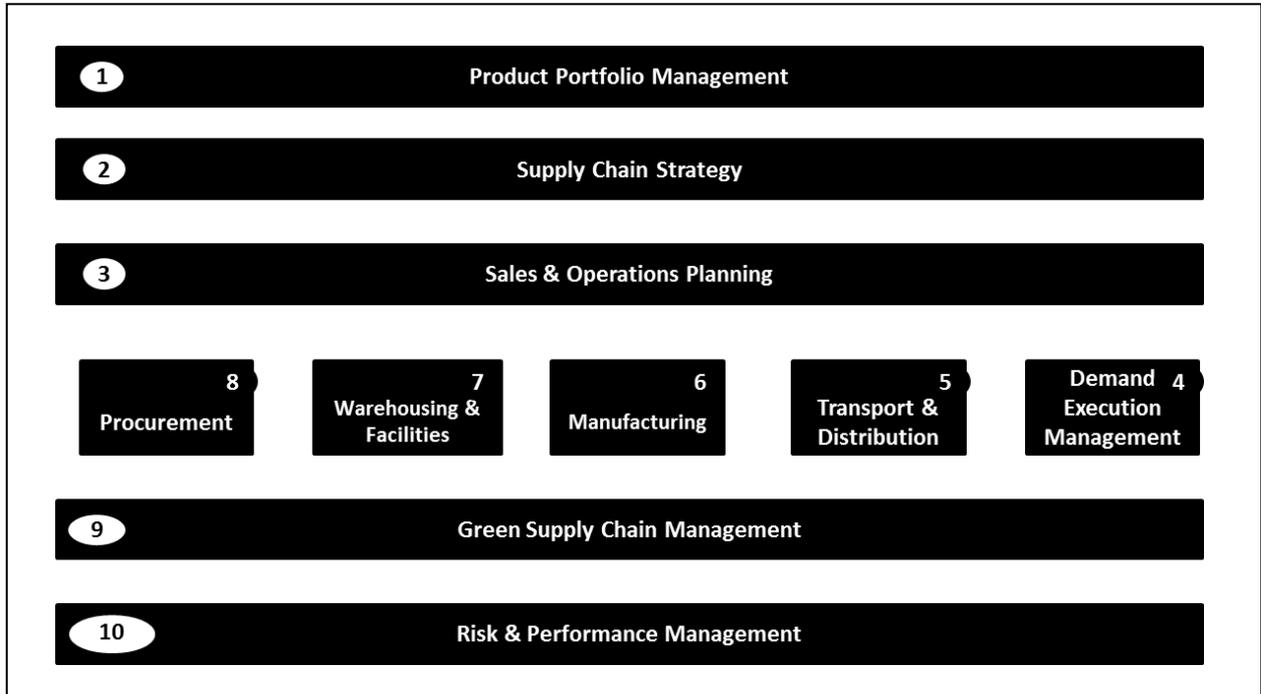
This first draft model was presented to a group of experts selected from the company based on their specialised expertise, in line with the approach explained in the research methodology. A group of six experts was used to evaluate the model. The focus of the evaluation was qualitative to create a first review of the model. No quantitative evaluation of the meta- or sub-competencies was done as the emphasis was primarily on a first evaluation of the structure and potential application of the model. This was done through a focus group discussion with all experts present and documenting their feedback on the model. The feedback is summarised as follows:

- The structure of the meta-competencies did not reflect the true nature of supply chain as the strategy elements were not visible enough;
- The broader supply chain role of meta-competencies such as having a strategic impact, cross-functional integration and tactical deployment was not positioned well enough;
- The number of sub-competencies was too large, with the result that the competency model would be difficult to apply as the measurement would take too long;
- Basic concepts did not warrant a meta-competency and should be integrated across the other meta-competencies;
- Product management needed to play a more important role in the model and should be elevated to a meta-competency as opposed to a sub-competency;
- The major focus on the green supply chain required more emphasis in the model on the green supply chain aspects;

Based on this feedback, a second version of the competency model was developed. This is outlined in the following section.

## 6.5. PHASE 4: DELPHI TESTING OF THE MODEL – ROUND 2

From the first draft model and the feedback from the first round of Delphi study, a second version of the supply chain competency model was developed which is depicted in Figure 6.3. The improved structuring and design logic that was followed is explained in the following section.



**Figure 6.3: The second version supply chain competency model**

The model followed a hierarchical design principle with three levels of competencies. Level 1 consists of ten meta-competencies which represent the core supply chain competencies. This is broken down into level 2, which identifies a further set of competencies.

The ten meta-competencies are:

- Product and portfolio management
- Supply chain strategy
- Sales and operations planning
- Demand execution management
- Transport and logistics
- Manufacturing
- Warehousing and facilities management
- Procurement
- Green supply chain management
- Performance, risk and governance, and improvement management.

These meta-competencies can be grouped into three types or groups of meta-competencies.

### **6.5.1. The integrative processes**

The integrative processes include:

- Product portfolio management
- Supply chain strategy
- Sales and operations planning.

The operating principles on which these integrative processes are based are the following:

- The product portfolio management is the link at the highest strategic level to the strategy of the business in terms of enabling the strategic marketing plan of the business through a combination of optimising the product portfolio as a first objective, and then integrating supply chain management with product development. This also addresses a major new trend of designing products for improved supply chain performance (adapted from Cravens, 2000; Trott, 2012).
- Supply chain strategy focuses on the implementation of the corporate strategy through the supply chain and includes all aspects of strategy, from demand strategy to sourcing strategy. The core focus is to achieve supply chain integration and optimisation at the strategic level. It also translates dynamic capabilities from business strategy into operational and process capabilities.
- The next layer of integration is converting strategic plans into tactical plans with sales and operations planning focusing on all aspects of tactical and operational planning. This is thus creating direction for operational execution.

In summary, the integrative processes include two strategic processes for converting business strategies and strategic marketing plans into supply chain strategies. This is then followed by a tactical and operational planning layer which converts strategies into operational plans for execution. These integrative layers of the competency model are consistent with the strategic elements and integrative layers identified in all the supply chain models reviewed.

### **6.5.2. The functional execution layer**

This focus of the operational execution layer is the execution of the tactical and operational planning which resulted from the previous layer. Execution elements include:

- Demand execution management
- Transport and distribution

- Manufacturing
- Warehousing and facilities
- Procurement.

The operating principles behind this layer can be summarised as follows:

- The focus of all these functional areas in this layer is execution of plans and strategies that were formulated at the previous layers.
- The competencies and sub-competencies included in this layer are thus all execution related and focus on operational processes such as order management and the execution activities of procurement.

### **6.5.3. The support and enablement layer**

This layer has three fundamental objectives: firstly, that of performance improvement; secondly, ensuring compliance and risk reduction; and thirdly, supply chain sustainability through green supply chain management. Performance management and improvement include all aspects related to this, such as performance metrics, improvement concepts, and improvement techniques. Sustainability and green supply chain are included in the model based on all the latest trends and research on future supply chain challenges. The enablement layer is an important implementation mechanism which ensures consistency with strategies and planning across the different functions.

### **6.5.4. Delphi testing round two**

The second round of Delphi testing was focused on external validation of the revised competency model. For this purpose, eleven external experts were chosen from different functional areas and across different industries, based on their expertise and experience. The different industries were in line with the industry segments in which the case-study company was competing. This is in line with the research strategy and the use of external experts in other published research as a means of achieving construct validity (Lewis *et al.*, 2005). During this round, the evaluation was quantitative. Two aspects were evaluated for each competency in the model. The relative importance was evaluated using a seven-point Likert scale and the role of each competency in the supply chain was evaluated by a selection from four different options, namely strategic integrative, tactical integrative, execution and enablement.

A questionnaire was sent out to each of the experts and their responses were captured upon the return. The traditional paper-based approach towards Delphi research was used. The questionnaire is included in Appendix 2. The results are summarised in Table 6.4.

Table 6.4: Delphi results

Competency	Summarised Definition	Average Score
<b>Meta-Competency 1. Product Portfolio Management:</b>		
<b>1.1 Product Development</b>	Influencing the product development process to improve supply chain performance during the life of the product	5.27
<b>1.2 Product Portfolio Management</b>	Optimising the portfolio of different products to reduce product complexity	5.45
<b>Meta-Competency 2. Supply Chain Strategy:</b>		
<b>2.1 The strategy formulation process</b>	The process of developing supply chain strategy	6.91
<b>2.2 Understanding different supply chains</b>	Understanding that different supply chains have different operating requirements	6.45
<b>2.3 Demand Management Strategy</b>	The strategy of selecting target markets, sales territories and service levels by market	5.91
<b>2.4 Developing demand fulfilment strategy</b>	Designing the supply chain to best serve the selected markets. This includes the network design.	6.18
<b>2.5 Strategic Sourcing</b>	Formulating sourcing strategies by product category and developing appropriate supplier strategies	6.00
<b>Meta-Competency 3. Sales &amp; Operations Planning:</b>		
<b>3.1 Demand Sensing</b>	Using various demand signals to capture real demand. This can include signals such as POS data	5.73
<b>3.2 Demand Planning</b>	Demand forecasting across the different products and sales regions	5.91
<b>3.3 Supply Planning</b>	Planning the fulfilment of demand from different sources of supply such as inventory, manufacturing and sourcing	5.91
<b>3.4 Demand – Supply Balancing</b>	Performing trade-offs to balance demand and supply levels	5.18
<b>3.5 Operations Scheduling</b>	Scheduling operations to execute supply plans	
<b>Meta-Competency 4. Demand Execution Management:</b>		
<b>4.1 Customer Relationship Management</b>	Establishing customer relationships for the purpose of achieving the demand plan	5.36
<b>4.2 Order Management</b>	Ensuring that demand plans are executed through managing order generation and delivering orders on hand	5.82
<b>5. Transport &amp; Distribution:</b>		
<b>5.1 International Logistics</b>		
<b>5.1.1 Global Supply Chain Integration</b>	Developing a global supply chain strategy across different trading zones and continents	6.09

**Table 6.4: Delphi results (continued)**

<b>Competency</b>	<b>Summarised Definition</b>	<b>Average Score</b>
<b>5.1.2 Developing global logistics strategies</b>	Develop global logistics solutions that can move products across the world	5.64
<b>5.1.3 Multi-Modal Solutions</b>	Integrating different modes of transport into a single transport solution	5.91
<b>5.1.4 Transport Operational Management</b>	Managing transport operations from order to final delivery.	6.00
<b>5.1.5 Reverse Logistics</b>	Managing product and packaging returns through a reverse logistics process	4.82
<b>5.1.6 Fleet Management</b>	Optimising the fleet of assets being deployed in the supply chain process	5.36
<b>5.2 Clearing &amp; Forwarding</b>		
<b>5.2.1 International Trade</b>	International trade regulations that control the flow of product and funds across different trading zones	6.18
<b>5.2.2 Clearing</b>	Clearing imports through the customs process which includes calculations of taxes and levies	5.27
<b>5.2.3 Forwarding</b>	Forwarding documentation and ownership based on customs rules	5.36
<b>5.2.4 Incoterms</b>	The terms that control the international movement of products	5.55
<b>5.2.5 Invoicing</b>	Invoicing customers for taxes and import levies related to imported products	4.64
<b>5.2.6 Disbursements</b>	Making payments of all costs, taxes and levies to the correct parties	4.73
<b>5.2.7 Foreign Exchange</b>	Handling of foreign exchange for imported products in terms of exchange rules	4.82
<b>5.2.8 Managing Transport Risk</b>	Managing all risks related to international transport of products. This includes aspects such HAZCHEM	5.45
<b>Meta-Competency 6. Make:</b>		
<b>6.1 Determine Manufacturing Strategy</b>	Determine which strategy between make-to-stock, make-to-order and engineer-to-order will be followed	6.09
<b>6.2 Product Design</b>	Product and packaging design which includes material specification	5.18
<b>6.3 Production Planning &amp; Scheduling</b>	Master production planning and detail scheduling	5.09
<b>6.4 Execution Management</b>	Managing the production execution process including quality management	5.45
<b>Meta-Competency 7. Warehouse &amp; Facility Management:</b>		
<b>7.1 Facility Design &amp; Layout</b>	Design the flow processes and infrastructure being used in facilities	5.73
<b>7.2 Facilities Operational Management</b>	Managing all operations within facilities, such as receiving, picking and despatch	5.09
<b>7.3 Inventory control</b>	Controlling all inventory to limit losses through shrinkage and damage	5.64

**Table 6.4: Delphi results (continued)**

Competency	Summarised Definition	Average Score
<b>7.4 Materials Handling</b>	Handling of different materials through the warehousing process to achieve risk compliance and achieve cost efficiency.	5.00
<b>Meta-Competency 8. Procure to Pay Process:</b>		
<b>8.1 Requisition to Pay Process</b>	Managing the sourcing execution process from order to delivery.	4.73
<b>Meta-Competency 9. Green Supply Chain Management:</b>		
<b>9.1 Supply chain sustainability</b>	Ensure sustainability through using alternative resources to operate the supply chain	5.09
<b>9.2 Environmental Management</b>	Limiting harmful effects of supply chain operations for the environment	4.82
<b>Meta-Competency 10. Risk &amp; Performance Management:</b>		
<b>10.1 Key Performance Indicators</b>	Using performance indicators across different levels to measure and improve performance	6.73
<b>10.2 Implementing Outsourcing</b>	Implementing outsourcing as a mechanism to improve performance of the supply chain	5.55
<b>10.3 Contract Management</b>	Managing contract compliance for all types of supplier contracts	5.09
<b>10.4 Cost Management</b>	Cost modelling of the supply chain to reduce the overall cost of operations. This includes concepts such as activity-based costing and TCO	6.00
<b>10.5 Process Optimisation</b>	Improving the performance of supply chain processes through process improvement techniques	5.82
<b>10.6 Improvement Concepts</b>	Improvements concepts such as JIT, LEAN to improve supply chain performance	5.36
<b>10.7 Systems &amp; Technology Implementation</b>	Using systems and technology to enable supply chain processes and functions	5.36
<b>10.8 Change Management</b>	Implementing transitions through change management interventions	5.09
<b>10.9 Risk and Compliance Management</b>	Managing supply chain risks and ensuring compliance to risk procedures	5.64

From the results in Table 6.4, the second version of the supply chain competency model could be confirmed in terms of the different elements. The lowest score that any competency received was 4.72, which confirms a level of agreement between the experts. The goal of this round was primarily to come to a greater consensus in the group. At the end of this round, the degree of consensus between the experts was measured using Kendall's W coefficient (Schmidt, 1997;

Siegel, 1988), specifically for the question on the minimum baseline. Schmidt (1997) offers an interpretation of Kendall's *W*, indicating that the reached level of consensus in this research of 0.72 can be considered acceptable, providing a high degree of confidence in the results. Based on this confirmation, the competency model was further developed by adding the theoretical definitions and foundations.

## **6.6. A MORE DETAILED OUTLINE OF THE COMPETENCY MODEL**

The individual competencies and their definition are outlined in the following section.

### **6.6.1. Meta-competency 1: Product and portfolio management**

The meta-competency is defined as follows:

Product and portfolio management is focused on improving supply chain performance through the early involvement in the product design process to ensure that product design is influenced to generate cost savings during the life cycle of a product. Portfolio management focuses on creating a balance between the revenue generation of each product and the associated supply chain costs (adapted from Trott, 2012; Cravens, 2000 & Council for Professional Supply Chain Management, 2010).

Product and portfolio management consist of two competencies, namely product development and managing the product portfolio.

#### **Product development**

Product development includes aspects such as design of products, not only to optimise the product, but also to optimise the supply chain cost during the life cycle of products. Product development can be organised into five basic management processes (plan, research, design, integrate, and amend) that provide the organisational structure of the DCOR model. It is useful to distinguish between the three process types in the model: planning, execution and enable. A planning element is a process that aligns expected resources to meet expected design requirements. Planning processes balance aggregated demand across a consistent planning horizon. Planning processes generally occur at regular intervals and can contribute to design chain response time. Execution processes are triggered by planned or actual demand that changes the state of products. They include scheduling and sequencing, researching and design, materials and integrating product, and amend. Enable processes prepare, maintain, and manage information or relationships upon which planning and execution processes rely (adapted from Trott, 2012; Cravens, 2000; Council for Professional Supply Chain Management, 2010 & Supply Chain Council, 2014).

## **Managing the product portfolio**

Portfolio management focuses on the alignment between optimising the product portfolio and supply chain performance. Aspects such as design of products to not only optimise the product but also optimise the supply chain cost during the life cycle of products are addressed. Product profitability and the contribution towards supply chain complexity are considered (adapted from Trott, 2012; Cravens, 2000 & Council for Professional Supply Chain Management, 2010).

### **6.6.2. Meta-competency 2: Supply chain strategy**

The meta-competency is defined as follows:

Supply chain strategy focuses on developing a strategy which integrates the different areas of supply chain, such as demand strategies, optimising the network through appropriate fulfilment strategies and strategic sourcing to maximise the synergies with suppliers. Strategic alignment between the supply chain strategy and the corporate strategy is critical (adapted from Fawcett, Ellram & Ogden, 2007 and Ballou, 2004).

## **The process of developing a supply chain strategy**

Reviewing an existing or developing a new supply chain strategy involves the integration of different elements of supply chain, such as demand strategy, demand fulfilment, sourcing strategy and supply chain planning, to form an integrated coherent supply chain that can deliver the required business results. Alignment with business strategy and other functional strategies such as marketing and manufacturing is also required (adapted from Gattorna, 2006).

## **Understanding different types of supply chains**

The identification of different supply chain models and the understanding of the difference in functioning between the different models is the focus of this competency. The emphasis is on the different performance objectives, different configurations required, the process requirements and how technology enablement will differ across different models (adapted from Gattorna, 2006).

## **Demand management strategy**

Demand management strategy development is the process of analysing the key trends and dynamics in the industries and markets. The objective of this analysis is to identify cost trends, technology trends, potential structural changes in the market and risk factors. This analysis will provide direction for the design of supply chain strategies. Demand sensing and changing of demand patterns are also included in this process (adapted from Crum & Palmatier, 2003; Langley, Coyle, Gibson, Novack & Bardi, 2008).

## **Developing demand fulfilment strategy**

The supply chain network includes all facilities in the inbound and outbound supply chain such as sources of supply and facilities, distribution centres, production facilities, tank depots, customer

facilities, transport routes and modes, and the inventory at the different inventory holding points across the network. The design and optimisation of the network is focused on achieving the best performance by optimising cost, customer service and inventory, given the network constraints (adapted from Gattorna, 2006; Fawcett *et al.*, 2007).

### **Strategic sourcing**

The process of commodity management focuses on the creation of a focused approach that manages procurement commodity groups from a consolidated perspective through the application of a unique management approach for each commodity group. The objective of the approach is to achieve the optimal total cost of ownership (TCO) for each commodity or commodity group at acceptable levels of supply risk (adapted from Handfield, Monczka, Giunipero; Patterson, 2009).

#### **6.6.3. Meta-competency 3: Sales and operations planning**

Sales and operations planning is the process of developing a demand plan for customer demand and then translating that into a supply plan that incorporates all the elements of supply across the different functions, from distribution to procurement. The objective is to balance supply and demand with taking profitability and the business plan into account (adapted from Seifert, 2003).

### **Demand sensing and shaping**

Demand sensing and shaping is defined as the process of developing an understanding of the factors that determine the true demand patterns of customers. This understanding is then used to implement strategies that influence or shape the demand pattern to improve the profitability of fulfilling that demand pattern (adapted from Friscia *et al.*, 2009).

### **Demand planning**

Demand planning is defined as the process of identifying, aggregating, and prioritising all sources of demand for the integrated supply chain of a product or service at the appropriate level, horizon and interval. The sales forecast comprises the following concepts: sales forecasting level, time horizon and time interval. The sales forecasting level is the focal point in the corporate hierarchy, where the forecast is needed at the most generic levels, namely corporate forecast, divisional forecast, product line forecast, stock keeping unit (SKU), and SKU by location (adapted from Crum & Palmatier, 2003).

### **Supply planning**

Supply planning is defined as the process of identifying, prioritising and aggregating, as a whole with constituent parts, all sources of supply that are required and add value in the supply chain of a product or service at the appropriate level, horizon and interval (adapted from Wisner, Tan & Leong, 2008). It includes the following planning elements:

- Inventory planning
- Distribution requirements planning
- Production planning
- Source planning
- Materials requirements planning.

### **Demand and supply balancing**

This is the process of identifying and measuring the gaps and imbalances between demand and resources in order to determine how to best resolve the variances through marketing, pricing, packaging, warehousing, outsource plans or some other action that will optimise service, flexibility, costs, and assets (or other supply chain inconsistencies) in an iterative and collaborative environment. It is the process of developing a time-phased course of action that commits supply chain resources to meet constraint-based supply chain requirements. This process includes the formalisation of the sales and operations plan through the sales and operations meeting (adapted from Crum & Palmatier; Ptak, 2000).

### **Operational scheduling**

Operations scheduling is the process to determine the optimal sequencing (schedule), allocation and routing of production orders guided by the production and supply plan and based on detailed product attributes, changeover requirements, customer order due dates, work centre capability, labour required, and other constraints (adapted from Schonberger & Knod, 1994).

#### **6.6.4. Meta-competency 4: Demand execution management**

Demand execution management focuses on the execution of demand strategies that require the implementation of different product offerings across different customer segments. The process not only involves the development and maintenance of customer relationships but also manages the receipt of and execution of customer orders (Ptak, 2000).

### **Customer relationship management**

Customer relationship management is the process of implementing demand or market strategies. It involves the implementation of different product offerings and customer service strategies in line with market and customer segmentation strategies. Establishing relationships with new customers and managing relationships with existing customers are included in the process. This process needs to be aligned with the sales process and calling cycles of the sales team (adapted from Peppers & Rogers, 2004).

### **Order management**

Order management involves the development, implementation and improvement of the process from allocation of inventory or production capacity and delivery up to invoicing the customer. This

includes translating the sales and operations plan into sales allocation planning, managing the inflow of orders, prioritisation of the orders for distribution, liaison with transport/distribution and ensuring despatch in line with priorities and allocations. The process will also include available to promise (ATP) and capable to promise (CTP) business rules and facilitates removal of credit or distribution blocks and re-routing/diversions (adapted from Ptak, 2000, Ballou, 2004; Langley *et al.*, 2008).

#### **6.6.5. Meta-competency 5: Transport & Logistics**

International logistics plays an important role in international supply chain management to achieve a cost-efficient and synchronised supply chain. The focus is placed on operational aspects such as conformance to documentary and legal requirements, but also on the strategic integration of the supply chain (adapted from Lambert, Stock & Ellram, 1998).

#### **Strategic integration of international logistics**

- **International logistics strategies**

International logistics strategies focus on the development of multi-modal transport solutions which combine different modes of transport into an integrated strategy for international logistics. The management and improvement of an international logistics network of agencies and service providers also forms part of the competency (adapted from Lambert *et al.*, 1998; Pienaar & Vogt, 2009).

- **Strategic supply chain integration of international logistics**

This involves the integration of international logistics with supply chain strategies to ensure a cost-effective and synchronised supply chain. The selection and combination of different transport modes and the integration of that with other elements such as warehousing and inventory levels will be of key importance to ensure a synchronised supply chain. The creation of supply chain visibility across multiple participants is a key element of this competency (adapted from Lambert *et al.*, 1998; Pienaar & Vogt, 2009).

#### **International logistics: Operations**

International logistics operations focus on the operational aspects of international logistics such as required documentation, operational procedures, quantification of the financial aspects and adherence to legal requirements.

- **International trade**

Demonstrate an understanding of interrelationships between the role players, infrastructure and regulatory framework through which international trade is conducted.

- **Clearing**

Administer international cargo logistics in conformity with client requirements and statutory compliance including the international movement of cargo by all modes.

- **Forwarding**

Carry out customs clearance and related procedures which are required for compliance with the statutory requirements of importing and exporting.

- **Incoterms**

Perform the process of estimating costs for client shipments for all modes, ranging from routine to complex, multimodal and capital projects.

- **Invoicing**

Manage the invoicing process from the point of raising the invoice to the assessment and reporting on client profitability.

- **Disbursements**

Manage the disbursement process including allocation and reconciliation.

- **Foreign exchange**

Manage the risk related to the purchase and sale of foreign exchange.

- **Managing transport risk**

Manage transport risk on behalf of importers and exporters, taking cognisance of the passing of risks under the Incoterms.

Transport and distribution involve the process of physical delivering of customer orders. The objective is to achieve customer service requirements but also to optimise the cost of delivery. This involves the development of distribution routes, vehicle selection and the operational management of day-to-day delivery activities (adapted from Gubbins, 2008; Tompkins & Harmelink, 1994).

### **Developing multi-modal solutions**

The process of developing multi-modal solutions starts with a thorough understanding of the transport requirements in terms of constraints, volumes, distances, routes and the functioning of the distribution network. An in-depth knowledge of the different transport modes of road, rail, marine, pipeline and airfreight is also required. An integrated multi-modal transport solution will combine the different transport modes into a solution that provides the required service levels at

the most cost-effective level (adapted from Ballou, 2004, Tompkins & Harmelink, 1994; Gubbins, 2008).

### **Fleet management**

Fleet management involves the end-to-end process of managing an internal or own transport fleet. This process starts with the development of fleet requirements based on the transport or distribution requirements. This will be followed by the selection of the best-suited transport fleet which would include selection of vehicles, trailers and other equipment that might be required in the transport process. Financing the fleet needs to be arranged in terms of the best approach from options such as full maintenance leasing and others. Once the fleet is operational, asset management is required, which manages the process of maintaining the fleet, scheduling services and repairs, cost accounting of all costs and the eventual replacement of the fleet (adapted from Tompkins & Harmelink, 1994) .

### **Transport operational management**

Transport operational management focuses on the process of moving cargo from the distribution requirements planning, load planning, route planning, vehicle scheduling to the assurance of quantity and quality. Tracking vehicles and cargo during the process of transport will be required to ensure on-time delivery, contingency planning if required and the safety and security of cargo. The process will be ended with the processing of PODs and managing the payment of transport service providers. Liaison with all stakeholders during the process of transport needs to provide visibility to all of the progress against scheduled delivery times. Key performance indicators such as vehicle utilisation, transport costs and customer service levels need to be optimised while complying with risk and governance requirements, including legislation (adapted from Ballou, 2004 and Tompkins & Harmelink, 1994).

### **Reverse logistics management**

Reverse logistics refers to the management of the movement involved in the return of products or empty containers from downstream customers to upstream operations for either rework or re-use in the production of new products. Planning the collection of such products needs to be synchronised with the distribution and transport processes. This includes disposal of products (adapted from Langley *et al.*, 2008).

#### **6.6.6. Meta-competency 6: Make**

Make as a Meta competency provides the link between the make element from the SCOR model and the rest of supply chain. In this context the make competency is extended to include elements of product design, production scheduling and execution management. The focus is to integrate this

activity in the supply chain into a seamless process. (adapted from SCOR 11, Langley et al, 2009, Process Standards Council for Professional Supply Chain Management, 2010, Trott 2012, and Jacobs, Berry, Whybark & Vollman, 2011)

### **Determine manufacturing strategy**

Manufacturing strategy is an integral part of an overall demand fulfillment design where options such as make-to-stock, make-to-order and assemble-to-order need to be combined with fulfillment design options such as managing complexity, achieving flexibility and balancing time to market at the most competitive cost and speed. Collaboration and global sourcing are key elements that needs to be taken into account in formulating a manufacturing strategy (Jacobs et al, 2011 & Gattorna, 2015).

### **Product design**

The activities included in the product design process is based on the DCOR model (Supply chain Council, 2011) but it also is integrated with the concepts of the “Dynamic Supply Chain” (Gattorna, 2015). A central theme from modern supply chain management is how to deal with the ever increasing demands from the supply chain. The product design competency also includes new thinking of product design for more efficient supply chain performance.

### **Production planning & scheduling**

Production planning is focused on translating demand planning into a manufacturing planning and control framework that can deliver on the demand in the most cost effective way. Master production planning and capacity planning is integrated with a fulfillment approach which is a combination of make-to-order, assemble-to-order and make-to-stock (Jacobs, et al., 2011).

### **Execution management**

Execution management focus on day-today delivery of the integrated resource plan to ensure that the master production schedule is delivered. Order management, re-planning and trade-off analysis forms part of this process. Visibility of the complete supply chain process is of key importance to be able to respond in near real time to deviation from the plan (Jacobs, et al., 2011).

#### **6.6.7. Meta-competency 7: Warehousing and facilities management**

Warehousing and facilities management focuses on the physical management of warehouses and facilities. This involves mainly the design and management of the facility itself and all the equipment in it, and secondly the product flows through the warehouses and facilities (adapted from Bowersox *et al.*, 1999).

### **Facility design and layout**

Facility design and layout focus firstly on the design and layout of the facility/building, which includes the size and configuration of the building/facility. The second element includes the design of the operational flow of material or product and selection of material handling equipment such as racking, forklifts and any other special equipment required. The objective is to maximise the productivity of the facility while achieving risk management, health and safety objectives through governance policies, procedures and legislation (adapted from Langley *et al.*, 2008; Tompkins & Harmelink, 1994).

### **Facilities operational management**

Facilities operational management focuses on achieving daily throughput targets while maintaining productivity, health and safety and risk management objectives. Operational activities include receiving, put-away, blending, picking, pre-loading, loading, returns, documentation and administration. Included in facilities operational management are physical inventory management and control, and housekeeping (adapted from Langley *et al.*, 2008; Tompkins & Harmelink, 1994).

### **Inventory control**

The process of inventory control is focused on controlling inventory or stock in warehouses or facilities. The activities involved are receiving of products into a warehouse or facility, putting away these products and issuing these products for customer orders or transfer to other warehouses or facilities. The key objective is to achieve inventory accuracy, which means that the inventory in the facilities is physically accurate in terms of what should be there based on the transactional processes (adapted from Ballou, 2004; Langley *et al.*, 2008).

### **Materials handling**

Materials handling focuses on ensuring that during the supply chain process products are handled with safe and productive mechanisms to limit the associated risks and avoid product damage. This involves the selection of appropriate material packaging, handling equipment and techniques for different products through the different stages of product handling (adapted from Tompkins & Harmelink, 1994; Ballou, 2004).

#### **6.6.8. Meta-competency 8: Procurement**

Procurement execution focuses on the implementation of the strategies formulated in strategic sourcing. The requisition-to-pay process involves all aspects related to ordering of material and equipment from suppliers to the final payment of suppliers (adapted from Handfield *et al.*, 2009; Burt, Petcavage & Pinkerton, 2010).

### **Requisition to pay process**

This involves the development, implementation and improvement of the process from the planning of sourcing orders based on a demand plan, through delivery up to supplier payment. It includes translating the operations plan into a sourcing plan with planned orders on suppliers, managing the placement of orders, prioritisation of the orders for delivery, liaison with transport/distribution to ensure delivery is in line with priorities and customer service commitments. The process will also include the formulation of business rules and constant co-ordination with stakeholders to resolve changes in planning if required (adapted from Handfield *et al.*, 2009).

#### **6.6.9. Meta-competency 9: Green supply chain management**

Green supply chain management focuses on the creation of a sustainable supply chain within a sustainable environment. To ensure sustainability, all potentially harmful effects need to be avoided.

### **Sustainability**

Supply chain sustainability focuses on the implementation of principles and strategies that ensure the long-term sustainability of the supply chain. Aspects included are renewable energy, creating energy savings and various others. It is important that supply chain sustainability initiatives should be aligned with corporate initiatives (adapted from Mutingi, 2013; Seuring & Müller, 2008).

### **Environmental management**

Environmental management within supply chain focuses on how the supply chain interfaces with the environment. The objective is to avoid any harmful effects that the supply chain might have on the environment. The process involves the identification of potential harmful effects, and the formulation of actions to avoid them (adapted from Mutingi, 2013; Seuring & Müller, 2008).

#### **6.6.10. Meta-competency 10: Performance management**

Performance management focuses on the quantification of supply chain performance at different levels to create visibility of performance. Once performance is quantified, improvement plans need to be formulated for the different areas of improvement. Supply chain performance includes aspects of performance such as reliability, responsiveness, agility, costs and asset efficiency (adapted from Supply Chain Council, 2014). This process involves not only suppliers and service providers but also the implementation of enabling technology (adapted from Bowersox *et al.*, 1999). Performance management includes the following competencies:

### **Key performance indicators**

Supply chain performance indicators include two aspects, namely performance attributes and performance metrics. A performance attribute is a grouping of indicators used to express a specific

strategy, while a performance metric is a standard for measurement of the performance of a supply chain or process. The performance attributes include:

- Reliability: the predictability of the outcome of a process
- Responsiveness: the speed at which tasks are performed
- Agility: the ability to respond to external influences
- Cost: the cost of operating a process, including all aspects of costs expressed as total costs to serve
- Assets: the ability to efficiently utilise assets, which include both fixed and variable assets.

Supply chain performance metrics are defined at different levels based on the composition of the relevant supply chain process. Performance metrics are aligned with performance attributes and provide cause-and-effect measurements at three levels to enable performance measurement to a detail or activity level. Table 6.5 illustrates the alignment of performance metrics with performance attributes.

**Table 6.5: Alignment of performance attributes with performance metrics**

Performance attribute	Performance metric
Reliability	Perfect order fulfilment
Responsiveness	Order fulfilment cycle time
Agility	Upside flexibility
	Upside adaptability
	Downside adaptability
	Overall value at risk
Cost	Total cost to serve
Asset management efficiency	Cash-to-cash cycle time
	Return on fixed assets
	Return on working capital

Source: Adapted from Supply Chain Council, 2014.

### **Implementation of outsourcing (all areas of outsourcing)**

Facilities outsourcing involves the process of using external facilities providers to fulfil facilities requirements. This will involve the in-depth understanding of the facilities requirement, the development of RFQ documentation, identification of potential service providers, requesting proposals, evaluation of proposals and the selection of the provider best suited for the requirement. Contract implementation will require the contracting process to be completed, followed by contract

management based on a service level agreement to ensure the required performance from both parties (adapted from Fawcett *et al.*, 2007; Burt *et al.*, 2010).

### **Business process optimisation in supply chain management**

This involves ensuring continuous improvement of business performance across the supply chain performance improvement. This would include assessment of current performance across and between all areas of supply chain, for example supply chain planning, outbound strategy, procurement strategy, demand fulfilment, facilities and transport management. Assessment will be followed by identification of improvement strategies, process development, master data planning, implementation plans and the actual implementation (adapted from Handfield & Nicols, 2002; Fawcett *et al.*, 2007).

### **Supply chain improvement concept and best practices**

For improving supply chain performance, it is important to have a good understanding of the improvement concepts that underline supply chain performance. These concepts need to be implemented as part of a process of performance improvement (adapted from Frazelle, 2002).

### **Change management and structuring**

This is the process of aligning people with different views and perspectives to create a shared vision in terms of supply chain strategy and direction. To achieve this, resistance to change needs to be addressed through change management interventions with communication mechanisms, dealing with obstacles in the process of managing different stakeholders representing different groups with different objectives (adapted from Gattorna, 1998; Ballou, 2004).

### **Systems and technology deployment**

This is the process of selecting and implementing different types of systems technology to enable outbound supply chain processes and operations for the purpose of performance improvement. This would include the identification of improvement opportunities, understanding the different types of system technologies available, how to assess the functionality of different technologies, integrating these system technologies into technology architecture and the formulation of an implementation plan to ensure the successful implementation of such system technologies (adapted from Gattorna, 1998; Langley *et al.*, 2008).

### **Contract management (all areas, including supplier performance management)**

This is the process of supplier performance management focused on establishing relationships with selected suppliers, achieving integration, supplier performance measurement for the purpose of achieving supplier performance and supplier development where required, taking into account industry-specific legislative requirements (Handfield *et al.*, 2009).

### **Supply chain cost management including total cost of ownership**

Reducing total cost of ownership is a process of analysing the total cost, direct and indirect cost of a procured item over its life cycle, with the objective of reducing the total cost of ownership over the life cycle of the product (adapted from Burt *et al.*, 2010).

### **Compliance and risk management in supply chain management**

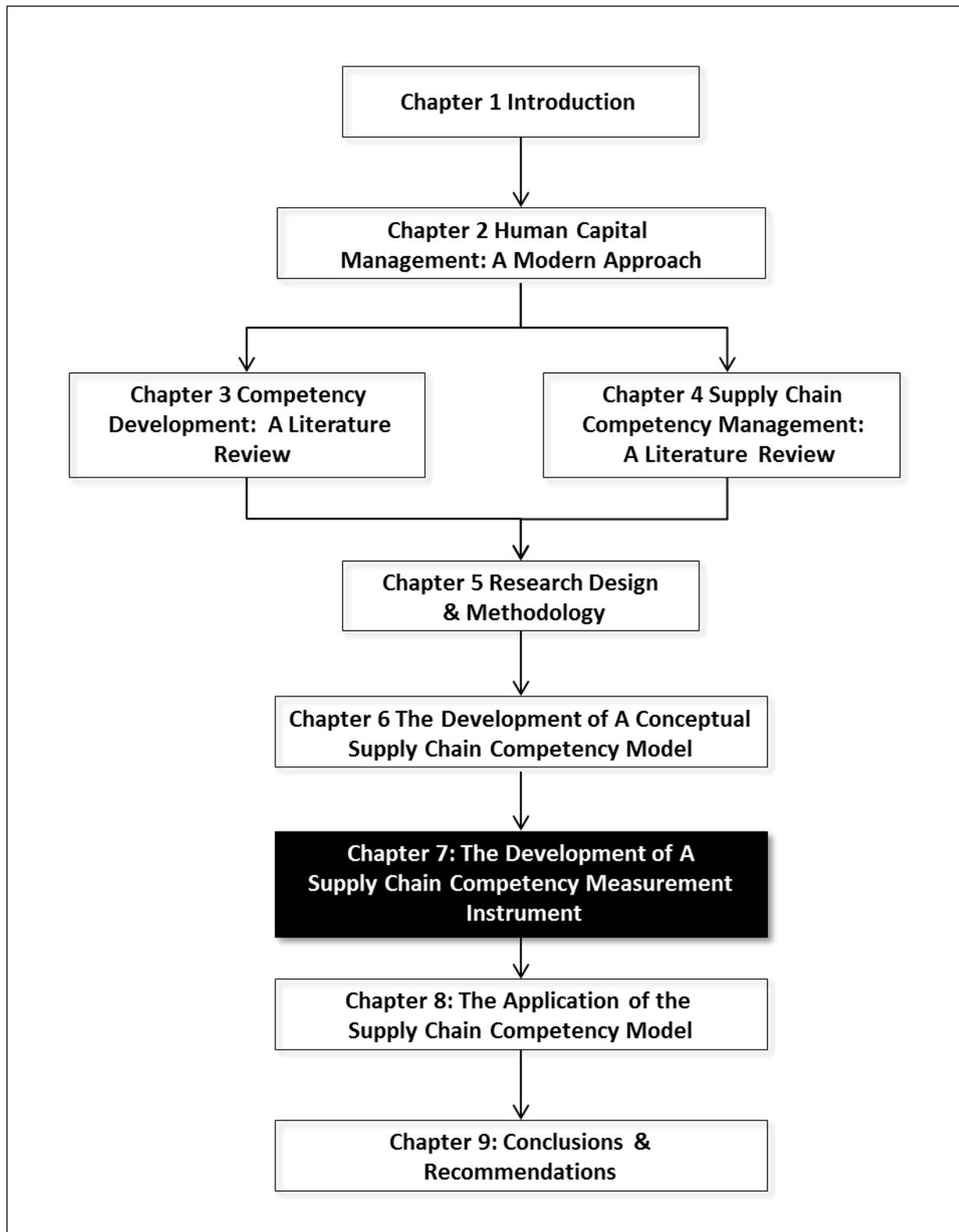
This involves the development of business rules, policies, procedures and controls to ensure the required governance and legislation during the creation, implementation and maintenance of supply chain strategies and processes. The objective is to ensure adherence to business rules at all times with the purpose of achieving consistent operational activities, mitigating supply chain risks and ensuring that the required contingencies are in place (adapted from Manuj & Mentzer, 2008; Bowersox *et al.*, 1999).

## **6.7. CONCLUSION**

Phases one to four of the development process were completed in this chapter. The objective was to develop a conceptual model for supply competency and test the model through two phases of Delphi research. With the conceptual model verified, the next chapter will deal with the next phases, which focus on the development of competency assessment.

## CHAPTER 7

### THE DEVELOPMENT OF A SUPPLY CHAIN COMPETENCY MEASUREMENT INSTRUMENT



## **7.1. INTRODUCTION**

The development of a conceptual supply chain competency model was described in the previous chapter. The application of the supply chain competency model requires the capability to measure competency. A competency model without measurement capability is only a theoretical exercise. The purpose of this chapter is the further development of the competency model from the previous chapter by adding measurement capability. The chapter is divided into two sections: the first deals with the discussion of a model on which the levels of proficiency are based, and the second, the development of the levels of proficiency.

## **7.2. THE REQUIREMENT FOR LEVELS OF PROFICIENCY**

With the application of a competency model for assessing competency, certain challenges need to be provided for:

- The group of job incumbents that the model needs to apply to is likely to be diverse due to a number of different jobs or positions.
- Each job or position might require a different combination of competencies to successfully perform in that job.
- Different jobs might require the same competencies but at different levels of development.
- When the competency model is applied to different companies, the competency requirements for the same job or position might be different.

A key requirement for the application of a competency model is thus linking competencies to the different job profiles and providing for different levels of development of the same competency. Unless this differentiation is developed, the ideal of using a single competency model across diverse positions or companies is not viable. A competency model can therefore not be applied to a variety of different supply positions without the development of different proficiency levels or a competency continuum.

The objective of this section is to explain the theoretical model that provides the basis for the development of the levels of proficiency. A theoretical basis was developed to serve as a point of departure for the development of a competency continuum.

## **7.3. FOUNDATION**

The foundation for the development of a competency continuum is the fact that different positions or jobs in the supply chain require different levels of proficiency of the same competency to perform a specific job function. In terms of this application, different levels of competency are based on different levels of cognitive functioning in terms of that competency. The foundation of a

competency continuum is therefore based on different levels of learning and application. A theoretical foundation for the development of different levels of supply chain competency should thus be found in the learning and development theory. The theory most applied to better understand learning and development is that of Bloom, which was used as the basis in this study.

#### **7.4. AN OVERVIEW OF BLOOM'S TAXONOMY: THE ORIGINAL MODEL**

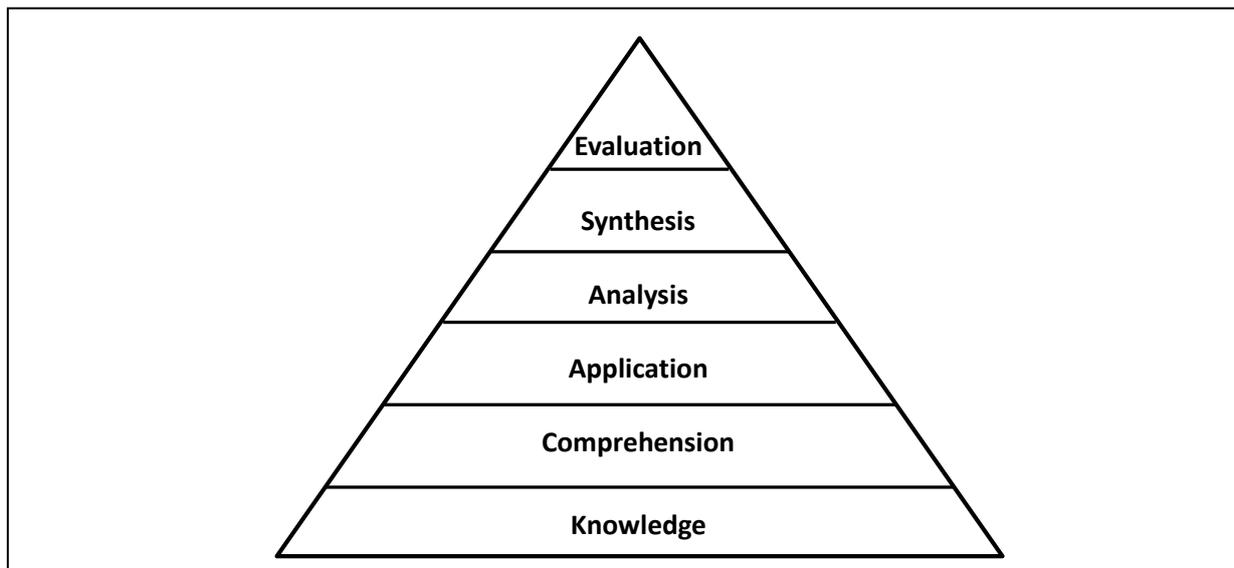
The most popular model for explaining different levels of learning and development is the model of Benjamin Bloom (Bloom, Engelhart, Furst, Hill & Krathwohl, 1956), which identified three domains of educational activities:

- Cognitive: mental skills (*knowledge*)
- Affective: growth in feelings or emotional areas (*attitude*)
- Psychomotor: manual or physical skills (*skills*).

A further exploration divides the three domains into subdivisions, starting from the simplest behaviour to the most complex. The divisions outlined are not absolutes, and other systems or hierarchies have been devised in the educational and training world. However, Bloom's taxonomy is easily understood and is probably the most widely applied one in use today (Florida International University, 2014).

Bloom's taxonomy is a multi-tiered model of classifying thinking according to six cognitive levels of complexity. The lowest three levels are knowledge, comprehension and application. The highest three levels are analysis, synthesis and evaluation. The taxonomy is hierarchical, in that each level is subsumed by the higher levels. In other words, a job incumbent functioning at the "application" level has also mastered the material at the "knowledge" and "comprehension" levels. One can easily see how this arrangement led to natural divisions of lower and higher level thinking (Florida International University, 2014).

The cognitive domain involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. There are six major categories, starting from the simplest behaviour to the most complex. The categories can be thought of as degrees of difficulties, that is, the first one must be mastered before the next one can take place. The different levels are illustrated in Figure 7.1.



**Figure 7.1: The cognitive domain of the Bloom taxonomy**

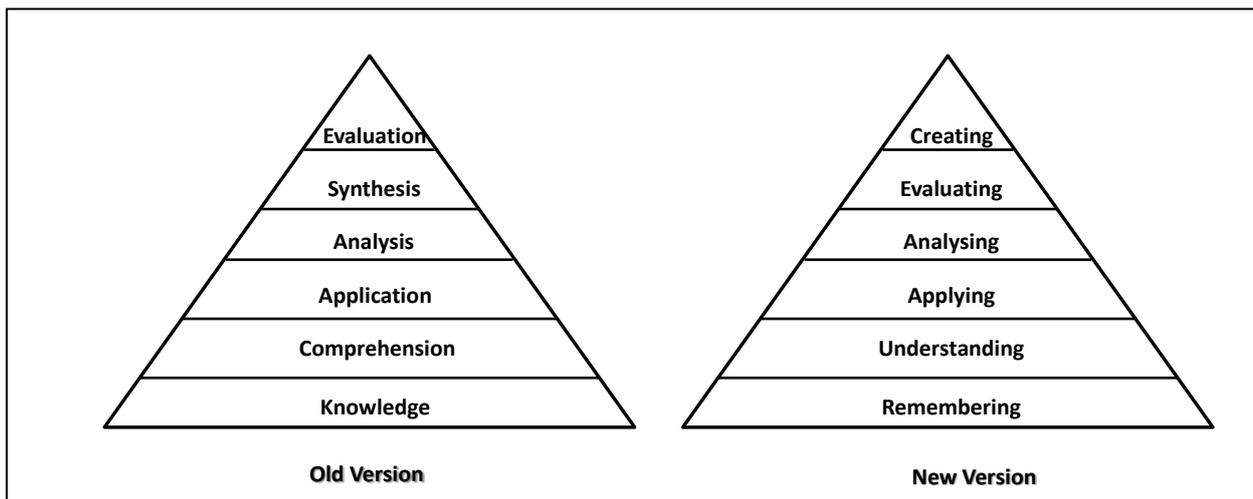
Source: Florida International University, 2014.

As the focus of the application to the competency model is on the cognitive domain, the other domains will not be analysed in any detail.

### **7.5. REVISED BLOOM'S TAXONOMY**

During the 1990s, a revised model was developed and then published in 2001. The revision includes several seemingly minor yet actually quite significant changes. Changes in terminology between the two versions are perhaps the most obvious differences and could cause the most confusion. Basically, Bloom's six major categories were changed from noun to verb forms. Additionally, the lowest level of the original, knowledge, was renamed and became remembering. Finally, comprehension and synthesis were re-titled to understanding and creating (Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths & Wittrock, 2000). In an effort to minimise the confusion, a comparison between the two models is outlined in Figure 7.2.

Bloom's original cognitive taxonomy was a one-dimensional form. With the addition of products, the revised Bloom's taxonomy takes the form of a two-dimensional table. One of the dimensions identifies the knowledge dimension (or the kind of knowledge to be learned), while the second identifies the cognitive process dimension (or the process used to learn). These changes are outlined in the Table 7.1.



**Figure 7.2: The revised Bloom taxonomy**

Source: Florida International University, 2014.

**Table 7.1: Bloom's revised taxonomy**

The knowledge dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual knowledge	List	Summarise	Classify	Order	Rank	Combine
Conceptual knowledge	Describe	Interpret	Experiment	Explain	Assess	Plan
Procedural knowledge	Tabulate	Predict	Calculate	Differentiate	Conclude	Compose
Meta-cognitive knowledge	Appropriate use	Execute	Construct	Achieve	Apply	Actualise

Source: Florida International University, 2014.

In order to operationalise this concept into a proficiency model, each of the blocks in Table 7.1 is explained in more detail in the following section.

**7.5.1. The knowledge dimension (vertical axis)**

The knowledge domain includes the following dimensions of knowledge from basic levels to more advanced levels.

### Level 1: Factual knowledge

The factual dimension is summarised as follows:

<b>Factual knowledge:</b> The basic elements job incumbents must know to be acquainted with a discipline or solve problems in it.	
<b>Knowledge of terminology:</b>	Technical vocabulary
<b>Knowledge of specific details and elements:</b>	Major natural resources, reliable sources of information

### Level 2: Conceptual knowledge

The conceptual dimension is summarised as follows:

<b>Conceptual knowledge:</b> The interrelationships among the basic elements within a larger structure that enables them to function together	
<b>Knowledge of classifications and categories :</b>	Periods of geologic time
<b>Knowledge of principles and generalisations :</b>	Pythagorean theorem, law of supply and demand
<b>Knowledge of theories:</b>	Models and structures: theory of evolution, structure of congress

### Level 3: Procedural knowledge

The procedural dimension is summarised as follows:

<b>Procedural knowledge:</b> How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.	
<b>Knowledge of subject-specific skills and algorithms:</b>	Painting with watercolours, whole-number division
<b>Knowledge of subject-specific techniques and methods:</b>	Interviewing techniques, scientific method
<b>Knowledge of criteria for determining when to use appropriate procedures:</b>	When to apply Newton's second law, when to use a particular method of estimation

### Level 4: Meta-cognitive knowledge

The meta-cognitive dimension is summarised as follows:

<b>Meta-cognitive knowledge:</b> Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.	
<b>Strategic knowledge:</b>	Outlining as a means of capturing the structure of a unit of subject matter in a textbook
<b>Cognitive tasks:</b>	Knowledge of the different types of tests, cognitive demands of different tasks
<b>Self-knowledge:</b>	Knowledge that critiquing essays is a personal strength, whereas writing essays is a personal weakness; awareness of one's own knowledge level

Source: Florida International University, 2014.

These categories can be used to categorise the knowledge domain into different levels of advancement, with factual knowledge as the basic level and meta-cognitive knowledge as the most advanced level.

### 7.5.2. The cognitive process dimension (horizontal axis)

The cognitive dimension can be further broken down into the following:

#### Level 1: Remember

The first level of the cognitive domain of remember is summarised in the following table:

<b>Remember means the following:</b>	
<b>Remember:</b>	Retrieve relevant knowledge from long-term memory.
<b>Recognising:</b>	Recognise the dates of important events in history.
<b>Recalling:</b>	Recall the dates of important events in history.
The actions required to demonstrate this are:	
<b>List:</b>	To identify the names, professional identities, and ideas of two or three of the major western sexologists
<b>Describe:</b>	Describe the history (and pre-history) of wild land fire
<b>Tabulate:</b>	Students will be able to demonstrate knowledge of each step a bill takes on its way through the legislative system.
<b>Appropriate use of terms:</b>	Use the Science of Foods terminology in relation to discussing foods or food products

#### Level 2: Understand

The second level of the cognitive domain of remember is summarised in the following table:

<b>Understand:</b> Construct meaning from instructional messages, including oral, written, and graphic communication.	
<b>Interpreting:</b>	Paraphrase important speeches and documents
<b>Exemplifying:</b>	Give examples of various artistic painting styles
<b>Classifying:</b>	Classify observed or described cases of mental disorders
<b>Summarising :</b>	Write a short summary of the events portrayed on videotapes
<b>Inferring:</b>	In learning a foreign language, infer grammatical principles from examples
<b>Comparing:</b>	Compare historical events to contemporary situations
<b>Explaining:</b>	Explain the causes of important 18 <sup>th</sup> -century events in France

**Level 3: Apply**

The third level of the cognitive domain of remember is summarised in the following table:

<b>Apply</b>	Carry out or use a procedure in a given situation
<b>Execute</b>	Divide one whole number by another whole number, both with multiple digits
<b>Implement</b>	Determine in which situations Newton's second law is appropriate
<b>Classify</b>	Understand fundraising and grant-making as function of the donor/beneficiary relationship and to apply theoretical principles to the act of fundraising
<b>Experiment</b>	Use the chemistry and composition of food to explain how it relates to the quality of a food product
<b>Calculate</b>	Devise and put into use a method of counting votes in an election
<b>Construct</b>	Complete a theme-based or place-based historical reconstruction of a topic or site

**Level 4: Analyse**

The fourth level of the cognitive domain of remember is summarised in the following table:

<b>Analyse</b>	Break material into constituent parts and determine how parts relate to one another and to an overall structure or purpose
<b>Differentiate</b>	Distinguish between relevant and irrelevant numbers in a mathematical word problem
<b>Organise</b>	Structure evidence in a historical description into evidence for or against a particular historical explanation
<b>Attribute</b>	Determine the point of view of the author of an essay in terms of his or her political perspective
<b>Order</b>	Students will be able to place important events in the order in which they happened
<b>Explain</b>	Explain why an understanding of wild land fire ecology is important
<b>Differentiate</b>	Differentiate between the terms gender and sex and understand the differences
<b>Achieve</b>	Students will achieve a level of understanding regarding their personal lifestyles and how the choices they make in their own lives change the environment

**Level 5: Evaluate**

The fourth level of the cognitive domain of remember is summarised in the following table:

<b>Evaluate</b>	Make judgements based on criteria and standards
<b>Check</b>	Determine whether scientists' conclusions follow from observed data
<b>Critique</b>	Judge which of two methods is the best way to solve a given problem
<b>Rank</b>	Students will be able to rank current political issues on how they feel emphasis should be placed
<b>Conclude</b>	Given a set of occurrences, students will be able to conclude which outcome is most likely
<b>Apply</b>	Apply concepts learned in class to implement a recycling programme

**Level 6: Create**

The fourth level of the cognitive domain of remember is summarised in the following table:

<b>Create</b>	Put elements together to form a coherent or functional whole; reorganise elements into a new pattern or structure
<b>Generate</b>	Generate hypotheses to account for an observed phenomenon
<b>Plan</b>	Plan a research paper on a given historical topic
<b>Produce</b>	Build habitats for certain species for certain purposes
<b>Combine</b>	Students will be able to combine healthy ingredients into an entire meal
<b>Plan</b>	Students will make personal and professional decisions regarding their own participation with non-profit organisations, third sector professions, citizen leadership, voluntary action, philanthropic studies and research, graduate education, volunteering and gifting and other philanthropic activities
<b>Compose</b>	Given a set of guidelines, students will be able to compose poetry which follows the constraints set out
<b>Actualise</b>	Engage in activism on behalf of social justice for women

Source: Florida International University, 2014.

This detailed analysis of the functioning of the revised Bloom taxonomy provided the basis for the development of different levels of development and thus different levels of competency. This model was applied to the supply chain competency model.

**7.6. APPLICATION TO THE SUPPLY CHAIN COMPETENCY MODEL**

The application of the revised model of Bloom's taxonomy for the development of the proficiency levels is outlined in this section. The theoretical framework explained in the previous section is now applied to the development of the proficiency definitions.

**7.6.1. The knowledge domain**

The application to the supply chain knowledge domain is summarised in the following tables.

**Table 7.2: Application of the revised Bloom taxonomy to the supply chain proficiency levels**

<b>Level 1: Factual knowledge</b>	
<b>Factual knowledge</b>	<b>The basic elements and facts about supply chain to be able to develop an understanding of it</b>
<b>Knowledge of terminology</b>	Knowledge of terms, concepts and definitions used in supply chains
<b>Knowledge of specific details and elements</b>	Knowledge of supply chain functions, processes and role players involved
<b>Level 2: Conceptual knowledge</b>	
<b>Conceptual knowledge</b>	<b>The interrelationships between the basic elements of supply chain and its interfaces and function as a unit together</b>
<b>Knowledge of classifications and categories</b>	Knowledge of different areas of supply chain, different ratios or different levels of strategies
<b>Knowledge of principles and generalisations</b>	Knowledge of improvement concepts and principles such as concept of variability, visibility and synchronisation
<b>Knowledge of theories, models and structures</b>	Knowledge of different approaches towards supply chain management, different process models and structures
<b>Level 3: Procedural knowledge</b>	
<b>Procedural knowledge</b>	<b>How to perform specific calculations, execute processes and complete functions</b>
<b>Knowledge of subject-specific skills and algorithms</b>	Perform calculations of key ratios, algorithms and analyse supply chain data
<b>Knowledge of subject-specific techniques and methods</b>	Techniques for analysing supply chain data issues. Supply chain diagnostics, cause-and-effect analysis
<b>Knowledge of criteria for determining when to use appropriate procedures</b>	Knowledge of when to use different techniques and calculations; when and in which circumstances to implement which improvement concepts or best practices
<b>Level 4: Meta-cognitive knowledge</b>	
<b>Meta-cognitive knowledge</b>	<b>Knowledge of the meta(abstraction) process of supply chain thinking</b>
<b>Strategic knowledge</b>	The process of strategic or long-term thinking and how it will impact on supply chains
<b>Cognitive tasks</b>	Knowledge of the different types of cognitive demands from different types of tasks in the supply chain; understand different types of supply chains
<b>Self-knowledge</b>	Awareness of one's own knowledge level and understanding

These levels were used to create different levels of supply chain knowledge and understanding.

### 7.6.2. The cognitive process dimension

The cognitive process dimension that provides the basis for application of knowledge is summarised in Table 7.3.

**Table 7.3: Cognitive process dimension**

<b>Level 1: Remember:</b>	
<ul style="list-style-type: none"> <li>• <b>Remember:</b> retrieve relevant knowledge about supply chain management from long-term memory</li> <li>• <b>Recognising:</b> recognise typical supply chain issues and challenges</li> <li>• <b>Recalling:</b> recall key concepts and principles of supply chain management</li> </ul>	
<b>List</b>	Identify supply chain functions, processes or issues
<b>Describe</b>	Describe the functioning of a supply chain
<b>Tabulate</b>	Demonstrate knowledge of how a process functions by tabulating the different steps
<b>Appropriate use of terms</b>	Use the correct terminology in specific scenarios, for example the correct use of shipping Incoterms
<b>Level 2: Understand:</b>	
Construct meaning from information from different sources:	
<ul style="list-style-type: none"> <li>• <b>Interpreting:</b> Extract meaning from supply chain data or information</li> <li>• <b>Exemplifying:</b> Provide examples of different levels of supply chain operations</li> <li>• <b>Classifying:</b> Identify issues and challenges from supply chain data</li> <li>• <b>Summarising:</b> Provide a summary of supply chain events or occurrences</li> <li>• <b>Inferring:</b> Infer different challenges from different supply chain scenarios</li> <li>• <b>Comparing:</b> Compare different issues and problems with each other</li> <li>• <b>Explaining:</b> Demonstrate cause-and-effect understanding by explaining why certain issues occurred</li> </ul>	
<b>Summarise</b>	Summarise a scenario which outlines different supply chain challenges. Select the key information or issues from various facts
<b>Interpret</b>	Establish a connection between certain issues in the supply chain and the lack of mechanisms or the wrong strategies being in place
<b>Predict</b>	Predict the potential outcome of the implementation of a specific strategy or improvement actions
<b>Execute</b>	Implement specific actions or strategies to manage or improve a supply chain scenario
<b>Level 3: Apply</b>	
Carry out a procedure or perform a function	
<ul style="list-style-type: none"> <li>• <b>Executing:</b> Perform certain activities or functions in the supply chain</li> <li>• <b>Implementing:</b> Determine which actions or strategies to implement given specific circumstances</li> </ul>	
<b>Classify</b>	Understand the different issues from a specific scenario and apply improvement concepts and principles for corrective action
<b>Experiment</b>	Use supply concepts or techniques to explore different potential solutions for a specific problem or challenge
<b>Calculate</b>	Calculate performance ratios, inventory levels or other variables for decision-making
<b>Construct</b>	Develop solutions for specific supply issues and construct an implementation plan to action these

**Table 7.3: Cognitive process dimension (continued)**

<b>Level 4: Analyse</b>	
Break the supply chain into its different parts or functions and determine how the parts fit together	
<ul style="list-style-type: none"> <li>• <b>Differentiating:</b> Distinguish between more and less important issues in the supply chain</li> <li>• <b>Organising:</b> Organise different parts or activities in the supply chain into logical units or processes</li> <li>• <b>Attributing:</b> Determine cause-and-effect, attributing the causal factors which contributed towards certain issues or constraints in the supply chain</li> </ul>	
<b>Order</b>	Place supply chain events or activities into a logical sequence or order
<b>Explain</b>	Explain why certain problems or issues occurred and how to rectify the issues
<b>Differentiate</b>	Differentiate between different types of issues, or different types of supply chains and which solutions will work in which circumstances
<b>Achieve</b>	Understand how and why issues occurred and how to improve these issues
<b>Level 5: Evaluate</b>	
Make judgments of supply chain performance and issues based on performance and other data	
<ul style="list-style-type: none"> <li>• <b>Checking:</b> Determine which issues resulted from where in the supply chain</li> <li>• <b>Critique:</b> Judge which solution or strategy will be best for a specific problem or challenge</li> </ul>	
<b>Rank</b>	Place a number of issues or problems in sequence of importance
<b>Assess</b>	Determine what the issues are, which factors contributed towards the issues and how to resolve those issues
<b>Conclude</b>	Given a set of challenges or issues, conclude which solution would be the best for the given challenges
<b>Apply</b>	Apply improvement programmes or actions to a problem
<b>Level 6: Create</b>	
Reorganise supply chain elements into a new structure	
<ul style="list-style-type: none"> <li>• <b>Generating:</b> Generate conclusions to explain certain issues. Create new ideas or innovations to improve performance</li> <li>• <b>Planning:</b> Develop supply chain strategy and the implementation plan to support the implementation</li> <li>• <b>Producing:</b> Implement and execute to realise the results of an improvement plan or action</li> </ul>	
<b>Combine</b>	Combine different elements or strategies into a coherent plan of action; combine problems from different industries into an improved strategy
<b>Plan</b>	Develop supply chain strategies, improvement plans, innovations of improved procedures and best practices
<b>Compose</b>	Given a specific set of challenges and constraints, compose a strategy or approach or action plan
<b>Actualise</b>	Realise the benefits of a strategy through the implementation or management

The translation of the previous application into levels of proficiency is outlined in Table 7.4.

**Table 7.4: Translation of Bloom's taxonomy to the different competency levels**

Level of proficiency	Revised Bloom model	
Awareness	<u><b>Knowledge domain:</b></u> Factual domain Conceptual domain Procedural domain	<u><b>Cognitive process:</b></u> Remember Understand
Knowledge	<u><b>Knowledge domain:</b></u> Factual domain Conceptual domain Procedural domain	<u><b>Cognitive process:</b></u> Apply in selected area (part of a business unit) Apply in more expanded area (total business unit or company)
Skilled	<u><b>Knowledge domain:</b></u> Factual domain Conceptual domain Procedural domain Meta-cognitive domain	<u><b>Cognitive process:</b></u> Apply in more expanded area (across business units or companies from different industries) Analyse the requirements of the area of application Evaluate other best practices Create new best practices or approaches

Three levels of proficiency are defined: awareness at the basic level, with knowledge as an intermediate level and skilled as the third level. The requirements expected from each level based on the revised Bloom taxonomy are explained with each level. The nature of the application in supply chain management added a further dimension of complexity. Supply chains consist of multiple units or functions or activities. These functions or activities operate within the context of an extended supply chain, thus functioning in interaction with suppliers, customers and partners. As more activities or functions are added, the complexity of supply chain management increases. As the extended supply chain is added, the complexity is further increased. This was also applied to the proficiency levels, with awareness only focusing on the subject, while knowledge and skill include different levels of supply chain focus – knowledge that of a single business, and skill that of the extended supply chain. The knowledge level focuses on a single business within the supply chain, while the skilled level focuses on the extended supply chain.

### 7.7. INTEGRATION AND CONSOLIDATION OF BEST PRACTICES

The best practices originate from the SCOR Model (version 10) and relate to the competency model through providing more detail for the individual competencies at the second level of the model.

These best practices will be included in the competency model and form a key input to the development of proficiency standards for the assessment of different levels of supply chain competency. The detail of the best practices is included in Appendix B for further reference.

## 7.8. LEVELS OF PROFICIENCY FOR THE SUPPLY CHAIN COMPETENCY MODEL

The framework developed for the competency proficiency levels is applied in this section. Three levels of proficiency were developed for each of the functional supply chain competencies identified in the supply chain competency model. The levels of proficiency were based on the best practices identified in Chapter 3 under section 3.6. The details of each of the proficiency definitions are outlined in this section. For the purpose of confidentiality was the proficiency definitions of clearing and forwarding not included in the detail provided in this section.

### 7.8.1. Meta-competency 1: Product and portfolio management

Competency 1.1: Product development
<p><b>Definition:</b> Product development can be defined as follows: Aspects such as design of products to not only optimise the product but also optimise the supply chain cost during the life cycle of products are addressed. Product development can be organised into five basic management processes (plan, research, design, integrate, and amend) that provide the organisational structure of the DCOR-model. It is useful to distinguish between the three process types in the model: plan, execute, and enable. A planning element is a process that aligns expected resources to meet expected design requirements. Planning processes balance aggregated demand across a consistent planning horizon. Planning processes generally occur at regular intervals and can contribute to design chain response time. Execution processes are triggered by planned or actual demand that changes the state of products. They include scheduling and sequencing, researching and design, materials and integrating product, and amend. Enable processes: prepare, maintain and manage information or relationships upon which planning and execution processes rely.</p>

Source: Adapted from Trott, 2012; Cravens, 2000; Council for Professional Supply Chain Management, 2010 & Supply Chain Council, 2014.

Awareness	Knowledge	Skilled
<p><b>Explain</b> why product design is important for supply chain management  <b>Explain</b> how product design can generate supply chain savings  <b>Explain</b> what the potential impact of product packaging is on supply chain performance  <b>Explain</b> the concept of collaborative design with supply chain partners such as suppliers  <b>Explain</b> what the objective of product portfolio management is  <b>Explain</b> how product portfolio management can affect supply chain performance</p>	<p><b>Apply</b> supply chain principles to the development of a product for a business or business unit  <b>Participate</b> in the process of designing a product for improved supply chain performance  <b>Participate</b> in a collaborative product design process with supply chain partners such as suppliers  <b>Apply</b> the principles of product portfolio management to a number of products within a business to improve supply chain performance  <b>Demonstrate</b> cause-and-effect understanding in the application of product portfolio management</p>	<p><b>Apply</b> supply chain principles to the development of multiple products for a business or business unit  <b>Participate</b> in the process of designing multiple products for improved supply chain performance  <b>Participate</b> in multiple collaborative product design processes with supply chain partners such as suppliers  <b>Apply</b> the principles of product portfolio management to a number of products across businesses to improve supply chain performance</p>

Source: Adapted from Trott, 2012; Cravens, 2000; Council for Professional Supply Chain Management, 2010 & Supply Chain Council, 2014.

Competency 1.2: Portfolio management
<p><b>Definition:</b> Managing the product portfolio can be defined as follows: Portfolio management focuses on the alignment between optimising the product portfolio and supply chain performance. Aspects such as design of products to not only optimise the product but also optimise the supply chain cost during the life cycle of products are addressed. Product profitability and the contribution towards supply chain complexity are considered.</p>

Source: Adapted from Trott, 2012; Cravens, 2000; Council for Professional Supply Chain Management, 2010.

Awareness	Knowledge	Skilled
<p><b>Explain</b> the objective of product portfolio management</p> <p><b>Explain</b> how product portfolio management can impact on supply chain performance</p> <p><b>Explain</b> the potential negative effects if the product portfolio is not managed</p> <p><b>Explain</b> how the product life cycle influences the performance of the product portfolio</p> <p><b>Explain</b> how the product portfolio impacts on the supply chain complexity</p>	<p><b>Apply</b> the principles of product portfolio management to a number of products within a business to improve supply chain performance</p> <p><b>Evaluate</b> the product portfolio of the company and identify the opportunities for improvement</p> <p><b>Demonstrate</b> cause-and-effect understanding in the application of product portfolio management</p> <p><b>Implement</b> a plan of action to optimise the product portfolio of the company</p>	<p><b>Manage</b> the application of the principles of product portfolio management to a number of products within a business to improve supply chain performance</p> <p><b>Manage</b> the evaluation of the product portfolio of the company and identify the opportunities for improvement</p> <p><b>Demonstrate</b> cause-and-effect understanding in the application of product portfolio management in different industries</p> <p><b>Manage</b> the implementation of a plan of action to optimise the product portfolio of the company</p>

Source: Adapted from Trott, 2012; Cravens, 2000.

### 7.8.2. Meta-competency 2: Supply chain strategy

Competency 2.1: Developing supply chain strategy
<p><b>Definition:</b></p> <p>Review an existing or develop a new supply chain strategy that involves the integration of different elements of supply chain, such as demand strategy, demand fulfilment, sourcing strategy and supply chain planning, to form an integrated coherent supply chain that can deliver the required business results. Alignment with business strategy and other functional strategies such as marketing and manufacturing is also required.</p>

Source: Adapted from Gattorna, 1998; Langley *et al.*, 2008; Gattorna, 2006; CSCMP, 2014; Pienaar & Vogt, 2009; Frazelle, 2002.

Awareness	Knowledge	Skilled
<p><b>Explain</b> the importance of supply chain strategy as mechanism to achieve integration across the different elements of procure &amp; supply</p> <p><b>Explain</b> the different elements of supply chain management, outbound strategy, procure &amp; supply strategy, managing the customer interface &amp; supply chain planning</p>	<p><b>Perform</b> basic strategic analysis of the elements of supply chain strategy such as outbound strategy and sub-strategies</p> <p><b>Apply</b> basic analysis techniques to identify improvement opportunities</p> <p><b>Develop</b> improvement plans for supply chain strategy, outbound strategy, procure &amp; supply strategy, managing the customer</p>	<p><b>Perform</b> basic strategic analysis of the supply chain</p> <p><b>Translate</b> business objectives into supply chain performance requirements.</p> <p><b>Align</b> business strategy with supply chain strategy</p> <p><b>Integrate</b> outbound, procure &amp; supply, supply chain planning &amp; managing the customer interface</p>

Awareness	Knowledge	Skilled
<p><b>Explain</b> the basic strategy formulation process that is followed to develop an outbound supply chain strategy</p> <p><b>Explain</b> why it is important that the business strategy and supply chain strategy should be integrated</p>	<p>interface &amp; supply chain planning.</p> <p><b>Align</b> strategies across macro process such as network strategy, facility design &amp; layout, customer demand fulfilment and transport operations management</p> <p><b>Develop</b> basic implementation plans for relevant elements of the supply chain strategies</p> <p><b>Align</b> supply chain action planning with key performance objectives</p>	<p>into an integrated strategy</p> <p><b>Design</b> processes to translate supply chain objectives into operational requirements</p> <p><b>Design</b> and implement supply chain performance management system, which include the identification of key performance indicators, business intelligence and master data</p> <p><b>Identify</b> new strategic models that can overcome current constraints to improve current performance of supply chain management</p>

Source: Adapted from Gattorna, 1998; Langley *et al.*, 2008; Gattorna, 2006; CSCMP, 2014; Pienaar & Vogt, 2009.

Competency 2.2: Understanding different types of supply chains
<p><b>Definition:</b></p> <p>This involves identification of different supply chain models and the understanding of the difference in functioning between the different models. The emphasis is on the different performance objectives, different configurations required, the process requirements and how technology enablement will differ across different models.</p>

Source: Adapted from Gattorna, 1998; Langley *et al.*, 2008; Gattorna, 2006; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p><b>Identify</b> different types of supply chains</p> <p><b>Explain</b> why different supply chains are functioning in different ways</p> <p><b>Provide</b> examples of the different types of supply chains</p> <p><b>Identify</b> the factors that distinguish different supply chains from one another</p> <p><b>Explain</b> why it is required to develop different strategies for different supply chains</p> <p><b>Identify</b> which aspects from different supply chains strategies need to be different</p>	<p><b>Differentiate</b> performance objectives of different types of supply chains from each other</p> <p><b>Explain</b> the different configurations required for different types of supply chains in detail</p> <p><b>Outline</b> how logistics networks between different supply models will operate differently from each other</p> <p><b>Develop</b> different inventory strategies for the different supply chain configurations</p> <p><b>Formulate</b> different strategies that deliver the desired results for the different supply chains</p> <p><b>Develop</b> process models to support the relevant supply chain configuration</p>	<p><b>Integrate</b> different types of supply chain configurations within the same business</p> <p><b>Identify</b> the unique and common areas across different supply chain models and optimise</p> <p><b>Integrate</b> different functional requirements such as manufacturing, procurement and marketing for different supply chains</p> <p><b>Implement</b> process models which leverage the common aspects of different supply chains, but provide unique functionality</p> <p><b>Implement</b> differentiated performance management approaches to integrate different supply chains in the same business</p>

Source: Adapted from Gattorna, 1998; Langley *et al.*, 2008; Gattorna, 2006; CSCMP, 2014.

**Competency 2.3: Demand management strategy****Definition:**

Demand management strategy development is the process of analysing the key trends and dynamics in the industries and markets. The objective of this analysis is to identify cost trends, technology trends, potential structural changes in the market and risk factors. This analysis will provide direction for the design of supply chain strategies.

Source: Adapted from Crum 2003; Langley *et al.*, 2008; Supply Chain Council, 2014; Friscia *et al.*, 2009.

Awareness	Knowledge	Skilled
<p><b>Explain</b> the concept of an industry business model and the potential impact on supply chain</p> <p><b>Explain</b> different industry models in terms of capital intensity and cost structures</p> <p><b>Explain</b> how the supply chain configuration for different industry models will be different in terms of its functioning</p> <p><b>Explain</b> how the key performance measures will be different for the different industry models</p> <p><b>Explain</b> how the supply chain process designs for different industry models will have a different focus</p> <p><b>Explain</b> the impact of different industry models on the scalability of the supply chain</p>	<p><b>Apply</b> the concept of an industry business model to selected industries and identify the potential impact on supply chain</p> <p><b>Use</b> different industry models and explain their capital intensity and cost structures</p> <p><b>Develop</b> the supply chain configuration for different industry models which will be different in terms of their functioning</p> <p><b>Develop</b> different key performance measures for different industry models</p> <p><b>Develop</b> broad templates for the supply chain process designs of different industry models</p> <p><b>Develop</b> models to illustrate the impact of different industry models on the scalability of the supply chain</p>	<p><b>Apply</b> the concept of an industry business model to a business unit and identify the potential impact on supply chain</p> <p><b>Use</b> the appropriate industry model to point out capital intensity and cost structures for a specific business unit</p> <p><b>Develop</b> the supply chain configuration and its functioning for a specific business unit given the relevant industry model</p> <p><b>Develop</b> the key performance measures for the supply chain model for a specific business unit within the context of the industry model</p> <p><b>Develop</b> a broad template for the supply chain process designs of a business unit given the industry model</p> <p><b>Develop</b> a model to illustrate scalability of the supply chain for a specific business unit given the relevant industry model</p>

Source: Adapted from Crum, 2003; Langley *et al.*, 2008; Supply Chain Council, 2014; Friscia *et al.*, 2009.

**Competency 2.4: Developing A Demand Fulfilment Strategy****Definition:**

The network includes all facilities in the inbound and outbound supply chain such as sources of supply and facilities, distribution centres, production facilities, tank depots, customer facilities, transport routes and modes, and the inventory at the different inventory holding points across the network. The design and optimisation of the network is focused on achieving the best performance by optimising cost, customer service and inventory given the network constraints

Source: .Adapted from Fawcett *et al.*, 2007; Pienaar & Vogt, 2009; Gattorna, 2006.

Awareness	Knowledge	Skilled
<p><b>Explain</b> the concept of a supply chain network</p> <p><b>Explain</b> all the components such as sources of supply, production facilities, depots, customer facilities and others that make up a total network</p> <p><b>Explain</b> the different inventory positioning strategies that can be followed</p> <p><b>Explain</b> the techniques for quantification of costs, service, constraints and other performance metrics of a network</p> <p><b>Explain</b> the different strategies that can be used for the optimisation of the network</p> <p><b>Explain</b> the different quantification techniques for the optimisation of the network</p>	<p>Map the network with components such as sources of supply, production facilities, depots, customer facilities and others that make up a total network for a specific business segment or mini supply chain</p> <p>Develop different inventory positioning strategies for the business segment network mapped in the previous point</p> <p>Develop a network model for the quantification of costs, service, constraints and other performance metrics for the network of a specific business segment</p> <p>Apply the different strategies to optimise the network of a specific business segment</p> <p>Apply some of the different quantification techniques to optimise the network mapped and quantified</p>	<p>Map the network with components such as sources of supply, production facilities, depots, customer facilities and others that make up a total network for the total business with different segments or mini supply chains</p> <p>Develop different inventory positioning strategies for the business with different market segments</p> <p>Develop a network model for the quantification of costs, service, constraints and other performance metrics for the network of the total business with different segments or markets</p> <p>Apply the different strategies to optimise the network of the total business with specific business segments</p> <p>Apply different quantification techniques to optimise the network mapped and quantified</p>

Source: Adapted from Fawcett *et al.*, 2007, Pienaar & Vogt, 2009, Gattorna, 2006.

Competency 2.5: Strategic sourcing
<p><b>Definition:</b></p> <p>The process of commodity management focuses on the creation of an approach that manages procurement commodity groups from a consolidated perspective through the application of a unique management approach for each commodity group. The objective of the approach is to achieve the optimal total cost of ownership for each commodity or commodity group at acceptable levels of supply risk.</p>

Source: Adapted from Hugo, Badenhorst-Weiss & Van Biljon, 2004; Burt *et al.*, 2010; Handfield *et al.*, 2009.

Awareness	Knowledge	Skilled
<p>Explain how the following processes lead to a particular sourcing strategy:</p> <ul style="list-style-type: none"> <li>• Sourcing strategy development <ul style="list-style-type: none"> <li>○ Spend &amp; supply demand analysis</li> <li>○ Industry &amp; supply market analysis</li> <li>○ Supplier selection criteria</li> </ul> </li> <li>• Reducing total cost of ownership</li> <li>• Spend database management</li> </ul>	<p>Apply to segment of supply demand or spend the following processes to lead to a particular sourcing strategy:</p> <ul style="list-style-type: none"> <li>• Sourcing strategy <ul style="list-style-type: none"> <li>○ Spend &amp; supply demand analysis</li> <li>○ Industry &amp; supply market analysis</li> <li>○ Supplier selection criteria</li> </ul> </li> <li>• Reducing total cost of ownership</li> <li>• Spend database management</li> <li>• RFX &amp; procurement process</li> <li>• Macro &amp; microeconomic</li> </ul>	<p>Lead the application to the total of supply demand or spend of a business unit with the following processes to lead to a particular sourcing strategy:</p> <ul style="list-style-type: none"> <li>• Sourcing strategy <ul style="list-style-type: none"> <li>○ Spend &amp; supply demand analysis</li> <li>○ Industry &amp; supply market analysis</li> <li>○ Supplier selection criteria</li> </ul> </li> <li>• Reducing total cost of ownership</li> <li>• Spend database management</li> <li>• RFX &amp; procurement process</li> <li>• Macro &amp; microeconomic influence</li> </ul>

Awareness	Knowledge	Skilled
<ul style="list-style-type: none"> <li>• RFX &amp; procurement process</li> <li>• Macro &amp; microeconomic influence on pricing</li> <li>• Explain the importance and process of integrating the results of all tools into a coherent sourcing strategy</li> </ul>	<p>influence on pricing</p> <ul style="list-style-type: none"> <li>• Integrate the results of all the tools and analysis into a coherent sourcing strategy for a segment of supply demand or spend</li> <li>• Participate in the implementation of the sourcing strategies developed</li> </ul>	<p>on pricing</p> <ul style="list-style-type: none"> <li>• Lead the integration of the results of all the tools and analysis into a coherent sourcing strategy for the total of supply demand or spend of a business</li> <li>• Lead the process of the implementation of the sourcing strategies developed</li> </ul>

Source: Adapted from Hugo *et al.*, 2004; Burt *et al.*, 2010; Handfield *et al.*, 2009.

### 7.8.3. Meta-competency 3: Sales and operations planning

Competency 3.1: Demand sensing and shaping
<p><b>Definition:</b></p> <p>Demand sensing and shaping is the process of developing an understanding of the factors that determine the true demand patterns of customers. This understanding is then used to implement strategies that influence or shape the demand pattern to improve the profitability of fulfilling that demand pattern.</p>

Source: Adapted from Crum & Palmatier, 2003; Supply Chain Council, 2014; CSCMP, 2014; Seifert, 2003; Friscia *et al.*, 2009.

Awareness	Knowledge	Skilled
<p>Explain how customer demand is the key driver of all supply chain activities</p> <p>Explain what the impact on the supply chain is of fluctuating demand patterns</p> <p>Explain what the bull-whip effect is and what factors cause it</p> <p>Identify the factors that can potentially influence the customer demand pattern</p> <p>Identify the potential strategies that can be implemented to influence the customer demand pattern</p>	<p>Map the demand of a specific customer and determine the demand pattern</p> <p>Identify the factors that drive or influence the actual demand pattern of a customer</p> <p>Identify and quantify the impact of a fluctuating demand pattern on the profitability of fulfilment</p> <p>Formulate strategies that can be implemented to improve the profitability of fulfilling that demand pattern</p> <p>Implement the strategies formulated to improve the profitability of fulfilling that demand pattern</p>	<p>Map the demand of different customers and determine the demand patterns across different industries</p> <p>Identify the factors that drive or influence the actual demand patterns of several customers in different industries</p> <p>Identify and quantify the impact of fluctuating demand patterns on the profitability of fulfilment</p> <p>Formulate strategies for the different industries that can be implemented to improve the profitability of fulfilling that demand pattern</p> <p>Implement the strategies formulated in different industries to improve the profitability of fulfilling that demand pattern</p>

Source: Adapted from Crum & Palmatier, 2003; Supply Chain Council, 2014; CSCMP, 2014; Seifert, 2003; Friscia *et al.*, 2009.

**Competency 3.2: Demand planning****Definition:**

Demand planning involves the process of identifying, aggregating, and prioritising all sources of demand for the integrated supply chain of a product or service at the appropriate level, horizon and interval. The sales forecast comprises the following concepts: sales forecasting level, time horizon and time interval. The sales forecasting level is the focal point in the corporate hierarchy where the forecast is needed at the most generic level, i.e. corporate forecast, divisional forecast, product-line forecast, stock keeping unit (SKU), and SKU by location. Cross-functional integration as required.

Source: Adapted from Crum & Palmatier, 2003; Supply Chain Council, 2014; CSCMP, 2014; Seifert, 2003; Friscia *et al.*, 2009.

Awareness	Knowledge	Skilled
Explain the basic economic/market factors that drive demand in the specific industry/market	Identify the basic economic/market factors that drive demand for a specific market or business segment	Identify the basic economic/market factors that drive demand for different market or business segments across a business unit
Explain the impact of business drivers and business planning (e.g. profitability, environmental) on demand planning	Perform the process of setting up demand planning which includes the selection of the best forecasting techniques for a specific market or business segment	Perform the process of setting up demand planning which includes the selection of the best forecasting techniques for different market or business segments across a business unit
Explain the importance of demand planning for the performance of the supply chain and the business	Perform the process of data clean-up and preparation for demand planning	Perform the process of data clean-up and preparation for demand planning for different market or business segments across a business unit
Explain the process of setting up demand planning which includes the selection of the best forecasting techniques	Generate a baseline sales forecast at the required level of detail for a specific market or business segment	Generate a baseline sales forecast at the required level of detail for different market or business segments across a business unit
Explain the process of incorporating supply chain events into the demand plan	Perform incorporation of supply chain events into the demand plan for a specific market or business segment	Perform incorporation of supply chain events into the demand plan for different market or business segments across a business unit
Explain the process of collaborative forecasting with selected customers	Facilitate the process of collaborative forecasting with selected customers for a specific market or business segment	Facilitate the process of collaborative forecasting with selected customers for different market or business segments across a business unit
Explain the process of aligning the demand plan with the business plan and business objectives	Facilitate the alignment of the demand plan with the business plan and business objectives	Facilitate the alignment of the demand plan with the business plan and business objectives
Explain the process of generating a consensus forecast through internal collaboration with sales and marketing	Generate a consensus forecast through internal collaboration with sales and marketing for a specific market or business segment	Generate a consensus forecast through internal collaboration with sales and marketing for different market or business segments across a business unit
Explain the process of identification of external demand constraints and risks across all sources of demand and how to resolve these constraints and mitigate the risks	Perform cross-functional integration and liaison as required for achieving good demand planning	Perform cross-functional integration and liaison as required for achieving good demand planning

Source: Adapted from Crum & Palmatier, 2003; Supply Chain Council, 2014; CSCMP, 2014; Seifert, 2003; Friscia *et al.*, 2009.

**Competency 3.3: Supply planning**

## Definition:

The process of identifying, prioritising, and aggregating, as a whole with constituent parts, all sources of supply that are required and add value in the supply chain of a product or service at the appropriate level, horizon and interval.

Source: Adapted from Burt *et al.*, 2010; Supply Chain Council, 2014; CSCMP, 2014; Seifert, 2003; Friscia *et al.*, 2009.

Awareness	Knowledge	Skilled
<p>Explain the basic economic/market factors that drive supply in a specific industry/market</p> <p>Explain the impact of business drivers and business planning (e.g. profitability, environmental) on supply planning</p> <p>Explain the importance of supply planning for the performance of the supply chain and the business</p> <p>Explain the process of supply planning from distribution requirements planning to source planning</p> <p>Explain the process of identification of supply constraints and risks across all sources of supply and how to resolve these constraints and mitigate the risks</p>	<p>Identify the basic economic/market factors that drive supply for a specific market or business segment</p> <p>Perform data maintenance and clean-up in preparation of the supply planning process for selected supply resources only</p> <p>Perform the process of generating a distribution requirements plan based on the consensus demand plan for selected distribution points only</p> <p>Generate inventory planning based on the distribution requirements plan, which includes review of inventory levels, safety inventory and re-order levels for selected distribution points only</p> <p>Generating a material requirements plan based on distribution requirements adjusted for inventory levels for only selected manufacturing sources</p> <p>Generate a master production schedule based on the material requirements plan adjusted for manufacturing constraints for only selected manufacturing sources</p> <p>Complete source planning based on the master production schedule for only selected sources of supply</p> <p>Identify supply constraints and risks for selected sources of supply and resolve these constraints and mitigate the risks</p>	<p>Identify the basic economic/market factors that drive supply for different market or business segments across a business unit</p> <p>Perform data maintenance and clean-up in preparation of the supply planning process for all supply resources across the business unit</p> <p>Perform the process of generating a distribution requirements plan based on the consensus demand plan for all distribution points across the business unit</p> <p>Generate inventory planning based on the distribution requirements plan, which includes review of inventory levels, safety inventory and re-order levels for all distribution points across the business unit</p> <p>Generate a material requirements plan based on distribution requirements adjusted for inventory levels for selected manufacturing sources across the business unit</p> <p>Generate a master production schedule based on the material requirements plan adjusted for manufacturing constraints for all manufacturing sources across the business unit</p> <p>Complete source planning based on the master production schedule for all sources of supply across the business unit</p> <p>Identify supply constraints and risks for all sources of supply across the business unit and resolve these constraints and mitigate the risks</p> <p>Perform cross-functional integration and liaison as required for achieving good supply planning</p>

Source: Adapted from Burt *et al.*, 2010; Supply Chain Council, 2014; CSCMP, 2014; Seifert, 2003.

**Competency 3.4: Demand and supply balancing****Definition:**

The process of identifying and measuring the gaps and imbalances between demand and resources in order to determine how to best resolve the variances through marketing, pricing, packaging, warehousing, outsource plans or some other action that will optimise service, flexibility, costs, and assets (or other supply chain inconsistencies) in an iterative and collaborative environment. The process of developing a time-phased course of action that commits supply chain resources to meet constraint based supply chain requirements. This process includes the formalisation of the sales and operations plan through the sales and operations meeting.

Source: Adapted from Burt *et al.*, 2010; Supply Chain Council, 2014; CSCMP, 2014; Seifert, 2003; Friscia *et al.*, 2009.

Awareness	Knowledge	Skilled
<p>Explain the process of demand &amp; supply balancing and its importance for supply chain performance</p> <p>Explain the potential gaps or imbalances between demand and supply that can occur</p> <p>Explain the difference between hard and soft constraints in demand supply balancing</p> <p>Explain the potential options to resolve these imbalances between demand and supply</p> <p>Explain the importance of communicating the plan, and influencing implementers of the plan to adhere to the constrained plan</p> <p>Explain the process of reviewing and re-planning to ensure that plans are adjusted based on changes during execution of the plan</p>	<p>Implement a process of demand &amp; supply balancing for a selected business segment to ensure supply chain performance</p> <p>Identify the potential gaps or imbalances between demand and supply that can occur for a selected business segment</p> <p>Identify hard and soft constraints in demand supply balancing for a selected business segment</p> <p>Identify the key business and supply drivers causing imbalances between demand and supply for a selected business segment</p> <p>Identify the potential options to resolve these imbalances between demand and supply for a selected business segment</p> <p>Re-balance the supply chain through selection of appropriate options for a selected business segment</p> <p>Formalise the plan, communicate (to whom communicate changes on different proficiency levels) adherence to the plan for a selected business segment</p> <p>Adapt plan and re-plan and influence people to implement new plan for a selected business segment</p>	<p>Implement a process of demand &amp; supply balancing across all business segments in a business unit to ensure supply chain performance</p> <p>Identify the potential gaps or imbalances between demand and supply that can occur across all business segments in a business unit</p> <p>Identify hard and soft constraints in demand supply balancing across all business segments in a business unit</p> <p>Identify the key business and supply drivers causing the imbalances between demand and supply across all business segments in a business unit</p> <p>Identify the potential options to resolve these imbalances between demand and supply across all business segments in a business unit</p> <p>Re-balance the supply chain through selection of the appropriate options across all business segments in a business unit</p> <p>Formalise the plan, communicate (to whom communicate changes on different proficiency levels) adherence to the plan for a selected business segment</p> <p>Adapt plan and re-plan and influence people to implement new plan for a selected business segment</p> <p>Facilitate the cross-functional integration required to improve demand &amp; supply balancing across segments in a business unit</p>

Source: Adapted from Burt *et al.*, 2010; Supply Chain Council, 2014; CSCMP, 2014; Seifert, 2003; Friscia *et al.*, 2009.

<b>Competency 3.5: Operations scheduling</b>
<b>Definition:</b> To determine the optimal sequencing (schedule), allocation and routing of production orders guided by the production and supply plan and based on detailed product attributes, changeover requirements, customer order due dates, work centre capability, labour required, and other constraints.

Source: Adapted from Schonberger & Knod, 1994; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain the detail production process related to a product and production unit</p> <p>Explain the implications of deviations from the production plan (indicating customer impact; impact on inventory, delivery plans and priorities; and showing understanding of broad business rules)</p> <p>Explain the interdependence between production schedules and production / supply planning</p> <p>Explain how process sequencing, staging and setting production run lengths work per product and production unit</p> <p>Explain the scheduling of people per work shift for a set production schedule</p> <p>Explain how the scheduling of a production unit depends on up- and downstream supply &amp; inventory</p> <p>Explain the impact of production schedule changes on material requirements</p>	<p>Perform process sequencing, staging and setting production run lengths per product and production unit within a set production &amp; supply plan and production targets while taking into account customer orders; inventory &amp; delivery plans and priorities; and broad business rules</p> <p>Perform scheduling of people per shift group for a set production schedule per product and production unit</p> <p>Perform plant &amp; labour scheduling according to set procedures</p> <p>Pro-actively influence the drafting of up- and downstream supply schedules &amp; inventory replenishment for a production unit's schedule</p> <p>Pro-actively influence material requirements based on production schedule changes per product and production unit</p>	<p>Perform and guide the process sequencing, staging and setting production run lengths for a range of products and production lines within set production &amp; supply plan and production targets while taking into account customer orders; inventory &amp; delivery plans and priorities; and broad business rules</p> <p>Perform scheduling of people per production line &amp; team for a set production schedules</p> <p>Perform plant &amp; labour scheduling with the aid of heuristics</p> <p>Participate in the drafting of up- and downstream supply schedules &amp; inventory replenishment for a production unit's schedule</p> <p>Pro-actively influence material requirements based on production schedule changes for a range of product and production lines</p>

Source: Adapted from Schonberger & Knod, 1994; Supply Chain Council, 2014; CSCMP, 2014.

#### 7.8.4. Meta-competency 4: Demand execution management

<b>Competency 4.1: Customer relationship management</b>
<b>Definition:</b> Customer relationship management is the process of implementing demand or market strategies. It involves the implementation of different product offerings in line with market and customer segmentation strategies. Establishing relationships with new customers and managing relationships with existing customers are included in the process. This process needs to be aligned with the sales process and calling cycles of the sales team.

Source: Adapted from Fawcett *et al.*, 2007; Gattorna, 2006; Christopher, 2005; Peppers & Rodgers, 2004.

Awareness	Knowledge	Skilled
Explain the basic concept of market and customer segmentation	Apply market and customer segmentation to a portfolio of customers for a business or business unit	Manage the process of market and customer segmentation of a portfolio of customers for different businesses or business units
Explain how product offerings for different customer segments might differ	Participate in the development of different product offerings for different customer segments	Manage the process of developing different product offerings for different customer segments
Explain the concepts of customer satisfaction and service quality	Participate in the process of measuring customer satisfaction or customer service for a portfolio of customers	Manage the process of measuring customer satisfaction or customer service for a portfolio of customers
Explain how customer service can be measured	Apply the pareto principle to a portfolio of customers to determine the different segments	Manage the application of the pareto principle to a portfolio of customers to determine the different segments
Explain the implication of the pareto principle applied to customers	Participate in the process of calculating customer profitability for a portfolio of customers	Manage the process of calculating customer profitability for a portfolio of customers
Explain the concept of customer profitability and how it should be calculated	Participate in the process of customer engagement to ensure that customer and revenue targets are realised	Manage or co-manage the process of customer engagement to ensure that customer and revenue targets are realised
Explain the process of customer engagement to ensure successful achievement of objectives		

Source: Adapted from Fawcett *et al.*, 2007; Gattorna, 2006; Christopher, 2005 & Peppers & Rodgers, 2004.

<b>Competency 4.2: Customer order management</b>
<p><b>Definition:</b></p> <p>Development, implementation and improvement of the process from allocation of inventory or production capacity and delivery up to invoicing the customer. This includes translating the sales and operations plan into sales allocation planning, managing the inflow of orders, prioritisation of the orders for distribution, liaison with transport/distribution and ensuring despatch in line with priorities and allocations. The process will also include ATP and CTP business rules and facilitate removal of credit or distribution blocks and re-routing/diversions.</p>

Source: Adapted from Supply Chain Council, 2014; CSCMP, 2014; Ballou, 2004.

Awareness	Knowledge	Skilled
Explain how the operational allocation planning process relates to customer fulfilment strategies	Perform operational allocation planning for a selected market or business segment	Perform/Manage operational allocation planning for different market or business segments across business units
Explain the operational allocation planning process	Align the segment operational allocation plan with the sales & operations plan	Align/ Manage the operational allocation plan with the sales & operations plan
Explain how the operational allocation planning process integrates with sales & operations planning	Calculate ATP or CTP dates for a specific market or business segment	Calculate/ Manage ATP or CTP dates for different market or business segments
Explain the calculation of ATP or CTP dates	Manage order inflow against operational allocation and correcting allocation problems	Manage order inflow against operational allocation and correcting allocation problems for different market or business segments across the business

Awareness	Knowledge	Skilled
<p>Explain the process of managing order inflow against operational allocation and correcting allocation problems</p> <p>Explain execution problems such as distribution or credit blocks and how to remove those</p> <p>Explain re-routing and diversions and how they are used to maximise customer service</p>	<p>for a specific market or business segment</p> <p>Identify execution problems such as distribution or credit blocks and removing those for a specific market or business segment</p> <p>Perform re-routing and diversions for a specific market or business segment to maximise customer service</p>	<p>Identify/ Manage identification of execution problems such as distribution or credit blocks and facilitate removal of those for different market or business segments</p> <p>Perform/ Manage re-routing and diversions for different market or business segments across the business to maximise customer service</p>

Source: Adapted from Supply Chain Council, 2014; CSCMP, 2014; Ballou, 2004.

### 7.8.5. Meta-competency 5: Transport & Distribution

Competency 5.1: International Logistics
Competency 5.1.1: Global supply chain integration
<p><b>Definition:</b></p> <p>This involves the integration of international logistics with supply chain strategies to ensure a cost-effective and synchronised supply chain. The selection and combination of different transport modes and their integration with other elements such as warehousing and inventory levels will be key to ensure a synchronised supply chain. The creation of supply chain visibility across multiple participants is a key element of this competency.</p>

Source: Adapted from Wisner *et al.*, 2008; Langley *et al.*, 2008; Fawcett *et al.*, 2007; Gattorna, 2006.

Awareness	Knowledge	Skilled
<p>Explain the importance of trade lanes and the development of international trade for the design of international supply chains</p> <p>Explain the integration of international logistics design with the types of supply chain strategies required for different industries</p> <p>Explain the integration of the international supply chain taking into account stock levels, product flow and different transport modes</p> <p>Explain the challenges and required strategies to synchronise operations across multiple players in the international supply chain</p> <p>Explain the challenge of creating visibility of requirements and progress across the different participants in the supply chain</p>	<p>Participate in the development of strategy templates or approaches for different trade lanes</p> <p>Participate in the development of different strategy templates for different types of supply chains in different industries</p> <p>Participate in the design of the synchronisation of the international supply chain across elements such as transport modes, product flow, customs, clearing and service providers</p> <p>Participate in the design of visibility and collaboration mechanisms across different participants in the international supply chain</p>	<p>Lead the process of developing strategy templates or approaches for different trade lanes for multiple industries</p> <p>Lead the process of developing different strategy templates for different types of supply chains in different industries</p> <p>Lead the process of designing the synchronisation of the international supply chain across elements such as transport modes, product flow, customs, clearing and service providers</p> <p>Lead the process of designing visibility and collaboration mechanisms across different participants in the international supply chain</p>

Source: Adapted from Wisner *et al.*, 2008; Langley *et al.*, 2008; Fawcett *et al.*, 2007; Gattorna, 2006.

**Competency 5.1.2: Developing global logistics strategies****Definition:**

International logistics strategies focus on the development of multi-modal transport solutions which combine different modes of transport into an integrated strategy for international logistics. The management and improvement of an international logistics network of agencies and service providers also forms part of the competency.

Source: Adapted from Wisner *et al.*, 2008; Langley *et al.*, 2008; Fawcett *et al.*, 2007.

Awareness	Knowledge	Skilled
Explain what is involved in putting together an international logistics solution	Participate in the process of formulating strategies to leverage a network of offices or agencies to generate volumes of international freight from different customers in a single industry	Lead the process of formulating strategies to leverage a network of offices or agencies to generate volumes of international freight from different customers across different industries
Explain the importance of an international network of agencies or offices to optimise international logistics solutions	Participate in the process of combining different types of cargo to ensure optimisation of transport capacity in a single industry	Lead the process of combining different types of cargo from different industries to ensure optimisation of transport capacity
Explain the concept of a base load to cover fixed costs, with added volumes to improve profitability of the load	Participate in the process of developing service providers for the provision of multi-modal international logistics in a single industry	Lead the process of developing service providers for the provision of multi-modal international logistics across different industries
Explain what challenges are involved in the management of international multi-modal logistics solutions	Participate in the process of developing multi-modal solutions for international logistics in a single industry	Lead the process of developing multi-modal solutions for international logistics across different industries
Explain the key strategic objectives to be achieved with airfreight as a key mode of transport in international logistics	Participate in the process of developing international airfreight solutions by balancing levels of consolidation of freight and levels of flexibility required in a single industry	Lead the process of developing international airfreight solutions by balancing levels of consolidation of freight and levels of flexibility required across different industries
Explain the key strategic objectives to be achieved with sea freight as a key mode of transport in international logistics	Participate in the process of developing international sea freight solutions by balancing levels of consolidation of freight and levels of flexibility and cost efficiency required in a single industry	Lead the process of developing international sea freight solutions by balancing levels of consolidation of freight and levels of flexibility and cost efficiency required across different industries
	Integrate land-based infrastructure design with multi-modal international logistics solutions in a single industry	Lead the process of integrating land-based infrastructure with multi-modal international logistics solutions across different industries

Source: Adapted from Wisner *et al.*, 2008; Langley *et al.*, 2008; Fawcett *et al.*, 2007.

**Competency 5.1.3: Developing multi-modal solutions****Definition:**

The process of developing multi-modal solutions starts with a thorough understanding of the transport requirements in terms of constraints, volumes, distances, routes and the functioning of the distribution network. An in-depth knowledge of the different transport modes of road, rail, marine, pipeline and airfreight is also required. An integrated multi-modal transport solution will combine the different transport modes into a solution that provides the required service levels at the most cost-effective level.

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain the different transport modes of rail, road, marine &amp; airfreight, in terms of transport economics, technical functioning and legal requirements</p> <p>Explain the different types of advantages offered by the different transport modes</p> <p>Explain the principles and process of developing a multi-modal transport solution</p> <p>Explain the potential risks of a multi-modal solution and how to mitigate those risks</p> <p>Explain the importance of providing operational visibility across the different transport modes</p> <p>Explain the different types of contracting requirements of the different transport modes</p>	<p>Develop a matrix with relevant advantages offered by the different transport modes for a specific business segment</p> <p>Develop a multi-modal transport solution for a specific transport requirement or business segment using a structured process</p> <p>Develop a risk profile or matrix of the potential risks of a multi-modal solution for a specific transport requirement or business segment and how to mitigate those risks</p> <p>Develop operational visibility for a specific transport requirement or business segment</p> <p>Develop contracts for the different transport modes used for a specific transport requirement or business segment</p>	<p>Develop a matrix with relevant advantages offered by the different transport modes for different business segments of a business unit</p> <p>Develop a multi-modal transport solution for different business segments of a business unit using a structured process</p> <p>Develop a risk profile or matrix of the potential risks of a multi-modal solution for different business segments of a business unit and how to mitigate those risks</p> <p>Develop operational visibility for different business segments of a business unit or business segment</p> <p>Develop contracts for the different transport modes used for different business segments of a business unit</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Competency 5.1.4: Transport operational management
<p><b>Definition:</b></p> <p>Transport operational management focuses on the process of moving cargo from the distribution requirements planning, load planning, route planning, vehicle scheduling to the assurance of quantity and quality. Tracking vehicles and cargo during the process of transport will be required to ensure on time delivery, contingency planning if required and the safety and security of cargo. The process will be ended with the processing of PODs and managing the payment of transport service providers. Liaison with all stakeholders during the process of transport needs to provide visibility to all of progress against scheduled delivery times. Key performance indicators such as vehicle utilisation, transport costs and customer service levels need to be optimised while complying with risk and governance requirements, including legislation.</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain the transport requirements or distribution requirements planning</p> <p>Explain the translation of distribution requirements and constraints into load planning</p> <p>Explain how vehicle selection (e.g. trucks, vessels, tankers,</p>	<p>Perform transport requirements or distribution requirements planning for a specific segment of business</p> <p>Translate distribution requirements into load planning for a specific segment of business</p>	<p>Perform transport requirements or distribution requirements planning for the total business unit</p> <p>Translate distribution requirements into load planning for the total business unit</p> <p>Perform vehicle selection (e.g. trucks, vessels, tankers, pipelines)</p>

Awareness	Knowledge	Skilled
<p>pipelines) takes place once load planning is completed</p> <p>Describe the route planning and vehicle scheduling process</p> <p>Show understanding of tracking vehicles and cargo during the process of delivery</p> <p>Explain management of inventory while in transit, including safeguarding and sealing systems</p> <p>Explain the types of contingency planning required to ensure that cargo is delivered on time</p> <p>Explain providing visibility to relevant stakeholders for cargo during delivery</p> <p>Explain diversions during the process of delivery</p> <p>Explain the admin requirements of PODs and the management thereof</p> <p>Describe the payment process of service providers once PODs are submitted</p>	<p>Perform vehicle selection (e.g. trucks, vessels, tankers, pipelines) once load planning is completed for a specific segment of business</p> <p>Perform route planning and vehicle scheduling for a specific segment of business</p> <p>Perform tracking vehicles and cargo during the process of delivery</p> <p>Perform contingency planning required to ensure that cargo is delivered on time</p> <p>Provide visibility to all stakeholders for cargo during delivery for a specific segment of business</p> <p>Manage diversions during the process of delivery</p> <p>Implement process of collecting and processing PODs for a specific segment of business</p> <p>Implement process for payment of service providers once PODs are submitted</p>	<p>once load planning is completed for the total business unit</p> <p>Perform route planning and vehicle scheduling for different routes and transport modes across the total business unit</p> <p>Track different transport modes and cargo during the process of delivery for the total business unit</p> <p>Contingency planning required to ensure that cargo is delivered on time for the total business unit</p> <p>Provide visibility to all stakeholders for cargo during delivery for the total business unit</p> <p>Manage diversions during the process of delivery for the total business unit</p> <p>Implement process of collecting and processing PODs for a specific segment of business for the total business unit</p> <p>Implement process for payment of service providers once PODs are submitted for the total business unit</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

<b>Competency 5.1.5: Reverse logistics management</b>
<p><b>Definition:</b></p> <p>Reverse logistics refers to the management of the movement involved in the return of products or empty containers from downstream customers to upstream operations for either rework or re-use in the production of new products. Planning the collection of such products needs to be synchronised with the distribution and transport processes. This includes disposal of products.</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain the role of reverse logistics in the total logistics network</p> <p>Explain how the requirements for reverse logistics are planned as part of the sales &amp; operations planning</p> <p>Explain the areas of synergies between normal and reverse logistics and how to exploit the opportunities for cost savings</p> <p>Explain how planning for reverse logistics needs to be integrated with transport operational</p>	<p>Integrate the role of reverse logistics in the total logistics network</p> <p>Determine the requirements for reverse logistics from the sales &amp; operations planning process</p> <p>Exploit the areas of synergies between normal and reverse logistics and how to exploit the opportunities for cost savings</p> <p>Integrate planning for reverse logistics through integration with transport operational scheduling</p>	<p>Integrate the role of reverse logistics in the total logistics network</p> <p>Determine the requirements for reserve logistics from the sales &amp; operations planning process</p> <p>Exploit the areas of synergies between normal and reverse logistics and how to exploit the opportunities for cost savings</p> <p>Integrate planning for reverse logistics through integration with transport operational scheduling</p>

Awareness	Knowledge	Skilled
scheduling Explain the special administration and documentation requirements of reverse logistics	Perform the special administration and documentation requirements of reverse logistics	Perform the special administration and documentation requirements of reverse logistics

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Competency 5.1.6: Fleet management
<p><b>Definition:</b> Fleet management involves the end-to-end process of managing an internal or own transport fleet. This process starts with the development of fleet requirements based on the transport or distribution requirements. This will be followed by the selection of the best-suited transport fleet, which would include selection of vehicles, trailers and other equipment that might be required in the transport process. Financing the fleet needs to be arranged in terms of the best approach from options such as full maintenance leasing and others. Once the fleet is operational, asset management is required which manages the process of maintaining the fleet, scheduling services and repairs, cost accounting of all costs and the eventual replacement of the fleet.</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
Describe the process of developing transport fleet requirements Explain requirements for compliance, including legal requirements, health and safety, business rules and labour legislation Explain the process of costing the different fleet options using a TCO approach Explain the process of selecting the best transport fleet for the specific requirement Explain the selection of the best support equipment required for transport requirements Explain the process, requirements, options and selection of the best financing option for selected fleet Explain the different maintenance requirements and strategies Describe the process of asset management to manage the operational availability and cost of an operational fleet, while maximising return on existing assets	Develop the transport fleet requirements for a specific transport requirement within a business unit Implement processes and business rules to ensure compliance, including legal requirements, health and safety, business rules and labour legislation Develop costing for the different fleet options using a TCO approach Select the best transport fleet for the specific requirement within a business unit Select the best support equipment required for transport requirements within a business unit Select the best financing option for selected fleet within a business unit Implement different maintenance strategies and programmes for a subset within a business unit Implement asset management approach to manage the operational availability and cost of an operational fleet within a business unit	Develop the transport fleet requirements for the total transport requirements of a business unit Develop processes and business rules to ensure compliance, including legal requirements, health and safety, business rules and labour legislation Develop costing for the different fleet options using a TCO approach Select the best transport fleet for the total requirements within a business unit Select the best support equipment required for the total transport requirements within a business unit Select a combination of financing options for selected fleet within a business unit Implement different maintenance strategies and programmes for a business unit Implement asset management approach to manage the operational availability and cost of an operational fleet for a business unit

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

### 7.8.6. Meta-competency 6: Make

#### Competency 6.1: Determine manufacturing strategy

**Definition:** Definition: Manufacturing strategy is the process that starts with understanding the market requirements in terms of product and customer service, translating these into order winning criteria as the key market drivers of manufacturing strategy. With the market drivers as the key driver, the manufacturing strategy focuses on taking key decisions regarding order fulfilment approach such make-to-stock, make-to-order or assemble to order, production capacity, location, collaboration, and partnerships and what manufacturing processes will be followed. Manufacturing processes include the manufacturing planning and control system, shop floor control system and the material flow approach. The ultimate objective is to integrate manufacturing with the overall supply chain into a seamless flow of material and products from suppliers to customers if the most cost effective way, meeting customer expectations.

Source: Hill, 2000, Jacobs, et al., 2011, Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p><b>Explain</b> the role of market requirements determining the manufacturing strategy that should be followed</p> <p><b>Explain</b> market requirements such as product and customer service requirements in more detail</p> <p><b>Explain</b> what key decisions need to be made in manufacturing strategy</p> <p>Explain what strategic concepts need to be considered in formulating a manufacturing strategy</p> <p><b>Explain</b> the different master production scheduling alternatives that could be followed based on the manufacturing strategy followed</p> <p><b>Explain</b> the alternative approaches with material requirements planning that could be followed based on the master production scheduling approach that is followed</p> <p><b>Explain</b> how the master production scheduling approach should be linked to approach to shop floor control</p>	<p><b>Identify</b> the role of market requirements determining the manufacturing strategy that should be followed</p> <p><b>Translate</b> the market requirements such as product and customer service requirements into manufacturing requirements</p> <p><b>Identify</b> the options available in making the key decisions in manufacturing strategy</p> <p><b>Apply</b> strategic concepts such complexity and flexibility in formulating a manufacturing strategy</p> <p><b>Align</b> the master production scheduling approach with the manufacturing strategy followed</p> <p><b>Align</b> the material requirements planning approach based on the master production scheduling approach that is followed</p> <p><b>Align</b> the master production scheduling approach with the shop floor control approach</p>	<p><b>Evaluate</b> the market requirements such as product and customer service requirements into manufacturing requirements</p> <p><b>Align</b> the options available in making the key decisions in manufacturing strategy with the market requirements</p> <p><b>Evaluate</b> the alignment of manufacturing strategy with multiple supply chain strategies</p> <p><b>Evaluate</b> approaches towards dealing with the strategic challenges such as complexity and flexibility in formulating a manufacturing strategy</p> <p><b>Evaluate</b> the alignment of the master production scheduling approach with the manufacturing strategy followed</p> <p><b>Evaluate</b> the alignment of the material requirements planning approach with the master production scheduling approach that is followed</p> <p><b>Evaluate</b> the alignment of the master production scheduling approach that is followed with the shop floor control approach</p>

Adapted from: Hill, 2000, Jacobs *et al.*, 2011, Supply Chain Council, 2014; CSCMP, 2014.

**Competency 6.2: Product design**

**Definition:** Product development can be defined as follows: Aspects such as design of products to not only optimise the product but also optimise the supply chain cost during the life cycle of products are addressed. Product development can be organised into five basic management processes (plan, research, design, integrate, and amend) that provide the organisational structure of the DCOR-model. It is useful to distinguish between the three process types in the model: plan, execute, and enable. A planning element is a process that aligns expected resources to meet expected design requirements. Planning processes balance aggregated demand across a consistent planning horizon. Planning processes generally occur at regular intervals and can contribute to design chain response time. Execution processes are triggered by planned or actual demand that changes the state of products. They include scheduling and sequencing, researching and design, materials and integrating product, and amend. Enable processes: prepare, maintain and manage information or relationships upon which planning and execution processes rely.

Source: Adapted from Trott, 2012; Cravens, 2000; Council for Professional Supply Chain Management, 2010 & Supply Chain Council, 2014.

Awareness	Knowledge	Skilled
<p><b>Explain</b> why product design is important for supply chain management</p> <p><b>Explain</b> how product design can generate supply chain savings</p> <p><b>Explain</b> what the potential impact of product packaging is on supply chain performance</p> <p><b>Explain</b> the concept of collaborative design with supply chain partners such as suppliers</p> <p><b>Explain</b> what the objective of product portfolio management is</p> <p><b>Explain</b> how product portfolio management can affect supply chain performance</p>	<p><b>Apply</b> supply chain principles to the development of a product for a business or business unit</p> <p><b>Participate</b> in the process of designing a product for improved supply chain performance</p> <p><b>Participate</b> in a collaborative product design process with supply chain partners such as suppliers</p> <p><b>Apply</b> the principles of product portfolio management to a number of products within a business to improve supply chain performance</p> <p><b>Demonstrate</b> cause-and-effect understanding in the application of product portfolio management</p>	<p><b>Apply</b> supply chain principles to the development of multiple products for a business or business unit</p> <p><b>Participate</b> in the process of designing multiple products for improved supply chain performance</p> <p><b>Participate</b> in multiple collaborative product design processes with supply chain partners such as suppliers</p> <p><b>Apply</b> the principles of product portfolio management to a number of products across businesses to improve supply chain performance</p>

Source: Adapted from Trott, 2012; Cravens, 2000; Council for Professional Supply Chain Management, 2010 & Supply Chain Council, 2014.

**Competency 6.3: Production planning & scheduling**

**Definition:** The development and establishment of courses of action over specified time periods that represent a projected utilisation of production resources to meet production requirements. To determine the optimal sequencing (schedule), allocation and routing of production orders guided by the production and supply plan and based on detailed product attributes, changeover requirements, customer order due dates, work centre capability, labour required, and other constraints.

Source: Adapted from Schonberger & Knod, 1994; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p><b>Explain</b> the basic economic/market factors that drive demand &amp; supply in the specific industry/market</p> <p><b>Explain</b> the impact of business drivers and business planning (e.g. profitability, external environment, transport procurement principles) on production planning</p> <p><b>Explain</b> in broad terms the production process and production realities</p> <p><b>Explain</b> which constraints and risks need to be taken into account during the development of a production plan, and how to resolve those constraints and mitigate the risks</p> <p><b>Explain</b> the process of compiling a production plan and its importance in ensuring supply chain performance</p> <p><b>Explain</b> how the production plan translate distribution requirements into manufacturing requirements to specify the planned production per plant and per line</p> <p><b>Explain</b> at what level of detail and what time line is used for the development of the production</p> <p><b>Explain</b> the interdependence between production schedules and production / supply planning</p> <p><b>Explain</b> how process sequencing, staging and setting production run lengths work per product and production unit</p> <p><b>Explain</b> the scheduling of people per work shift for a set production schedule</p> <p><b>Explain</b> how the scheduling of a production unit depends on up- and downstream supply &amp; inventory</p> <p><b>Explain</b> the impact of production schedule changes on material requirements</p>	<p><b>Apply</b> the basic economic/market factors that drive demand &amp; supply in a specific industry/market</p> <p><b>Apply</b> business drivers and business planning (e.g. profitability, external environment, transport procurement principles) to production planning</p> <p><b>Perform</b> the process of compiling a production plan for selected lines or plants to secure supply chain performance</p> <p><b>Identify</b> the constraints and risks that need to be taken into account during the development of a production plan, and formulate strategies to resolve those constraints and mitigate the risks</p> <p><b>Perform</b> the translation of market demand into manufacturing requirements to specify the planned production per plant and per line for selected lines or plants</p> <p><b>Develop</b> the required level of detail and time line used for the development of the production plan for selected lines or plants</p> <p><b>Apply</b> the manufacturing rules such as sequencing in the process of developing a production plan for selected lines or plants</p> <p><b>Confirm</b> resource availability to be confirmed in the process of developing a production plan for selected lines or plants</p> <p><b>Perform</b> process sequencing, staging and setting production run lengths per product and production unit within a set production &amp; supply plan and production targets while taking into account customer orders; inventory &amp; delivery plans and priorities; and broad business rules</p> <p><b>Perform</b> scheduling of people per shift group for a set production schedule per product and production unit</p> <p><b>Perform</b> plant &amp; labour scheduling according to set procedures</p> <p><b>Pro-actively influence</b> the drafting of up- and downstream supply schedules &amp; inventory replenishment for a production unit's schedule</p> <p><b>Pro-actively influence</b> material requirements based on production schedule changes per product and production unit</p>	<p><b>Apply</b> the basic economic/market factors that drive demand &amp; supply in a specific industry/market</p> <p><b>Apply</b> business drivers and business planning (e.g. profitability, external environment, transport procurement principles) to production planning</p> <p><b>Perform</b> the process of compiling a production plan for all lines or plants in a business unit to secure supply chain performance</p> <p><b>Identify</b> the constraints and risks that need to be taken into account during the development of a production plan, and formulate strategies to resolve those constraints and mitigate the risks</p> <p><b>Perform</b> the translation of market demand into manufacturing requirements to specify the planned production for all lines or plants in a business unit</p> <p><b>Develop</b> the required level of detail and time line used for the development of the production plan for all lines or plants in a business unit</p> <p><b>Apply</b> the manufacturing rules such as sequencing in the process of developing a production plan for all lines or plants in a business unit</p> <p><b>Confirm</b> resource availability to be confirmed in the process of developing a production plan for all lines or plants in a business unit</p> <p><b>Develop</b> more innovate approaches to improve production planning across business units</p> <p><b>Facilitate</b> cross-functional integration as required to optimise production planning across business units</p> <p><b>Perform</b> scheduling of people per production line &amp; team for a set production schedules</p> <p><b>Perform</b> plant &amp; labour scheduling with the aid of heuristics</p> <p><b>Participate</b> in the drafting of up- and downstream supply schedules &amp; inventory replenishment for a production unit's schedule</p> <p><b>Pro-actively influence</b> material requirements based on production schedule changes for a range of product and production lines</p>

Source: Adapted from Schonberger & Knod, 1994; Supply Chain Council, 2014; CSCMP, 2014.

**Competency 6.4: Execution management**

**Definition:** Manufacturing execution is focused on delivering against the master production schedule through the different layers of planning down to the materials requirements plan and detailed order schedule. The detailed capacity and detailed materials plan is used as the key drivers of execution management. The execution process extends across all sources of production, that includes internal production, contracted production, suppliers for raw material or components. A primary interface for execution management is the shop floor control system linked to visibility of delivery from external sources. Concepts such as lead time management, theory of constraints and priority sequencing are applied.

Source: Hill, 2000, Jacobs, et al., 2011, Schonberger & Knod, 1994; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p><b>Explain</b> the concept of production activity control or manufacturing execution management</p> <p><b>Identify</b> the key variables that need to be controlled through production execution management</p> <p><b>Explain</b> what are the key input or drivers of the execution management process</p> <p><b>Explain</b> how a concept such as just-in-time can impact of execution management</p> <p><b>Explain</b> how the concept of theory of constraints can impact on execution management</p> <p><b>Explain</b> what techniques will be applied during the execution management process</p> <p><b>Explain</b> the concept of buffer management as part of execution management</p> <p><b>Explain</b> how workflow management can enable execution management</p> <p><b>Explain</b> how vendor scheduling can be applied in execution management</p> <p><b>Explain</b> how a manufacturing execution system can enable the execution process</p>	<p><b>Implement</b> the concept of production activity control or manufacturing execution management</p> <p><b>Implement</b> detailed capacity and materials planning to control production execution management</p> <p>Identify the key input or drivers of the execution management process</p> <p><b>Implement</b> the concept such as just-in-time can impact of execution management</p> <p><b>Implement</b> the concept of theory of constraints can impact on execution management</p> <p><b>Apply</b> the techniques will be applied during the execution management process</p> <p><b>Apply</b> the concept of buffer management as part of execution management</p> <p><b>Apply</b> workflow management to enable execution management</p> <p><b>Apply</b> vendor scheduling can be applied in execution management</p> <p><b>Implement</b> a manufacturing execution system to enable the execution process</p>	<p><b>Evaluate</b> the process of production activity control or manufacturing execution management</p> <p><b>Evaluate</b> detailed capacity and materials planning as drivers of control production execution management</p> <p><b>Evaluate</b> the key input or drivers of the execution management process</p> <p><b>Evaluate</b> the implementation of just-in-time to improve execution management</p> <p><b>Evaluate</b> the implementation of the concept of theory of constraints to improve execution management</p> <p><b>Evaluate</b> the application of various techniques during the execution management process</p> <p><b>Evaluate</b> the application of buffer management as part of execution management</p> <p><b>Evaluate</b> the use of workflow management to enable execution management</p> <p><b>Evaluate</b> the application of vendor scheduling in execution management</p> <p><b>Identify</b> opportunities for the improvement of the implementation of a manufacturing execution system to enable the execution process</p>

Source: Hill, 2000, Jacobs, et al., 2011, Schonberger & Knod, 1994; Supply Chain Council, 2014; CSCMP, 2014.

### 7.8.7. Meta-competency 7: Warehousing and facilities management

#### Competency 7.1: Facility design and layout

##### Definition:

Facility design and layout focuses firstly on the design and layout of the facility/building which includes the size and configuration of the building/facility. The second element includes the design of the operational flow of material or product and selection of material handling equipment such as racking, forklifts and any other special equipment required. The objective is to maximise the productivity of the facility while achieving risk management, health and safety objectives through governance policies, procedures and legislation.

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain the principles applicable to the design and layout of facilities</p> <p>Explain the different flow patterns that can be applied in the design and layout of facilities</p> <p>Explain the design of applicable storage equipment</p> <p>Explain the layout and design of the site (outside of the facility) required for movement of vehicles or other transport modes</p> <p>Explain the integration of the facility with the inflow and outflow of product, such as routes, roads, pipelines, marine or rail</p> <p>Explain the health, safety and legal requirements that should be taken into account including product compatibility</p> <p>Explain the potential risks that should be taken into account with facility design</p>	<p>Apply the principles applicable to the design and layout of facilities to the design of a small facility or part of a facility</p> <p>Design the required flow pattern for the design and layout of a small facility or part of a facility</p> <p>Design applicable storage equipment that might be required of a small facility or part of a facility</p> <p>Complete the layout and design of the site (outside of the facility) required for movement of vehicles or other transport modes of a small facility or part of a facility</p> <p>Integrate the facility with the inflow and outflow of product, such as routes, roads, pipelines, marine or rail</p> <p>Apply the health, safety and legal requirements that should be taken into account including product compatibility</p> <p>Identify the potential risks that should be taken into account with facility design and formulate mitigation strategies</p>	<p>Apply the principles applicable to the design and layout of facilities to the design of a large facility with different products and handling approaches</p> <p>Design the required flow pattern for the design and layout of a large facility with different products and handling approaches</p> <p>Design applicable storage equipment that might be required of a large facility with different products and handling approaches</p> <p>Complete the layout and design of the site (outside of the facility) required for movement of vehicles or other transport modes of a large facility with multi-modal links</p> <p>Integrate the facility with the inflow and outflow of product, such as routes, roads, pipelines, marine or rail</p> <p>Apply the health, safety and legal requirements that should be taken into account including product compatibility</p> <p>Identify the potential risks that should be taken into account with facility design and formulate mitigation strategies</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

**Competency 7.2: Facilities operational management****Definition:**

Facilities operational management focuses on achieving daily throughput targets while maintaining productivity, health and safety and risk management objectives. Operational activities include receiving, put-away, blending, picking, pre-loading, loading, returns, documentation and administration. Included in facilities operational management are physical inventory management and control, and housekeeping.

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain the technical requirements of the specific type of facility managed</p> <p>Explain the basic operational activities taking place within facilities such as receiving, put-away, picking, pre-loading and loading</p> <p>Explain the documentation and administration requirements of the operational processes in facilities</p> <p>Describe the process of physical inventory management, including normal &amp; perpetual inventory takes</p> <p>Explain the health, safety and legal requirements involved in facility operational management, including product compatibility</p> <p>Explain the potential risks involved in daily facility operational management and required mitigation strategies</p> <p>Explain the basic rules of housekeeping and its importance for good operational management</p>	<p>Design &amp; implement the documentation and administration process for a small to medium single product facility (only hazardous or non-hazardous)</p> <p>Design &amp; implement the process of physical inventory management, including normal &amp; perpetual inventory takes for a small to medium single product facility</p> <p>Apply health, safety and legal management for a small to medium single product facility including product compatibility</p> <p>Identify the potential risks involved in daily facility operational management and implement the required mitigation strategies for a small to medium single product facility</p> <p>Apply the basic rules of housekeeping and its importance for good operational management for a small to medium single product facility</p>	<p>Design &amp; implement the documentation and administration process for a large multi-product facility for a business unit (hazardous &amp; non-hazardous)</p> <p>Design &amp; implement the process of physical inventory management, including normal &amp; perpetual inventory takes for a large multi-product facility</p> <p>Apply health, safety and legal management for a large multi-product facility including product compatibility</p> <p>Identify the potential risks involved in daily facility operational management and implement the required mitigation strategies for a large multi-product facility</p> <p>Apply the basic rules of housekeeping and its importance for good operational management for a large multi-product facility</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

**Competency 7.3: Inventory control****Definition**

The process of inventory control is focused on controlling inventory or stock in warehouses or facilities. The activities involved are receiving of products into a warehouse or facility, putting away these products and issuing these products for customer orders or transfer to other warehouses or facilities. The key objective is to achieve inventory accuracy, namely that the inventory physically in the facilities is accurate in terms of what should be there based on the transactional processes.

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain what the objective of inventory control is</p> <p>Explain how to calculate stock accuracy</p> <p>Explain the concept of reserved stock and how to manage that</p> <p>Explain what activities through a warehouse or facility need to be managed to ensure stock control</p> <p>Explain the potential causes of inaccurate stock on the floor</p> <p>Explain what techniques can be applied to monitor stock accuracy</p>	<p>Determine stock accuracy for a number of warehouses or facilities</p> <p>Identify the root causes which can result in low stock accuracy across a number of warehouses or facilities</p> <p>Implement strategies to ensure stock accuracy across different warehouses or facilities</p> <p>Implement strategies to ensure stock accuracy across different warehouses or facilities for different types of products</p>	<p>Manage the determination of stock accuracy for a number of warehouses or facilities</p> <p>Manage the identification of the root causes which can result in low stock accuracy across a number of warehouses or facilities</p> <p>Manage the implementation of strategies to ensure stock accuracy across different warehouses or facilities</p> <p>Manage the implementation of strategies to ensure stock accuracy across different warehouses or facilities for different types of products</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Competency 7.4: Materials handling
<p><b>Definition:</b></p> <p>Materials handling focuses on ensuring that products that are handled through the supply chain process are handled with safe and productive mechanisms to limit the associated risks and avoid product damage. This involves the selection of appropriate material packaging, handling equipment and techniques for different products through the different stages of product handling.</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain the objectives of material handling</p> <p>Explain the cost elements involved in material handling</p> <p>Explain the potential risks involved in material handling</p> <p>Explain the importance of product packaging in the handling process</p> <p>Explain where products are typically handled in the warehousing process</p> <p>Explain which factors would be considered in the process of selecting material handling equipment</p>	<p>Quantify the cost of material handling for all different warehouses and facilities</p> <p>Identify the opportunities for generating savings in material handling costs</p> <p>Identify the potential risk areas where material is handled through the supply chain</p> <p>Implement initiatives for generating cost savings in material handling cost</p> <p>Implement initiatives for risk mitigation in areas where products are handled</p> <p>Develop and implement a framework for the evaluation and selection of material handling equipment for different types of products that are handled</p>	<p>Manage the process to quantify the cost of material handling for all different warehouses and facilities</p> <p>Manage the identification of opportunities for generating savings in material handling costs</p> <p>Manage the identification of the potential risk areas where material is handled through the supply chain</p> <p>Manage the implementation of initiatives for generating cost savings in material handling cost</p> <p>Manage the implementation of initiatives for risk mitigation in areas where products are handled</p> <p>Manage the development and implementation of a framework for the evaluation and selection of material handling equipment for different types of products that are handled</p>

Source: Adapted from Ballou, 2004; Langley *et al.*, 2008; Bowersox *et al.*, 1999; Supply Chain Council, 2014; CSCMP, 2014.

### 7.8.8. Meta-competency 8: Procurement execution

#### Competency 8.1: Requisition-to-pay process

##### Definition:

Development, implementation and improvement of the process from the planning of sourcing orders based on a demand plan, through delivery up to supplier payment. This includes translating the operations plan into a sourcing plan with planned orders on suppliers, managing the placement of orders, prioritisation of the orders for delivery, liaison with transport/distribution ensuring delivery in line with priorities and customer service commitments. The process will also include the formulation of business rules and constant co-ordination with stakeholders to resolve changes in planning if required

Source: Adapted from Handfield *et al.*, 2009; Burt *et al.*, 2010; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
Explain how the supply order planning process relates to stakeholder fulfilment strategy	Align the supply order planning process with the stakeholder fulfilment strategy for a selected part of supply orders in a business unit	Align the supply order planning process with the stakeholder fulfilment strategy for all supply orders in a business unit
Explain the supply order planning process	Perform the supply order planning process for a selected part of supply orders in a business unit	Perform the supply order planning process for a selected part of supply orders in a business unit
Explain how the supply order planning process integrates with sales & operations planning	Integrate supply order planning process with sales & operations planning for a selected part of supply orders in a business unit	Integrate supply order planning process with sales & operations planning for all supply orders in a business unit
Explain how planned delivery dates of orders need to be aligned with customer service requirements, risks management and governance requirements	Align planned delivery dates of orders with customer service requirements, risks management and governance requirements for a selected part of supply orders in a business unit	Align planned delivery dates of orders with customer service requirements, risks management and governance requirements for all supply orders in a business unit
Explain what type of execution problems can occur such as distribution or credit blocks and how to remove those	Identify potential execution problems that can occur such as distribution or credit blocks and how to remove those for a selected part of supply orders in a business unit	Identify potential execution problems that can occur such as distribution or credit blocks and how to remove those for all supply orders in a business unit
Explain the process of stakeholder management during order execution to provide visibility and manage expectations	Perform stakeholder management during order execution to provide visibility and manage expectations for supply orders in a business unit	Perform the process of stakeholder management during order execution to provide visibility and manage expectations for all supply orders in a business unit

Source: Adapted from Handfield *et al.*, 2009; Burt *et al.*, 2010; Supply Chain Council, 2014; CSCMP, 2014.

### 7.8.9. Meta-competency 9: Green supply chain management

#### Competency 9.1: Supply chain sustainability

##### Definition:

Supply chain sustainability focuses on the implementation of principles and strategies that ensure the long-term sustainability of the supply chain. Aspects that are included in this are renewable energy, creating energy savings and various others. It is important that supply chain sustainability initiatives should be aligned with corporate initiatives.

Source: Adapted from Shi, Koh, Baldwin and Cucchiella, 2012; Cervera & Flores, 2012; Supply Chain Council, 2014.

Awareness	Knowledge	Skilled
Explain the concept of supply chain sustainability	Evaluate the current status of supply chain sustainability of your company	Manage the evaluation of the current status of supply chain sustainability of your company
Explain the importance of supply chain sustainability	Identify the areas for improvement in supply chain sustainability and which actions should be implemented	Manage the identification of areas for improvement in supply chain sustainability and which actions should be implemented
Explain what initiatives can be implemented to improve supply chain sustainability	Implement improvement actions to improve the supply chain sustainability of your company	Manage the implementation of improvement actions to improve the supply chain sustainability of your company
Explain who should be involved in the implementation of supply chain sustainability initiatives	Implement improvement actions in collaboration with supply chain partners to improve the supply chain sustainability of your company	Manage the implementation of improvement actions in collaboration with supply chain partners to improve the supply chain sustainability of your company

Source: Adapted from Shi *et al.*, 2012; Cervera & Flores, 2012; Supply Chain Council, 2014.

#### Competency 9.2: Environmental management

##### Definition:

Environmental management within supply chain focuses on how the supply chain interfaces with the environment. The objective is to avoid any harmful effects that the supply chain might have on the environment. The process involves the identification of potentially harmful impacts, and the formulation of actions to avoid such impact.

Source: Adapted from Shi *et al.*, 2012; Cervera & Flores, 2012; Supply Chain Council, 2014.

Awareness	Knowledge	Skilled
Explain why environmental management is important for supply chain management	Complete an assessment for the environmental impact of the supply chain of your company	Manage the completion of an assessment for the environmental impact of the supply chain of your company
Explain what potential harmful impacts the supply chain can have on the environment	Identify the potential harmful impacts that the supply chain of your company might have on the environment	Manage the identification of the potential harmful impacts that the supply chain of your company might have on the environment
Explain what strategies can be implemented to avoid the harmful impact of supply chain on the environment	Develop action plans to reduce the harmful impact and increase the positive impacts on the environment	Manage the development of action plans to reduce the harmful impact and increase the positive impacts on the environment

Awareness	Knowledge	Skilled
Explain who should be involved in environmental management	Implement action plans to reduce the harmful impact and increase the positive impacts on the environment	Manage the implementation of action plans to reduce the harmful impact and increase the positive impacts on the environment

Source: Adapted from Shi *et al.*, 2012; Cervera & Flores, 2012; Supply Chain Council, 2014.

### 7.8.10. Meta-competency 10: Performance management

Competency 10.1: Supply chain performance indicators
<p><b>Definition:</b> Supply chain performance indicators include two aspects, performance attributes and performance metrics. A performance attribute is a grouping of indicators used to express a specific strategy, while an indicator is a standard for measurement of the performance or a supply chain or process. The performance attributes include reliability (this focuses on the predictability of the outcome of a process); responsiveness (describes the speed at which tasks are performed); agility (describes the ability to respond to external influences); cost (describes the cost of operating a process and includes all aspects of costs expressed as total costs to serve); and assets (describes the ability to efficiently utilise assets, which includes both fixed and variable assets). Supply chain performance metrics are defined at different levels based on the composition of the relevant supply chain process. Performance metrics are aligned with performance attributes and provide cause-and-effect measurements at three levels to enable performance measurement to a detail or activity level.</p>

Source: Adapted from Supply Chain Council, 2014; CSCMP, 2014; Bowersox *et al.*, 1999.

Awareness	Knowledge	Skilled
<p>Explain the concept of supply chain performance attributes</p> <p>Explain the concept of supply chain performance metrics or measures</p> <p>Explain the different supply chain performance attributes such as reliability, etc.</p> <p>Explain what the different levels of supply chain metrics or indicators are</p> <p>Explain how the different levels of supply chain performance metrics or indicators relate to each other</p> <p>Outline the supply chain performance metrics at level 1</p> <p>Explain the importance of master data for supply chain performance measurement</p> <p>Identify some of the different types of master data</p>	<p>Calculate perfect order fulfilment for a business unit or a business</p> <p>Calculate order fulfilment cycle time for a business unit or business</p> <p>Calculate total cost to serve for a business unit of business</p> <p>Calculate the cash-to-cash cycle time for a business unit or business</p> <p>Calculate the return on fixed assets for a business unit or business</p> <p>Calculate the return on working capital for a business unit or a business</p> <p>Identify which supply chain processes would impact on each of the above supply chain performance metrics</p>	<p>Calculate the level two and three performance metrics that would impact on perfect order fulfilment</p> <p>Calculate the level two and three performance metrics that would impact on order fulfilment cycle time</p> <p>Calculate the level two and three performance metrics that would impact total cost to serve</p> <p>Calculate the level two and three performance metrics that would impact the cash-to-cash cycle time</p> <p>Calculate the level two and three performance metrics that would impact the return on fixed assets</p> <p>Calculate the level two and three performance metrics that would impact the return on working capital</p> <p>Link the relevant supply chain best practices to each of the above calculations</p> <p>Explain how the extended supply chain would impact on the above performance metrics</p>

Source: Adapted from Supply Chain Council, 2014; CSCMP, 2014; Bowersox *et al.*, 1999.

**Competency 10.2: Implementation of outsourcing****Definition:**

Facilities outsourcing involves the process of using external facilities providers to fulfil facilities requirements. This will involve the in-depth understanding of the facilities requirement, the development of RFQ documentation, identification of potential service providers, requesting proposals, evaluation of proposals and the selection of the provider best suited for the requirement. Contract implementation will require the contracting process to be completed followed by contract management based on a service level agreement to ensure the required performance from both parties.

Source: Adapted from Burt *et al.*, 2010; Fawcett *et al.*, 2007.

Awareness	Knowledge	Skilled
<p>Explain the technical requirements of the specific type of facility to be outsourced</p> <p>Explain the development of a facilities requirements plan and scope of work</p> <p>Explain the development of RFQ documentation which clearly states requirements and assumptions</p> <p>Explain the identification and qualification of potential facilities service providers</p> <p>Explain the process of requesting facilities proposals from various service providers</p> <p>Explain the evaluation of alternative proposals provided by different service providers</p> <p>Explain the development and negotiation of agreements, e.g. commercial, operational, service level agreements</p> <p>Explain the issues and process of commissioning new service providers</p> <p>Describe the process of contract management and dealing with changes required in the contract during its duration</p>	<p>Develop a facilities requirements plan and scope of work for a specific contract focusing on a business segment</p> <p>Develop RFQ documentation which clearly states requirements and assumptions focusing on a business segment</p> <p>Identify and qualify potential facilities service providers for a specific contract</p> <p>Request facilities proposals from various service providers for a specific contract</p> <p>Evaluate alternative proposals provided by different service providers for a specific contract</p> <p>Develop and negotiate agreements, e.g. commercial, operational, service level agreements, for a specific contract</p> <p>Commission new service providers for a specific contract</p> <p>Contract management and dealing with changes required in the contract during its duration for a specific contract</p>	<p>Develop a facilities requirements plan and scope of work for a variety of contracts focusing on a business unit</p> <p>Develop RFQ documentation which clearly states requirements and assumptions for different contracts focusing on a business unit</p> <p>Identify and qualify potential facilities service providers for a variety of contracts within a business unit</p> <p>Request facilities proposals from various service providers for a variety of contracts</p> <p>Evaluate alternative proposals provided by different service providers for a variety of contracts</p> <p>Develop and negotiate agreements, e.g. commercial, operational, service level agreements, for a variety of contracts for a business unit</p> <p>Commission new service providers for a variety of contracts</p> <p>Contract management and dealing with changes required in various contracts during the duration of those contracts</p>

Source: Adapted from Burt *et al.*, 2010; Fawcett *et al.*, 2007.

**Competency 10.3: Process optimisation across the supply chain****Definition:**

Ensure continuous improvement of business performance across the supply chain performance improvement. This would include assessment of current performance across and between all areas of supply chain, for example supply chain planning, outbound strategy, procurement strategy, demand fulfilment, facilities and transport management. Assessment will be followed by identification of improvement strategies, process development, master data planning, implementation plans and the actual implementation.

Source: Adapted from Fawcett *et al.*, 2007; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain the importance of business process optimisation</p> <p>Identify the potential areas of how business process improvement can be achieved</p> <p>Identify potential ways to improve business performance</p> <p>Explain some of the basic analysis techniques to identify opportunities for improvement</p> <p>Explain some of the barriers towards achieving business process optimisation</p>	<p>Implement business process optimisation within a specific supply chain process group or sub-process</p> <p>Identify opportunities for improvement of a sub-process such as customer demand management or facilities management</p> <p>Perform analysis of activities, sub-processes and resources to quantify the improvement opportunities</p> <p>Compare alternative plans to achieve process improvement and select the best plan of action</p> <p>Formulate implementation plan for the execution of the plan</p> <p>Identify the potential barriers to success and develop contingency plans</p>	<p>Manage business process optimisation across supply chain management processes within the same business</p> <p>Manage process optimisation through trade-offs and resolving conflicting functional objectives in the different areas of the supply chain</p> <p>Implement process optimisation through integration of all elements such as strategy, infrastructure, processes and people management</p> <p>Identify cause-and-effect drivers of performance using performance multi-level scorecards</p> <p>Test optimisation alternatives using decision support tools such as simulations</p> <p>Formulate change management initiatives to ensure successful implementation of process optimisation</p>

Source: Adapted from Fawcett *et al.*, 2007; Supply Chain Council, 2014; CSCMP, 2014.

Competency 10.4: Supply chain improvement concepts
<p><b>Definition</b></p> <p>For improving supply chain performance, it is important to have a good understanding of the improvement concepts that underline supply chain performance. These concepts need to be implemented as part of a process of performance improvement.</p>

Source: Adapted from Fawcett *et al.*, 2007; Ireland and Crum, 2005; Lambert *et al.*, 1998; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Identify potential improvement concepts that can be implemented to improve supply chain performance</p> <p>Explain why it is important to understand the improvement concepts before performance can be improved</p> <p>Explain the concepts and principles of improvement</p>	<p>Identify which supply chain improvement concepts can be applied for the improvement of the performance of the company's supply chain</p> <p>Formulate an action plan to implement improvement concepts such as quick response and others in the supply chain of the company</p> <p>Implement the action with improvement concepts such as quick response and others in the supply chain of the company</p>	<p>Manage the identification of which supply chain improvement concepts can be applied for the improvement of the performance of the company's supply chain</p> <p>Manage the formulation of an action plan to implement improvement concepts such as quick response and others in the supply chain of the company</p> <p>Manage the implementation of the action with improvement concepts such as quick response and others in the supply chain of the company</p>

Source: Adapted from Fawcett *et al.*, 2007; Ireland and Crum, 2005; Lambert *et al.*, 1998; Supply Chain Council, 2014; CSCMP, 2014.

<b>Competency 10.5: Structuring and change management</b>
<p><b>Definition:</b></p> <p>This is the process of aligning people with different views and perspectives with a shared vision and objectives in terms of outbound supply chain strategy and direction. It involves addressing resistance to change through change management interventions with communication mechanisms, dealing with obstacles in the process of managing different stakeholders representing different groups with different objectives.</p>

Source: Adapted from Gattorna, 2006; Ballou, 2004; Christopher, 2005.

<b>Awareness</b>	<b>Knowledge</b>	<b>Skilled</b>
<p>Explain the importance of change management to implement outbound supply chain strategies successfully</p> <p>Explain the basic principles and concepts involved in change management</p> <p>Explain the concept of stakeholder management</p> <p>Explain the potential barriers to change</p> <p>Identify potential strategies to overcome barriers to change</p>	<p>Participate in change management for initiatives within a specific sub-process or function of the supply chain</p> <p>Identify potential barriers to implementing outbound supply chain projects</p> <p>Formulate and implement a change management programme</p> <p>Identify conflicting objectives of different stakeholders within a sub-process</p> <p>Facilitate a process of compromises to achieve a common goal within a sub-process</p> <p>Participate in the process of aligning performance objectives for a sub-process</p>	<p>Develop and implement change management programmes across macro processes within a business</p> <p>Facilitate a process to align vision and objectives across different supply chain macro processes such as procure &amp; supply, outbound and planning</p> <p>Facilitate a process of aligning objectives across functions such as supply chain, marketing, manufacturing and financial management</p> <p>Formulate communication programmes to align stakeholders across different levels of the business</p>

Source: Adapted from Gattorna, 2006; Ballou, 2004; Christopher, 2005.

<b>Competency 10.6: Systems technology deployment</b>
<p><b>Definition:</b></p> <p>This involves the process of selecting and implementing different types of systems technology to enable outbound supply chain processes and operations for the purpose of performance improvement. This will include the identification of improvement opportunities, understanding the different types of system technologies available, how to assess the functionality of different technologies, integrating these system technologies into technology architecture and the formulation of an implementation plan to ensure the successful implementation of such system technologies.</p>

Source: Adapted from Lambert *et al.*, 1998; Frazelle, 2002; Supply Chain Council, 2014; CSCMP, 2014.

<b>Awareness</b>	<b>Foundation</b>	<b>Skilled</b>
<p>Explain the importance of systems technology for achieving outbound supply chain improvement</p> <p>Identify different types of systems technologies that might be applied to achieve enablement of outbound supply chain</p>	<p>Implement systems technology enablement for a specific sub-process such as customer demand fulfilment</p> <p>Link different types of system technologies to the different areas of outbound supply chain management where it can be used for enablement</p> <p>Manage the process of implementing</p>	<p>Implement technology enablement projects for macro-processes such as outbound supply chain.</p> <p>Manage multi-functional technology enablement projects that span different functions such as procure &amp; supply, outbound supply chain</p> <p>Interface with stakeholders across different levels and functions to align</p>

Awareness	Foundation	Skilled
<p>management</p> <p>Explain the process of implementing systems technology to achieve improvement</p> <p>Explain some of the challenges of successful systems technology implementation</p>	<p>systems technology projects in selected areas of the sub-strategy such as customer demand management</p> <p>Manage the interface with different stakeholders such as IM department and outside vendors during small scale projects</p> <p>Interface with business users to ensure successful implementation</p> <p>Complete post-implementation audit to track performance improvement achieved</p>	<p>objectives within a business case for technology</p> <p>Manage the process of developing functional requirements across business functions</p> <p>Manage the process of technology and vendor selection with the involvement of management across different levels of the business</p> <p>Manage the process of technology implementation that involves multiple functions of the business with significant capital investment involved</p>

Source: Adapted from Lambert *et al.*, 1998; Frazelle, 2002; Supply Chain Council, 2014; CSCMP, 2014.

Competency 10.7: Contract and supplier performance management
<p><b>Definition:</b></p> <p>The process of supplier performance management focuses on establishing relationships with selected suppliers, achieving integration, supplier performance measurement for the purpose of achieving supplier performance and supplier development where required, taking into account industry-specific legislative requirements.</p>

Source: Adapted from Handfield *et al.*, 2009; Burt *et al.*, 2010; Supply Chain Council, 2014; CSCMP, 2014.

Awareness	Knowledge	Skilled
<p>Explain the importance of supplier performance management in achieving successful demand fulfilment</p> <p>Explain the key principles and objectives of supplier relationship management</p> <p>Explain which strategies for supplier relationship management can be applied</p> <p>Explain the purpose and process of supplier integration</p> <p>Explain which strategies for supplier integration can be applied</p> <p>Explain the principles and process of supplier performance measurement</p> <p>Explain the alternative</p>	<p>Perform supplier relationship management for a selected part of the procurement portfolio of a business unit</p> <p>Apply different strategies for supplier relationship management for a selected part of the procurement portfolio of a business unit</p> <p>Perform the process of supplier integration for a selected part of the procurement portfolio of a business unit</p> <p>Apply the strategies for supplier integration for a selected part of the procurement portfolio of a business unit</p> <p>Perform the process of supplier performance management for a selected part of the procurement portfolio of a business unit</p> <p>Implement alternative corrective actions in case of supplier non-performance for a selected part of the procurement portfolio of a business unit</p> <p>Implement the alternative corrective action in case of supplier non-performance for a selected part of the procurement portfolio of a business unit</p>	<p>Perform supplier relationship management for total procurement portfolio of a business unit</p> <p>Apply different strategies for supplier relationship management for the total procurement portfolio of a business unit</p> <p>Perform the process of supplier integration for the total procurement portfolio of a business unit</p> <p>Apply the strategies for supplier integration for the total procurement portfolio of a business unit</p> <p>Perform process of supplier performance management for the total procurement portfolio of a business unit</p> <p>Implement alternative corrective actions in case of supplier non-performance for the total procurement portfolio of a business unit</p> <p>Implement the alternative corrective action in case of supplier non-performance for the total procurement portfolio of a business unit</p>

Awareness	Knowledge	Skilled
corrective action in case of supplier non-performance Explain the purpose and process of supplier development	Perform the process of supplier development for a selected part of the procurement portfolio of a business unit	Perform the process of supplier development for the total procurement portfolio of a business unit

Source: Adapted from Handfield *et al.*, 2009; Burt *et al.*, 2010; Supply Chain Council, 2014; CSCMP, 2014.

Competency 10.8: Supply chain cost management (including TCO)
<b>Definition:</b> Reducing TCO is a process of analysing the total cost, direct and indirect cost of a procured item over its life cycle, with the objective of reducing the TCO.

Source: Adapted from Fawcett *et al.*, 2007; Supply Chain Council, 2014; Burt *et al.*, 2010; Handfield *et al.*, 2009.

Awareness	Knowledge	Skilled
Explain the concept of TCO Explain the process of analysing the TCO Explain the internal cost drivers of TCO Explain the external drivers of TCO Explain the potential strategies that can be applied to reduce the TCO Explain the process of implementing initiatives for the reduction of TCO Explain how strategic sourcing can enhance the reduction of TCO Explain how strategic supplier partnerships can reduce the TCO Explain how the redesign of certain internal practices can reduce the TCO	Apply the process of analysing TCO for selected procured items or parts of the procurement portfolio Identify the internal cost drivers of TCO for selected procured items or parts of the procurement portfolio Identify the external drivers of TCO for selected procured items or parts of the procurement portfolio Identify the potential strategies that can be applied to reduce the TCO for selected procured items or parts of the procurement portfolio Implement initiatives for the reduction of TCO for selected procured items or parts of the procurement portfolio Reduce TCO through strategic sourcing TCO Recommend strategic supplier partnerships to reduce the TCO for selected procured items or parts of the procurement portfolio Redesign certain internal practices to reduce the TCO for selected procured items or parts of the procurement portfolio	Apply the process of analysing TCO for appropriate items of the procurement portfolio of a business unit Identify the internal cost drivers of TCO for appropriate items of the procurement portfolio of a business unit Identify the external drivers of TCO for appropriate items of the procurement portfolio of a business unit Identify the potential strategies that can be applied to reduce the TCO for appropriate items of the procurement portfolio of a business unit Implement initiatives for the reduction of TCO for appropriate items of the procurement portfolio of a business unit Reduce TCO through strategic sourcing TCO for appropriate items of the procurement portfolio of a business unit Recommend strategic supplier partnerships to reduce the TCO for appropriate items of the procurement portfolio of a business unit

Source: Adapted from Fawcett *et al.*, 2007; Supply Chain Council, 2014; Burt *et al.*, 2010; Handfield *et al.*, 2009.

<b>Competency 10.9: Governance and risk management across the supply chain</b>
<p><b>Definition:</b></p> <p>The development of business rules, policies, procedures and controls to ensure the required governance and legislation during the creation, implementation and maintenance of supply chain strategies and processes. The objective is to ensure adherence to business rules at all times with the purpose of achieving consistent operational activities, mitigating supply chain risks and ensuring that the required contingencies are in place.</p>

Source: Adapted from Manuj & Mentzer, 2008; Supply Chain Council, 2014; Bowersox *et al.*, 1999.

<b>Awareness</b>	<b>Knowledge</b>	<b>Skilled</b>
<p>Explain the importance of governance in achieving supply chain objectives</p> <p>Describe the different types of governance required</p> <p>Explain the resistance to successful implementation of governance procedures</p> <p>Explain the risks if governance is not complied with in the broader business context</p> <p>Explain the rationale for the different approaches, regulatory frameworks and tools, e.g. SOX, Risk matrix</p> <p>Explain in broad terms the relevant ISO systems (Quality – 9001:2000; Environmental – 14001; Safety and Health – 18000)</p> <p>Explain the auditing and assessment process by IRCA and DQS</p>	<p>Develop basic governance for specific sub-processes and processes such as customer demand or facilities management</p> <p>Implement governance such as operating procedures, policies and business rules for identified risks in the different areas</p> <p>Complete compliance audits to determine the extent of governance</p> <p>Monitor key performance indicators to track adherence to business rules and policies</p> <p>Implement corrective actions in case of non-compliance</p> <p>Develop a basic risk matrix which identifies potential risks in the different areas across the supply chain</p> <p>Apply the relevant ISO systems (Quality – 9001:2000; Environmental – 14001; Safety and Health – 18000) for selected parts of the transport of a business unit</p>	<p>Identify all the potential risk areas across the supply chain of a business unit where governance will be required</p> <p>Develop key performance indicators to track potential risk areas</p> <p>Develop compliance audits to be implemented to measure the extent of governance</p> <p>Align outbound supply chain governance with governance requirements from other areas such as procure &amp; supply &amp; supply chain planning</p> <p>Enable governance through the use of systems technology to ease measurement and improve responsiveness to non-compliance</p> <p>Implement change programmes to improve the level of governance</p> <p>Develop an integrated risk matrix which would reflect risks in the different areas</p> <p>Monitor compliance to assess performance</p> <p>Design and conduct internal audits</p> <p>Contribute to audit design and how it is applied to various areas of risk</p>

Source: Adapted from Manuj & Mentzer, 2008; Supply Chain Council, 2014; Bowersox *et al.*, 1999.

## 7.9. CONCLUDING COMMENTS

The supply chain competency model was further developed in this chapter by adding the different levels of proficiency to the conceptual model developed in Chapter 6. Without different levels of proficiency, the competency model cannot be applied to a variety of supply chain positions. Reflection on the development in this chapter has relevance to the following aspects:

- **Foundation for the levels of proficiency**

The basis theory used for the development of the levels of proficiency, the revised Bloom's taxonomy, is in all probability the most used and referenced work on different levels of knowledge and learning. This model thus provided a good foundation for the development of the levels of

proficiency. The principles of the model were applied within the context of the supply chain competency model.

- **Application of the best practice framework for competency modelling**

The development of the proficiency standards was based on the best practice framework from Chapter 3. This applies to both format and design. The format and design of the proficiency definitions is consistent with the best practices, thus providing a first version model for supply chain which complies with the best practices.

- **Validation of proficiency standards**

Validating the competency proficiency standards offers a challenge from a research perspective. As indicated in the research design, evaluating a conceptual model of this nature is challenging, as the classical research techniques are difficult to apply. Proficiency standards cannot be tested through survey research primarily due the scope and volumes. Research quality measures such as reliability and validity are therefore a different challenge within the context of this research. Although reliability would be difficult to test, validity however could be determined through construct validity, which was achieved through the testing of the conceptual model in the previous chapter, and the academic references used to develop the proficiency standards.

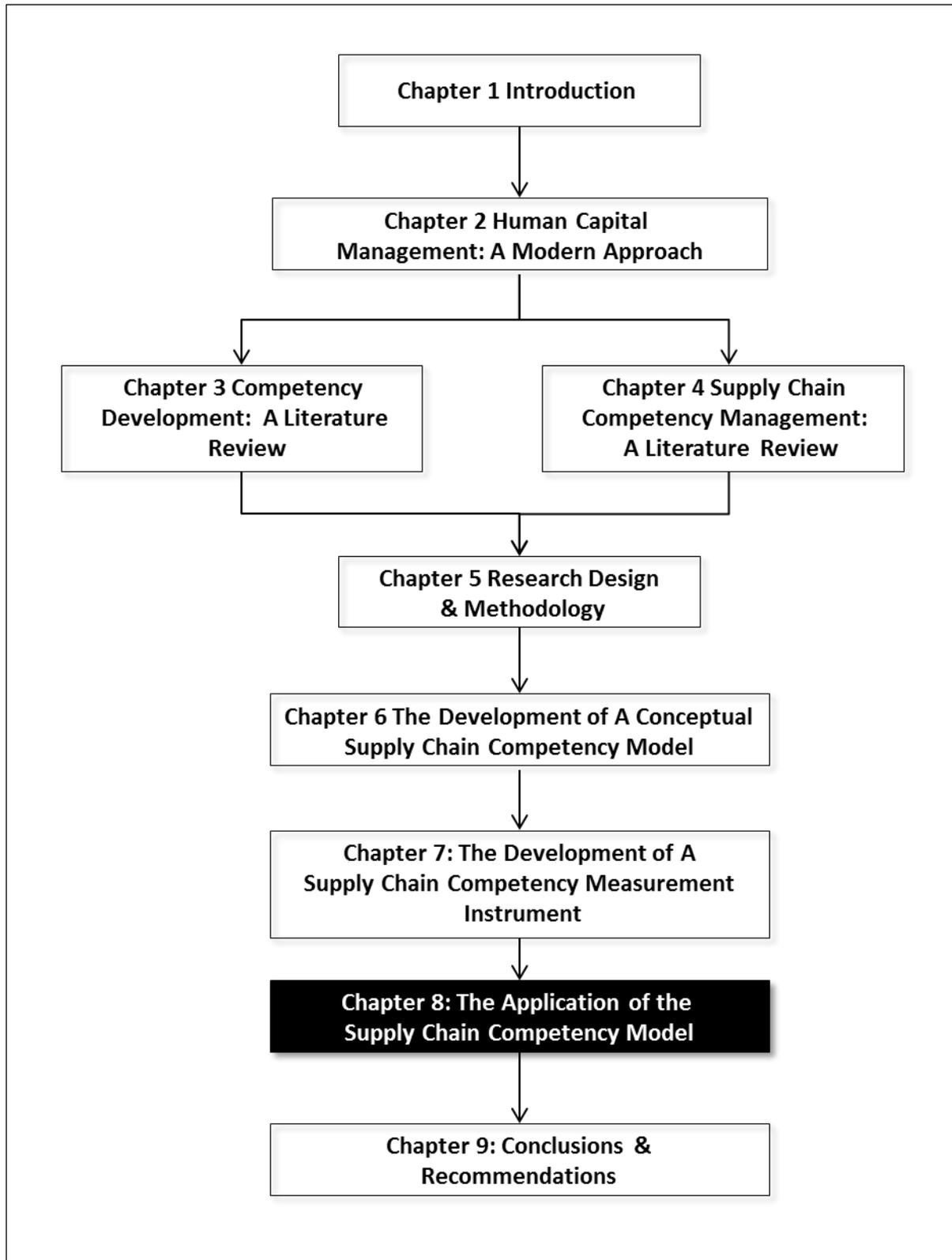
- **Research value of the proficiency standards**

Throughout the research the limited publication of research on supply chain competency modelling was pointed out. Proficiency definitions were not available for the supply chain competency models that do exist, such as the SCOR model. Although some competencies were identified and levels of proficiency defined, no publication on proficiency standards was identified. The potential value from the proficiency standards is that a first model is now available for further research and improvement. Although no reliability-based validity could be provided, construct validity is provided through both the Delphi research and the literature used for the development.

The proficiency standards will provide the basis for the application of the competency model which is discussed in the next chapter. The next step in the process of application is the development of a measurement instrument that can measure the level of competency based on the proficiency standards.

## CHAPTER 8

### THE APPLICATION OF THE SUPPLY CHAIN COMPETENCY MODEL



## 8.1. INTRODUCTION

The value derived from a supply chain competency model is limited without the capability to perform competency assessments. Achieving the required level of competency for all supply chain job incumbents is the ultimate goal of developing a competency model. This cannot be achieved without being able to perform competency assessments and provide job incumbents with feedback on their competency relative to the job requirements.

The objectives of this chapter are twofold, firstly to discuss the development of a competency assessment instrument, and secondly to report on the application of the measurement instrument in terms of results and learnings.

## 8.2. THE COMPANY SELECTED FOR THE CASE STUDY

The merits of the case-study approach were outlined under the research design. It is however relevant to identify the criteria that were used in the selection of the company as a case study. Yin (2008) identified the following criteria for selecting the case study:

- The case study must be significant.
- The case study must be complete.
- The case study must display sufficient evidence.

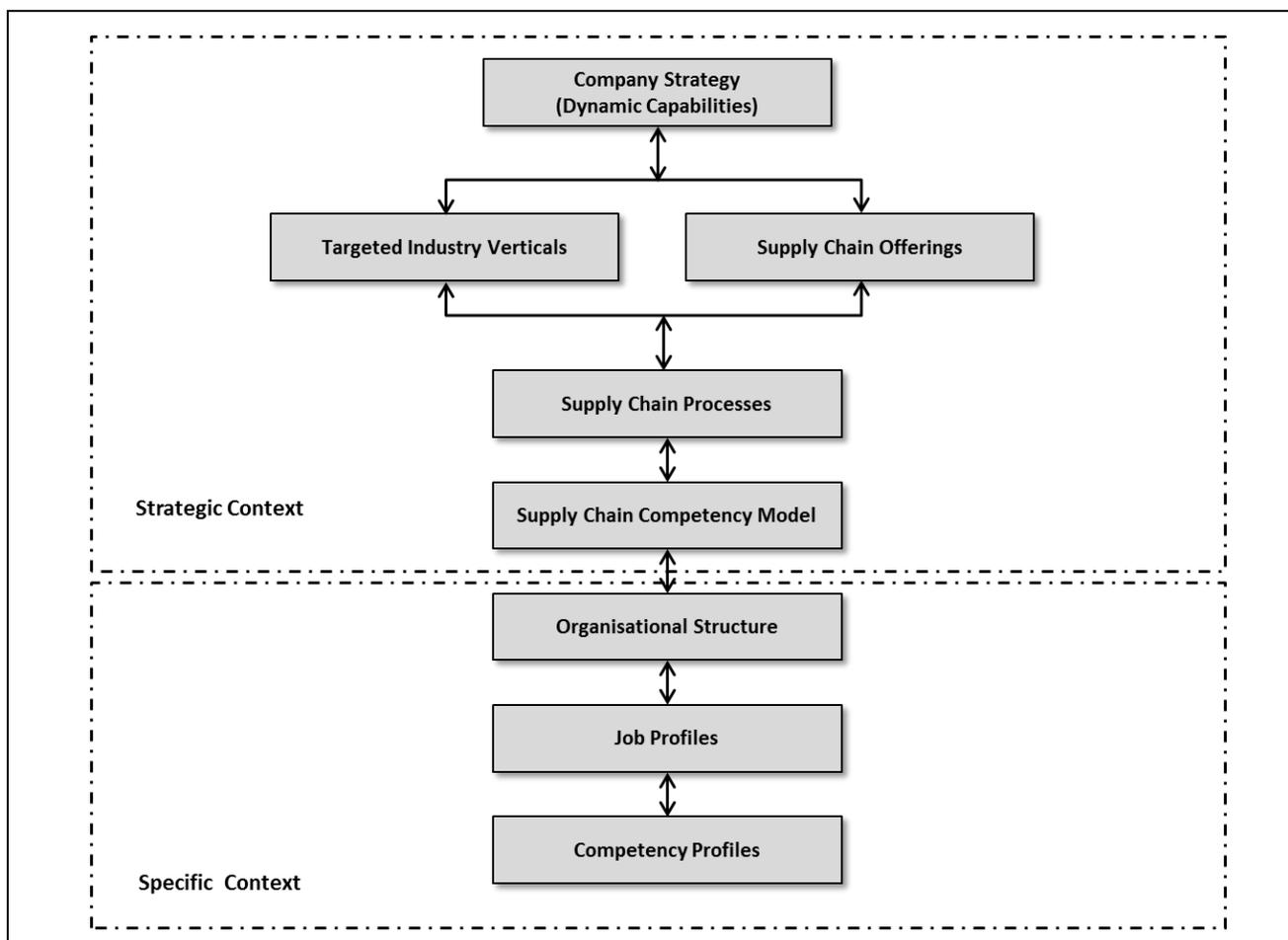
When these criteria were applied to a supply chain context the following adapted version was used:

- Supply chain management must be the core business of the company.
- The service offering to customers should cover various aspects of supply chain management.
- The company should be a global company operating across continents.
- The size of the workforce should be adequate for the development of the assessment.
- The customer base should include multiple industry verticals.
- The executive team should value the importance of supply chain competency.

Based on these criteria, a company was selected that provides supply chain solutions with clearing and forwarding as a core business. The company complied with all the criteria identified and hence it was an ideal case for the purpose of this case study. The context of the case study will be discussed next.

### 8.3. DETERMINING THE STRATEGIC CONTEXT OF THE ASSESSMENT

Based on the best practices framework developed in Chapters 2 and 3, competency assessment needs to be applied within a framework. The framework is determined at two levels, as is illustrated in Figure 8.1.



**Figure 8.1: Creating context for supply chain competency assessments**

Strategic context is determined by the company strategy, which is based on the dynamic capability approach to company strategy. The company strategy thus determines the dynamic capabilities that will be required. The translation of company strategy into market strategy defines the targeted industry verticals and the supply chain offerings that will be marketed. The dynamic capabilities combined with industry verticals and supply chain offerings will be delivered through a supply chain process model and a competency model.

The organisational structure will translate processes into specific jobs for people to perform the activities required in each process. Job profiles define the scope of the job, the activities and the performance measures. Based on the job profiles, the competency profile will determine which competencies and at which level of proficiency will be required. Developing a supply chain

competency assessment thus needs to be based on a strategic and a specific context. The strategic context that will now be discussed in more detail is the application of the guiding principles of organisational alignment of the competency model which was explained in Chapter 2 from the work of *Campion et al.* (2011).

### **8.3.1. Targeted industry verticals**

The supply chain competency assessment should have context; the supply chain challenges are different based on the industry vertical in which it is applied. Developing an assessment should thus be done with the targeted industry verticals as a context to provide further focus to the assessment. The targeted industry verticals were:

- Automotive
- Chemicals & Pharmaceuticals
- High technology
- Telecommunications
- Construction/Engineering
- Department store/Fashion
- Mining (Equipment procurement)
- Oil & Gas (Equipment procurement).

These industry verticals provided the input into the development of the supply chain competency assessment instrument. A competency requirement is thus the application of supply chain management in each of these industries. The next aspect to consider is the supply chain offerings aimed at the targeted markets.

### **8.3.2. Supply chain offerings**

The supply chain offerings are relevant as they define the functional areas of supply chain management that need to form part of the demarcation of the application and the required competencies. They therefore define which functional elements of supply chain management should be included in the assessment. The industry verticals and supply chain offerings create a matrix which provides specific context to the development of the assessment instrument. The supply chain offerings are as follows:

- Supply chain consulting for optimising supply chains
- Forwarding
- Clearing
- Logistics, which includes transport and warehousing
- Finance

- IT integration.

The next relevant aspect to consider is the specific supply chain challenges that are faced by the company given the industry verticals and the supply chain offerings.

### **8.3.3. Supply chain challenges**

The supply chain challenges faced by the company provided further context to the application of the competency model by indicating what the challenges are within the context of the matrix created by the previous two sections. The supply chain challenges identified were:

- Supply chain solution thinking, i.e. integrating the various logistics elements into a solution per client
- The development of supply chain strategy, i.e. developing a supply chain strategy for a client by integrating the following elements:
  - Strategic alignment
  - Network design
  - Material flow optimisation
  - Strategic sourcing
  - Supply chain performance measurement and management
  - Inventory management and optimisation
  - Inventory control and stock accuracy
  - Risk management across the supply chain.
- Understanding for the different types of supply chain solutions required by different industry verticals:
  - Project management as a tool to successfully implement supply chain solutions
  - The improvement of operational planning and scheduling of logistics operations
  - Solution pricing for individual supply chain solutions developed
  - Using technology enablement for performance improvement.

These challenges with the application of supply chain management within the context of the matrix provided further guidelines for developing the assessment. The next aspect that needs to be addressed is the sample.

## **8.4. THE ASSESSMENT REQUIREMENTS**

Competency assessment needs to be based on specific competency requirements. This was achieved by developing job profiles and competency profiles that specified the required level of proficiency for each competency within each job profile. The approach that was used for the

development of the relevant job and competency profiles was based on the guidelines developed in Chapter 3. The process for developing the job profiles was as follows:

- The key positions were selected by the project steering committee consisting of senior executives. The template for the job profile was developed based on the key requirements identified from the theoretical framework, with the focus on functional competencies. The base profile was developed with primarily the input from a team of job incumbents selected by the steering committee.
- The job profiles were evaluated by the immediate supervisor or manager and amended where required. If significant changes were required, the job incumbents and supervisors were consulted together to reach consensus on the changes.
- The job profiles were then evaluated by the project steering committee which included supply chain experts. If major changes were required, the same process of consultation was followed to reach consensus. Important inputs to the process were the competency framework and strategic objectives of the company, thus translating the strategic objectives into job requirements through the competency model.

An example of a job profile is provided in Table 8.1.

**Table 8.1: Example of a job profile**

<b>JOB PROFILE</b>	
<b>Job Title</b> Controller – Forwarding, Exports & Imports	<b>Department; Business Unit; Section</b> Operations
<b>Job Purpose Summary</b> Controls procedures to process the flow of cargo from the time that an order is placed on an overseas supplier until the goods are delivered to the importer. Includes all operational functions in a specific department/allocated section/at the client's site.	
<b>Key Responsibilities and Outputs</b> <b>1. Forwarding of export cargo in accordance with client requirements</b> <ol style="list-style-type: none"> <li>a. Receive and track client purchase orders from time of receipt to time of dispatch of cargo from country of origin</li> <li>b. Liaise with exporters and report on readiness status of export shipments to relevant stakeholders</li> <li>c. Receive instructions from clients</li> <li>d. Arrange shipment with carriers and agents (book cargo)</li> <li>e. Coordinate movement of cargo with the transport operators</li> <li>f. Report on shipment status to clients and other stakeholders</li> <li>g. Process and distribute documentation in accordance with client requirements</li> <li>h. Generate pro forma invoice in accordance with client rate structure and transaction disbursements (Sea freight)</li> <li>i. Check for client rates applicable to the transaction (Airfreight)</li> </ol> <b>2. Clearing of import cargo in accordance with client requirements</b> <ol style="list-style-type: none"> <li>a. Track documentation flow from time of shipment to time of receipt in the operational offices</li> <li>b. Receive instructions and documents</li> <li>c. Check for completeness and accuracy; if necessary obtain further</li> </ol>	<b>Pipeline position</b> Manage Self Operational
	<b>Job grading</b> B+/C+/C-
	<b>Position reports to:</b> Supervisor/BU Manager
	<b>Who reports to this position:</b> None
	<b>Working Context:</b> At regional office, in a team; office bound
	<b>Key Working Relationships</b> <b>Internal:</b> Groupage, Break bulk, Entry Clerk, Invoicing clerk, Transport department, Freight Desk,

<b>JOB PROFILE</b>	
<p>details/instructions</p> <ul style="list-style-type: none"> <li>d. Create shipping file (paper) and register on system</li> <li>e. Obtain master/house transport document information from carriers/consolidators</li> <li>f. Distribute work to other departments</li> <li>g. Track cargo for which he/she is responsible</li> <li>h. Expedite cargo with carriers, terminals, depots and other transport operators</li> <li>i. Keep clients informed and handle queries from clients and other stakeholders and departments</li> <li>j. Keep system updated with all communication and documentation received and effected</li> <li>k. Ensure that all disbursements are recorded and recovered</li> <li>l. Initiate claims in respect of lost, damaged or discrepant cargo</li> <li>m. Record PODs</li> <li>n. Carry out acquittal procedures</li> </ul> <p>3. <b>Performing import operations in accordance with procedures</b></p> <ul style="list-style-type: none"> <li>a. Receive documentation through e-mail from controllers</li> <li>b. Open file, allocate file number from spread sheet, load file on CCL</li> <li>c. Forward invoice to invoicing quality controller to confirm correct rates</li> <li>d. Follow up with shipping line for arrival notification – direct and transshipments</li> <li>e. On receipt of ANF, update file (including invoicing amount) and print</li> <li>f. Hand file over to invoicing clerk to generate pro forma invoice</li> <li>g. On receipt of file from invoicing clerk, hand copy of pro forma and ANF to Business Unit (Operations)</li> <li>h. Solve queries, if applicable</li> <li>i. In the case of FCLG: release groupage containers for unpacking</li> </ul>	<p>Accounts, Client Services Department, Invoicing Quality Controller, Internal regions</p> <p><b>External</b> Clients, Third party service providers, Banks, Inspection bodies</p>
<p><b>Performance Indicators/Measures</b></p> <ul style="list-style-type: none"> <li>1. Cargo movement is controlled in accordance with the agreed tariffs and client requirements</li> <li>2. Rents, fines and demurrage charges are minimised</li> <li>3. Claims are handled in accordance with insurance, carrier and other transport operator time bar stipulations</li> <li>4. Status reports submitted in accordance with SOPs</li> <li>5. Client queries are addressed satisfactorily</li> <li>6. Queries addressed satisfactorily</li> <li>4. Time frames stipulated in procedures adhered to</li> <li>5. Accuracy of upload on CCL</li> <li>6. Documentation processed in full</li> </ul>	
<p><b>Qualifications:</b> Matric Certificate Accreditation in Customs &amp; Clearing Introduction Courses to Supply Chain Management</p>	
<p><b>Experience:</b> 2-4 years' experience in customs and clearing operations Experience in dealings with clients Experience with dealings with internal operations Relevant customs systems</p>	
<p><b>Personal Attributes:</b> Attention to detail Patience in dealing with people Follow-through in completion of tasks Good language skills Good writing skills Integrity</p>	

The process for developing job profiles was rated based on the best practice framework from Chapter 3, section 3.6 with the dots in the columns indicating the level of rigour applied in each of the areas. The only area of low rigour was the actual statistical testing of the job profiles that needed a longitudinal study to verify. This is not only another application of the guiding principles but also a key requirement from the case-study methodology to achieve both validity and reliability using multiple sources of evidence (Yin, 2008).

**Table 8.2: Rating of procedure for job analysis and competency profiling**

Variable:	Low Rigour	Low/Medium Rigour	Medium Rigour	Medium/High Rigour	High Rigour
1. Method of investigation					●
2. Type of descriptor content					●
3. Procedure for developing descriptor content					●
4. Detail of descriptor content					●
5. Link to business goals					●
6. Content review					●
7. Ranking of content					●
8. Assessment of reliability	●				
9. Item criteria					●
10. Documentation					●

Source: Campion *et al.*, 2011.

The job profiles formed the basis for developing competency profiles, which is an application of the competency model. The different competences were rated through the same process used to develop the job profiles to determine the required level of competence for each competency. The supporting competency profile for the job profile in Table 8.3 is provided below.

**Table 8.3: An example of a competency profile**

Competency Profile: Operations Controller					
Functional Competencies	N.A.	Awareness	Knowledge	Skilled	Other competencies
<b>1. Product &amp; Portfolio Management</b>					Foundational Competencies
1.1 Product development		●			
1.2 Portfolio management		●			
<b>2. Supply Chain Strategy</b>					
2.1 Supply Chain Strategy		●			
2.2 Understanding of different types of supply chains		●			
2.3 Demand management strategy		●			
2.4 Strategic sourcing		●			
<b>3. Sales &amp; Operations Planning (Tactical)</b>					
3.1 Demand Sensing & Shaping		●			
3.2 Demand Planning			●		
3.3 Supply Planning			●		
3.4 Demand & Supply Balancing			●		
3.5 Operations scheduling			●		
<b>4. Demand Execution Management</b>					
4.1 Customer Relationship Management			●		
4.2 Customer Order Management			●		
<b>5. Transport &amp; Distribution</b>					
<b>5.1 Strategic integration of international logistics</b>					
5.1.1 International logistics strategies			●		
5.1.2 Strategic supply chain integration of international logistics				●	
<b>5.2 International Logistics Operations</b>			●		
5.1.1 International trade					Management and Leadership
5.1.2 Freight Forwarding				●	
5.1.3 Customs				●	
5.1.4 Managing Transport Risk				●	
5.3 Developing multi-modal solutions					
5.4 Fleet management			●		
5.5 Transport operational management			●		
5.6 Reverse logistics management					
<b>6. Make</b>					
6.1 Determine manufacturing strategy			●		
6.2 Product design		●			
6.3 Production planning & scheduling			●		
6.4 Execution management			●		

**Table 8.3: An example of a competency profile (continued)**

<b>7. Warehousing and Facilities Management</b>				
7.1 Facility design and layout		●		
7.2 Facilities Operational Management		●		
7.3 Inventory Control		●		
7.4 Materials handling		●		
<b>8. Procurement Execution</b>				
8.1 Requisition to pay process		●		
<b>9. Green Supply Chain Management</b>				
9.1 Supply chain sustainability		●		
9.2 Environmental management		●		
<b>10. Performance Management</b>				
10.1 Supply chain performance indicators			●	
10.2 Implementation of outsourcing			●	
10.3 Process optimisation across the supply chain			●	
10.4 Process chain improvement concepts			●	
10.5 Structuring and Change Management		●		
10.6 Systems Technology Deployment			●	
10.7 Contract and supplier performance management			●	
10.8 Supply chain cost management			●	
10.9 Governance & Risk Management in Supply Chain Management			●	

The competency profile is the application of the competency model through the job profile. The job profile defines the job and the key responsibilities, while the competency profile uses the competency model, with specific reference to the proficiency statements, and translates that into a set of competency requirements for the specific job profile. The validity of both the job and competency profiles was ensured through a rigorous approach that was followed in the development process. Three groups of people participated in the development: firstly, a team of job incumbents selected on experience and performance; secondly, a group of operational managers; and thirdly, a group of company experts. Construct validity was achieved through the involvement of teams of experts based on the research (Lewis, 2008). Reliability was achieved through multiple sources of evidence, consistent with the case-study methodology (Yin, 2008).

### 8.5. FURTHER DEVELOPMENT OF THE COMPETENCY ASSESSMENT

The development of the competency assessment instrument will be discussed in the following section and will be based on three aspects, the practical development guidelines, research guidelines and the approach followed with the assessment questions.

### 8.5.1. Practical guidelines

Competency assessment was developed in a practical context given the challenges and requirements. These had to be taken into account in formulating the development approach. The objective was to develop a competency assessment instrument that can be used in the following circumstances:

- It has to assess competency against the competency model developed and, more specifically, translate proficiency statements into an assessment.
- It has to be an online assessment instrument. In order to increase the practical use of the instrument, it cannot be a paper-based instrument. A paper-based instrument has the following disadvantages:
  - It would be time-consuming to conduct the test due to the data capturing that would be required after paper-based completion.
  - Feedback to the person assessed can only be given once the assessment is completed, data captured and results processed.
  - Access to the instrument would be limited and costly to send paperwork via mail and collect afterwards.
  - Paper-based assessments are biased and face the challenge of overcoming different perceptions that will be proven in the results section.
- Against this background, the guidelines for the development of the instrument are as follows:
  - It has to be an on-line instrument which can be completed by delegates through a computerised process.
  - The length of the assessment has to be practical; it cannot take several hours to complete the assessment.
  - Feedback to the respondent has to be immediate after completion of the instrument.
  - Assessment has to be done based on the proficiency levels or capability continuum developed.
  - Assessment has to be consistent with the competency profile developed for the specific job or position that is assessed.

Given the practical assessment requirements, the development of an assessment instrument needs to be grounded in sound theory and principles from published research. The next section will establish the academic framework for the development of an assessment instrument.

### 8.5.2. Research guidelines

The research guidelines for developing assessments instruments (Baartman *et al.*, 2006) were discussed in Chapter 5 as part of the research design. The application of these guidelines is summarised in Table 8.4.

**Table 8.4: The application of competency assessment guidelines**

Guiding Principle	Application to the Supply Chain Competency Assessment Instrument
<b>Fitness for purpose</b>	The process of developing supply chain competencies is aimed at improving skills and capabilities in the application of supply chain management. The focus is thus on practical application as opposed to theoretical knowledge and understanding. The assessment instrument will thus test application capabilities and not knowledge and understanding of theory. It also needs to focus on application in different industries.
<b>Comparability</b>	Comparability will be ensured through a computerised process that will ensure that the assessment will be done consistently across multiple assessments as follows: <ul style="list-style-type: none"> <li>• Random selection of assessment scenarios based on what the competency profile requires(enabled by the software)</li> <li>• Random selection of assessment questions based on what the competency profile requires(enabled by the software)</li> <li>• Time allowed for each assessment will be consistent.</li> <li>• The user interface with the software will be consistent.</li> <li>• Scoring of the assessment results will be automated with no human intervention.</li> <li>• Assessment will be done against a competency profile which will be consistent across different assessments.</li> </ul>
<b>Reproducibility</b>	This is ensured through the following: <ul style="list-style-type: none"> <li>• Assessment scores are not dependent on assessors but on software that calculates the scores based on the assessment.</li> <li>• No assessors are involved in each assessment; hence any biased interpretation is avoided.</li> <li>• The same assessment can be reproduced by selecting the same set of scenarios and questions related to those scenarios.</li> </ul>
<b>Transparency</b>	Transparency is provided through the following means: <ul style="list-style-type: none"> <li>• A competency model which defines all the competencies is available for review.</li> <li>• Levels of proficiency are defined on a capability continuum which clearly defines what level of competency is expected.</li> <li>• A competency profile is used as benchmark for each candidate to be assessed. The required levels for each candidate are thus clearly defined.</li> <li>• The actual calculation of the scoring is also provided in the guidelines to the assessment.</li> </ul>
<b>Authenticity</b>	Authenticity is provided through the following: <ul style="list-style-type: none"> <li>• The competency profiles are based on a well-developed competency model which is consistent for all assessments.</li> <li>• The assessment is application-based, and aligned with the future professional life of the candidate being assessed.</li> <li>• The competency profile which is used as benchmark is based on the input of a team that understands the job requirements well.</li> <li>• This is further ensured through a secure logon procedure which ensures that only the candidate being assessed can have access to that specific assessment.</li> </ul>

**Table 8.4: The application of competency assessment guidelines (continued)**

Guiding Principle	Application to the Supply Chain Competency Assessment Instrument
<b>Cognitive complexity</b>	The assessment is based on different levels of cognitive complexity. The levels of proficiency that form the basis for the assessment are derived from the revised taxonomy of Bloom, one of the most widely used theories of defining different levels of cognitive complexity. Different levels of complexity are linked to each competency profile that is assessed. The type of assessment questions are also aligned with different levels of cognitive complexity.
<b>Meaningfulness</b>	The value of the assessment for both candidates that are being assessed and the employer is the fact that it provides an immediate, objective assessment based on the actual job requirements. The outcome of the assessment can then be used for focusing development initiatives and determining levels of competency.
<b>Fairness</b>	The fact that the assessment instrument is computer-based eliminates any form of bias almost completely from the process.
<b>Development consequences</b>	This is visible and linked to the process of individual performance assessments and the creation of individual development plans which outline the required interventions to improve the competencies where gaps are identified.
<b>Directness</b>	This is provided through the following: <ul style="list-style-type: none"> <li>• Results of the assessment are immediately available after completion of the assessment.</li> <li>• Results are calculated consistently based on predefined formulas and frameworks.</li> <li>• Results are linked to specific competencies or sub-competencies.</li> </ul>
<b>Costs and efficiency</b>	Costs and efficiency are provided through the following: <ul style="list-style-type: none"> <li>• The instrument is an online instrument which allows candidates to take assessment at their own convenience.</li> <li>• No assessors need to be present during the assessment, which creates further flexibility and cost savings.</li> <li>• There is no practical limit to the number of times that the assessment can be completed, which adds further value to the instrument.</li> <li>• A significant number of candidates can be assessed in a short time due to the on-line web-based design of the instrument.</li> </ul>

Table 8.4 provides evidence that the guidelines for accurate assessment were applied in the development of the assessment instrument. Further practical guidelines were also developed and will now be introduced.

### **8.5.3. The assessment questions**

#### *8.5.3.1. Scenario-based assessment*

Based on the practical and scientific guidelines, the assessment needs to be aligned with the real application of the competency that is assessed. After evaluating different approaches, the best option was to design scenario-based assessment. Each scenario was developed with the following in mind:

- The length of each scenario should be short; it should take only a couple minutes to read. If the reading time is too long it negatively affects the total time required for an assessment and can have an adverse effect on the practical application of the assessment.
- Scenarios cannot be too long – ideally, 5–10 lines of text. This is important to allow candidates to interface effectively with the scenario during assessment. If it is too long, then scrolling down the page can be a problem. Printing a scenario is also not an option, due to the confidentiality of each scenario.
- The practical supply chain issues included in the scenario should be aligned and reflective of the issues faced in that particular industry vertical.
- Based on the type of issues included in the scenario, questions at the different levels of proficiency should be asked from the same scenario.
- The practical issues from each industry vertical were developed in conjunction with industry experts working in the company for many years, dealing with the practical challenges from that particular industry vertical.
- Supply chain terminology was used in the scenarios, which required a certain base knowledge from the person being assessed. Understanding the terminology was thus also part of the assessment.
- A matrix with industry verticals and supply chain competencies was used to ensure that all verticals and all competencies were covered.
- All assessments are scenario-based, thus practical cases. At the lower levels of the taxonomy, a number of more theoretical questions were used.
- Scenarios in real application environments are multi-dimensional, thus more than one type of challenge will be experienced in the same scenario.
- A further motivation for using different types of scenarios is the fact that a wider variety of issues can be assessed.
- Avoiding the risk that candidates learn the assessment is achieved by using many different mini scenarios in different combinations.
- A scenario can contain multiple issues or challenges of supply chain management. These issues and challenges might be at different levels of complexity and proficiency.
- The questions that will be asked based on the scenario will also be at different levels of complexity and proficiency.

- Combining different types of questions during the assessment provides further validity in the sense that it requires different skills to complete. The type of scenario and issue in the scenario will determine what type of question will be used.

With the scenario-based assessment approach decided and designed, the next aspect is the type of questions to be used in the assessment.

#### *8.5.3.2. Assessment questions*

The key requirement was to develop question types that would be in line with the proficiency levels, both in terms of the content and the level of learning required, based on the application of the revised Bloom's taxonomy. To achieve this, different types of questions were used with the following types of questions being developed:

**True/False questions:** This is the normal true-false question where a statement is developed and the respondent asked to indicate if the statement is true or false. The benefit of this type of question is the speed at which it can be answered and the limited amount of screen space that is required.

**Multiple choices:** The normal multiple-choice question where multiple options are provided and the respondent has to select the correct or incorrect statement. This is also a question type that could be answered quickly and could be used either paper based or technology enabled.

**Matching position:** This required respondents to physically match answers with positions provided on a map. The typical application was geography questions for international trade and trade lanes.

**Selection type:** Respondents were required to select the correct or incorrect answers from a list provided. In each list of options provided, distracters were built in to provide added complexity and force the respondent to distinguish between concepts or applications of principles or strategies.

**Matching columns:** In this question type, two columns were provided and the respondent requested to match items from the different columns with each other. It could be supply chain challenges and the correct strategies to address those, or it could be the root causes for those issues. These questions are more complex to answer and hence were used at the higher levels of proficiency.

The questions were linked to the different levels of proficiency. The allocation of question types to the different levels of proficiency is summarised in Table 8.5.

**Table 8.5: Allocation of question type to levels of proficiency**

Level of Proficiency	Question Type
<b>Level 1: Awareness</b>	<ul style="list-style-type: none"> <li>• True or false questions</li> <li>• Multiple-choice questions</li> <li>• Matching position (matching positions on a map)</li> </ul>
<b>Level 2: Knowledge</b>	Multiple-Choice Selection Type Matching Columns
<b>Level 3: Skilled</b>	Selection Type Matching Columns

The next step in the process was the development of the scenarios. This is discussed in the next section.

#### 8.5.3.3. *An example of an assessment scenario*

With these guidelines in mind, different scenarios were developed. These scenarios varied from a two-line explanation of a practical situation to a more complex scenario. A combination of these scenarios was used. Each scenario consisted of the scenario itself, the classification of scenario in terms of the competencies it covered and the questions asked. An example of such a scenario is provided in the Table 8.6:

**Table 8.6: Scenario example from the assessment**

Technostuff is a supplier of electronic components that are used in communication and IT networks. These components are supplied to telecommunications and IT companies who build these components into the communication networks which they install and manage on behalf of companies. Customers place their orders via telephone or fax with the sales office. A source of frustration for customers is that they need to know if stock is available at the point of order placement due to short lead time requirements of two days and pressure from the end customer. Sometimes it takes up to two days before stock availability can be confirmed by salespeople of Technostuff. Stock of components is kept in seven different warehouses across South Africa in different locations such as Durban, Cape Town and Johannesburg. The policy of Technostuff is to keep the same level of stock for all of the 450 different products at all locations. Stock planning is based on historic sales.

The more complex scenario as outlined in the table above contains some basic facts about the industry vertical and a short description of the practical situation. The objective was that the practical situation would allow questions to be asked at different levels using the same set of facts. For each scenario, the following was developed to identify the scenario as outlined in Table 8.7.

**Table 8.7: The classification of each scenario**

<b>Industry Vertical:</b>	<ul style="list-style-type: none"> <li>• High Tech</li> </ul>
<b>Supply Chain Meta Clusters:</b>	<ul style="list-style-type: none"> <li>• Supply chain strategy</li> <li>• Sales &amp; Operations planning</li> <li>• Demand execution management</li> </ul>
<b>Scope:</b>	<ul style="list-style-type: none"> <li>• Supply chain strategy – network design</li> <li>• Customer order management</li> <li>• Inventory visibility</li> <li>• Sales &amp; Operations planning – forecasting</li> <li>• Stock management – risk pooling</li> <li>• Stock management – ABC analysis</li> </ul>

The classification of each scenario provided the basis for balancing the industry verticals and the questions by meta- and individual competency. An example of the different type of questions asked is provided in the following tables.

**Table 8.8: Example of questions**

<b>Supply Chain Strategy: Competency 2.1 Developing supply chain strategy</b>
<b>Proficiency Level: Awareness:</b>
<p>1. <u>If you are requested to review the supply chain network of Technostuff, which elements would you include in your review? Select from the list provided.</u></p> <ul style="list-style-type: none"> <li>• Customer locations</li> <li>• Warehouse locations</li> <li>• <i>Human resource policy of role players</i></li> <li>• Supplier locations</li> <li>• <i>Outstanding debtors</i></li> <li>• Modes of transport</li> <li>• Inventory at each location</li> <li>• <i>Corporate identity at each location</i></li> <li>• Demand and volumes at each location</li> <li>• Cost of operating the network</li> <li>• Customer service levels required</li> <li>• Physical characteristics of each location</li> </ul> <p><i>(Distractors are in italics)</i></p>

**Table 8.8: Example of questions (continued)**

<b>Sales &amp; Operations Planning: Competency 3.2 Demand planning</b>
<b>Proficiency Level: Skilled:</b>
<p>2. <b><u>Which of the following actions would you implement to ensure that the sales &amp; operations planning process of Technostuff is aligned with the unique requirements of a high technology supply chain?</u></b></p> <ul style="list-style-type: none"> <li>• Shorter planning review cycles</li> <li>• Collaborative demand planning with customers</li> <li>• Collaborative planning with suppliers</li> <li>• Collaborative product design with suppliers</li> <li>• Improved monitoring of competitive sales</li> <li>• <i>Longer sales cycles of salespeople</i></li> <li>• Planning more at an aggregate level</li> <li>• Closer integration of sales promotional activity into the planning process</li> <li>• Less emphasis on statistical forecasting techniques</li> </ul> <p><i>(Distractors are in italics)</i></p>
<b>Demand Execution Management: Competency 4.2 Order management</b>
<b>Proficiency Level: Skilled</b>
<p>3. <b><u>What are the key objectives of customer order management? Please select from the list provided.</u></b></p> <ul style="list-style-type: none"> <li>• <i>Improving order picking accuracy</i></li> <li>• <i>Reducing minimum production lot sizes</i></li> <li>• Capturing of customer orders</li> <li>• Reduction of emergency orders from customers</li> <li>• Influencing the demand pattern from customers</li> <li>• Ensuring adherence to minimum order quantities</li> <li>• Ensuring adherence to order cut-off times</li> <li>• Addressing customer service issues &amp; queries</li> </ul> <p>Determining the stock replenishment levels of products</p> <p><i>(Distractors are in italics)</i></p>

All questions were developed with the input of a team of experts in the company. These experts varied from operational supervisors to subject matter experts. Each question was evaluated in terms of its content and relevance given the competency definition and the level of proficiency required. To ensure that job incumbents would be able to complete multiple assessment in their own time, around 3 000 questions were developed that would sustain the process. If too few questions were used as a basis, repeating the process of multiple assessments would not be possible without asking the same questions and running the risk of incumbents learning the questions.

Content and construct validity of questions was thus provided through the involvement of a team of experts (Lewis *et al.*, 2005). A key guideline from case-study research is to gather information from multiple sources; this was also achieved through this process to ensure improved reliability (Yin, 2008).

#### *8.5.3.4. Technology enablement*

Based on the application requirements for an on-line assessment, software was developed to enable the complete process. This included the loading of the questions and setting up rules for selecting questions based on the competency profile selected. Each candidate thus selected a competency profile to be assessed against, and the software would select the appropriate questions for that assessment. The scenarios and the relevant questions were then presented to the respondent and the results captured, with an instant result at the end of the assessment. All results are stored in a database with standard reports available.

## **8.6. RESULTS OF THE ASSESSMENT**

A summary of the results is provided in this section. A first assessment which was perception-based was performed with the objective of developing an understanding of the constraints of perception-based assessments.

### **8.6.1. Perception-based assessment**

A perception-based assessment was done with a selected sub-sample of the controllers. The controllers in the Gauteng region, a total of 70, were selected to complete the assessment. A questionnaire with the ten meta-competencies was presented to the controllers and their supervisors. The request was to rate the performance of each candidate on a ten-point scale, and then evaluate the ten supply chain meta-competencies both in terms of their importance and their perceived skills level. The objectives of this were:

- To improve the understanding of the dynamics of the environment;
- To test the effectiveness of a perception-based assessment; and
- To provide an additional source of evidence based on the guidelines for improved case-study research.

#### *8.6.1.1. Results of the paper-based assessment*

The results of paper-based assessment are summarised in Table 8.9.

**Table 8.9: Results of paper-based assessment: Importance of competencies**

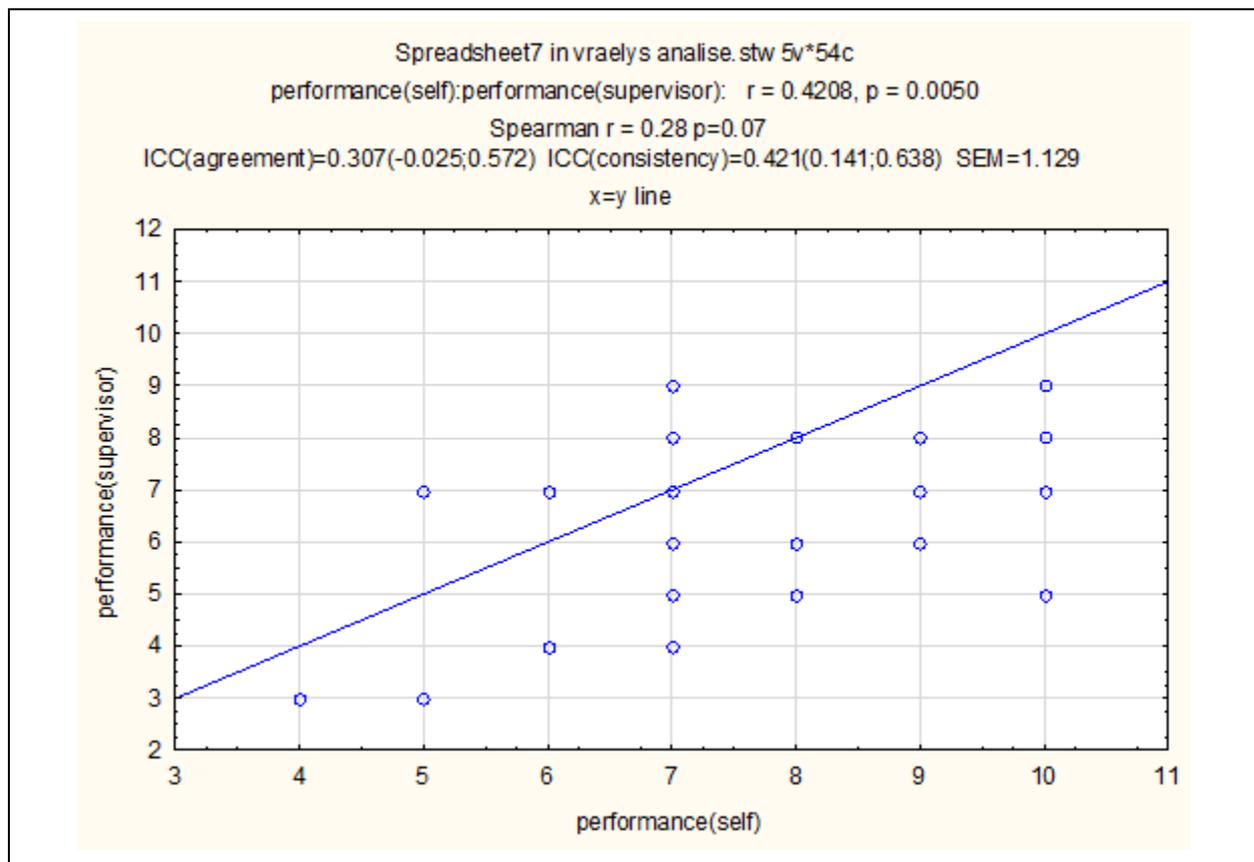
Aspect evaluated	Controllers	Supervisors	Gap (supervisor to controller)
Please rate the OVERALL JOB PERFORMANCE OF THE CONTROLLER on the following scale	7.7	6.5	-1.2
<b>Overall IMPORTANCE score</b>	<b>7.7</b>	<b>6.4</b>	<b>-1.3</b>
Understand how to buy raw materials from suppliers	7.3	5.1	-2.2
Understand the environmental impact of supply chains	7.5	6.2	-1.2
Understand warehouse operations	8.5	8.3	-0.2
Understand how to develop long-term plans for the supply chain	8.2	6.3	-1.9
Understand how to improve supply chain performance	8.0	5.6	-2.5
Understand how to manage the international supply chain	8.4	8.9	0.6
Understand how to plan activities across the supply chain	8.2	7.1	-1.1
Understand how to manage transport operations	7.7	6.0	-1.7
Understand international trade	8.6	8.2	-0.4
Understand how to manage transport risks	7.5	7.5	0.0
Understand that different types of businesses need different global supply chains	7.8	8.1	0.3
Understand the customs processes and calculations	8.2	7.0	-1.2
Understand customer service management	8.2	6.0	-2.2
Understand foreign exchange	7.5	5.5	-2.0
Understand freight forwarding	5.2	3.2	-2.0
Understand disbursements	6.8	4.0	-2.8
Understand invoicing	7.6	6.1	-1.5

Using the averages of the analyses from Table 8.9, candidates rated the relative importance of each of the competencies presented in the questionnaire. The same competences were then presented to the supervisors who also rated the importance. Table 8.10 summarises the ratings on performance or competency of the same items which were rated in terms of the performance of the job incumbent.

**Table 8.10: Competency rating scores**

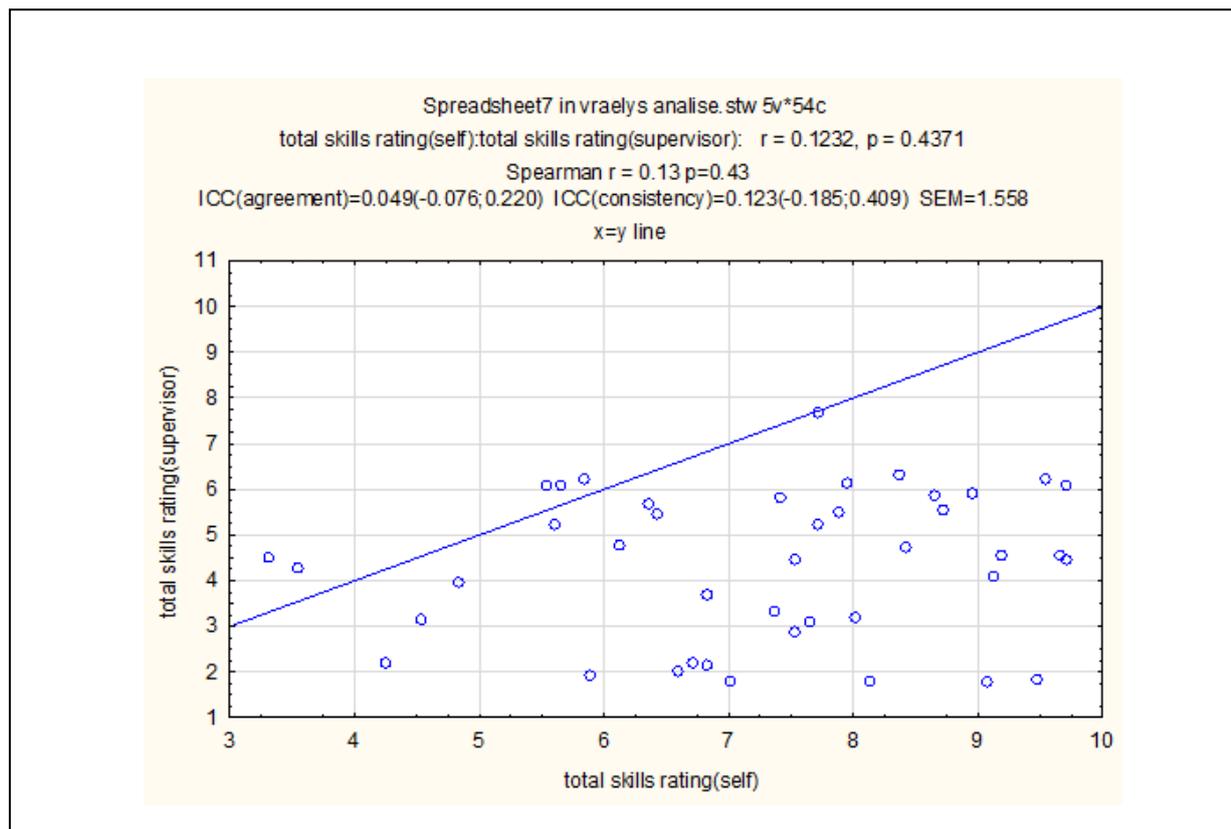
Aspect evaluated	Controllers	Supervisors	Gap (supervisor to controller)
<b>Overall PERFORMANCE score</b>	<b>7.1</b>	<b>4.5</b>	<b>-2.5</b>
Understand how to buy raw materials from suppliers	6.6	3.6	-3.1
Understand the environmental impact of supply chains	6.9	4.1	-2.8
Understand how to improve supply chain performance	7.9	5.9	-1.9
Understand warehouse operations	7.5	4.4	-3.1
Understand the customs processes and calculations	7.5	3.7	-3.8
Understand how to manage transport operations	8.0	6.6	-1.4
Understand how to develop long-term plans for the supply chain	7.4	5.0	-2.4
Understand how to plan activities across the supply chain	6.9	4.2	-2.7
Understand how to manage the international supply chain	8.0	5.9	-2.1
Understand how to manage transport risks	7.4	5.2	-2.1
Understand international trade	7.1	5.9	-1.1
Understand that different types of businesses need different global supply chains	7.1	4.9	-2.3
Understand freight forwarding	7.3	4.3	-3.0
Understand foreign exchange	7.2	3.9	-3.3
Understand disbursements	4.7	2.9	-1.8
Understand customer service management	6.2	3.0	-3.2
Understand invoicing	6.8	3.6	-3.2

The competency rating scores indicates an overall gap of 2.5 when the scores of controllers are compared with those of the job incumbents. Competency was consistently rated lower by the supervisor than the job incumbent. Performing further analysis on these scores indicated that there are no statistically significant correlations between these two scores. The scores of rating the relative importance of competencies also indicated that there was no statistically significant correlation between the scores of job incumbents and those of their supervisors. The statistical analysis performed on this assessment is summarised in Figure 8.2.



**Figure 8.2: Summary of statistical analysis for perception-based assessment: Importance**

A comparison of the performance ratings between the job incumbents and their supervisors had no statistically reliable correlation. The Spearman coefficient indicated a correlation of 0.28 at a 93 percent level of confidence. The ICC rating for agreement indicated a score of 0.0307 and consistency of 0.42 with standard error measurement of 1.129. Based on the guidelines for interpretation (Sheskin, 2004), the Spearman coefficient confirm strong correlates with values closer to 1. A value of 0.28 thus indicates a very low correlation between the variables. West, Welch and Galecki (2006) provide guidelines for the interpretation of the intra-class correlation coefficient (ICC), where a value closer to 1 would indicate statistically significant correlation. The same analysis was done for skills ratings between those of job incumbents and supervisors. These results are summarised in Figure 8.3.



**Figure 8.3: Summary of statistical analysis for perception-based assessment: Competency ratings**

A comparison of the competency ratings between the job incumbents and their supervisors had no statistically reliable correlation. The Spearman coefficient indicated a correlation of 0.13 at a 43 percent level of confidence. The ICC rating for agreement indicated a score of .049 and consistency of 0.123 with standard error measurement of 1.558. Based on the guidelines for interpretation (Sheskin, 2004), the Spearman coefficient confirms strong correlates with values closer to 1. A value of 0.13 thus indicated a very low correlation between the variables. West *et al.* (2006) provide guidelines for the interpretation of the intra-class correlation coefficient (ICC), where a value closer to 1 would indicate statistically significant correlation.

A possible conclusion that could be drawn from this analysis is the limitation of perception-based evaluations of competency and performance ratings. Although this was only a selected sample that was not representative of the total workforce, it can prove the limitations of perception-based assessments. The results of the online assessment are discussed in the next section.

## **8.6.2. The online assessment**

Given the learnings from the paper-based assessment, the technology-based assessment was done in two phases, a testing phase and a full assessment phase.

### *8.6.2.1. Testing*

The first testing of the assessment was aimed at testing the process followed and the understanding of the software interface. The length of the assessment was also evaluated during the first testing. A group of 20 respondents was selected following a convenience sampling approach: the group needed to represent different job titles and be physically accessible in order to get their feedback verbally. The assessment questions were set up as explained in the previous section and the twenty participants were requested to complete the assessment in the presence of the researcher. The type of questions asked and the issues raised provided an indication of the first experience with the assessment.

The key learning from the first testing was that the assessment was too long and the number of questions was reduced. Some of the initial assessments took more than four hours to complete. The questions were proportionally reduced to keep all competencies equally represented in the assessment. After these adjustments were made, the assessment was ready to be used on the bigger sample. Due to the random nature of the selection of the questions, the respondents involved in the testing could participate in the study again during the main assessment.

### *8.6.2.2. Respondents*

The total sample of potential participants consisted of 650 participants across four geographical regions and 23 different job profiles. Invitations were sent out to all respondents and they were allowed two months to complete the assessment. As the assessment was electronic, respondents could complete the assessment in their own time.

A total of 534 respondents completed the assessment. The distribution of participants across regions is outlined in Table 8.11. The group was representative of the population, given the size of the different regions.

**Table 8.11: Respondents by region**

<b>Geographical Region</b>	<b>Population</b>	<b>Number of Respondents</b>
Gauteng	315	255
Western Cape	95	85
Eastern Cape	55	49
KwaZulu-Natal	185	142
<b>Total</b>	<b>650</b>	<b>534</b>

Table 8.12 provides the breakdown of the respondents by job title.

**Table 8.12: Respondents by job title**

Disbursement Clerk	10
Invoicing Clerk	24
Trade Lane Specialist	2
Warehouse Manager	2
Client Services Manager	3
Key Account Manager	6
Managers – non-operational	7
Supervisor – Fleet Maintenance	1
Admin and support staff	122
Business Unit Manager	24
Customs Specialist	4
Sales and Servicing Administrator	7
Sales Manager	1
Business Development Consultant	11
Claims Administrator	1
Client Services Consultant	9
Controller	196
Entry Pool	68
Estimator	1
Logistics Coordinator	17
Logistics Engineer	4
Supervisor – Logistics	11
Supervisor – ORT Customs	1
Head Office	2
<b>Total</b>	<b>532</b>

Based on these profiles of the respondents, the following limitations for analyses were identified:

- The disproportionate number of respondents by region limited any detailed analyses by region, as the results would not be statistically significant.
- The distribution of respondents across the supply chain positions was also disproportioned. Certain positions only had a single respondent while others had 196. The consequence was that no analysis could be done by position, as the results would also be statistically insignificant.

Analysis was thus restricted to that of the consolidated group.

#### 8.6.2.3. *Analyses: Quality of questions*

The first objective of the analyses was to evaluate the quality of the individual questions. Two key aspects are relevant in terms of the quality of the questions:

- The first aspect focuses on the construct validity of each question as per the methodology of Lewis *et al.* (2005). A degree of construct validity in this case is already achieved through the approach taken with the development of the individual questions. Each question was developed by a team of job incumbents and then reviewed by the team of internal experts. This process can be compared to the quantitative procedure of Lawshe (cited in Lewis *et al.*, 2005). Although the content validity ration was not calculated, only questions that were rated essential were included in the assessment. Content validity was also provided through the analysis of content of each question by the experts. This is an acceptable means of achieving content validity based on the methodology of Lewis *et al.* (2005). It is also in line with the best practices from Champion *et al.* (2011), Shippmann *et al.* (2000) and Baartman *et al.* (2006).
- Although construct validity should ideally be analysed through advanced techniques such as factor analysis and the calculation on reliability measures such as Cronbach coefficients based on the methodology of Lewis *et al.* (2005), the characteristics of the data posed specific challenges. A total of 3 558 questions were developed for the question pool. The questions used in each assessment were selected randomly based on the competency to be assessed, and the level of proficiency required. This was a key competency development requirement for job incumbents to be able to take repeated assessments to determine improvement in competency. The result is, however, that not all questions will be used in a single cycle of assessment. A further consequence will be that the number of responses for each question will be different, posing a challenge for further analyses. The net effect is that factor analysis and equation modelling recommended in the methodologies of Lewis *et al.* (2005) and Siddhartha (2009) could not be applied. This would represent this first limitation

of the analyses that the underlying structure of the construct of supply chain competency could not be tested. The underlying structure, which is based on the theoretical and expert input, will be accepted for the purpose of this analysis, which is an acceptable outcome for an exploratory phase of development (Lewis *et al.*, 2005).

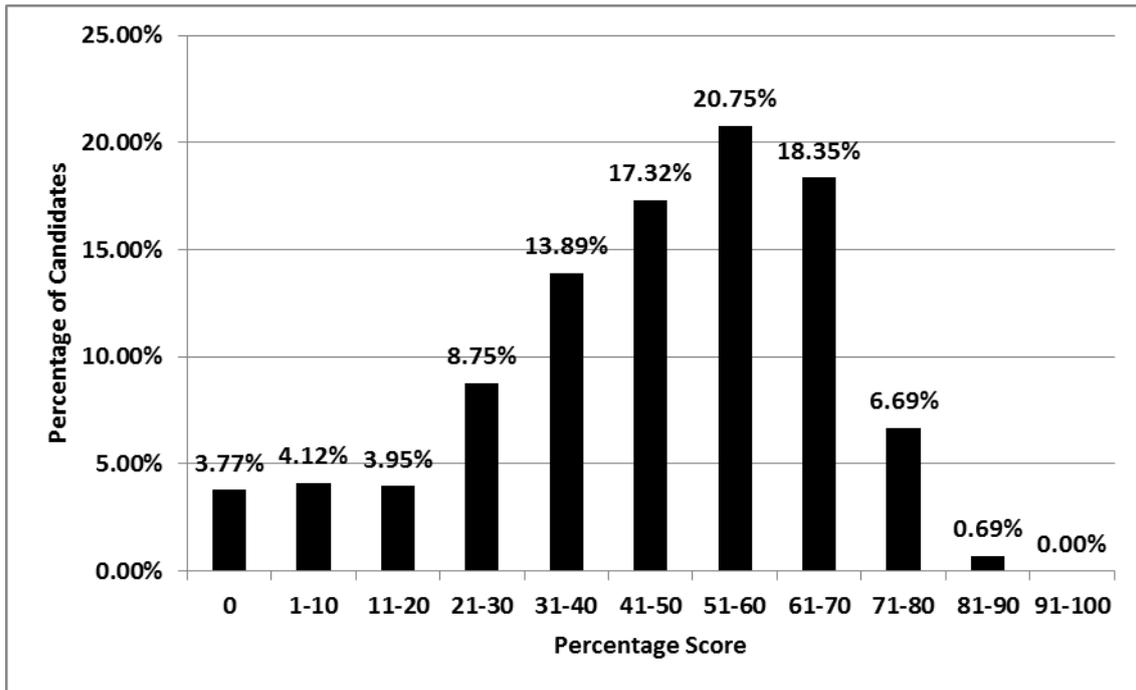
- The next evaluation is to what extent each question performed reliably in providing discriminative capability during the assessment of competency. The second limitation of the analyses is that not all questions could be evaluated. Certain questions did not generate enough responses to be analysed. These questions were eliminated from the analyses. For the balance of the questions, further analyses were done. The response per question was analysed and all questions with fewer than five correct and five incorrect responses were eliminated from further analyses. A total of 1 555 questions were removed from the analyses. These questions will have to be further evaluated in a next phase of research.

For the remaining questions, the discrimination capability was calculated using effect size, which is based on determining the discrimination capability of a question, thus discriminating between correct and incorrect answers. For the remainder of the questions, Table 8.13 provides the summary of results.

**Table 8.13: Summary of discrimination analyses**

Number of Questions	Effect size value range	Discrimination Class
454	1.45 – 6.24	Huge Discrimination Value
450	1.10 – 1.44	Very Large Discrimination Value
594	0.75 – 1.01	Large Discrimination Value
397	0.40 – 0.74	Medium Discrimination Value
108	0.15 – 0.39	Small Discrimination Value
30	0.01 – 0.14	Negligible Discrimination Value

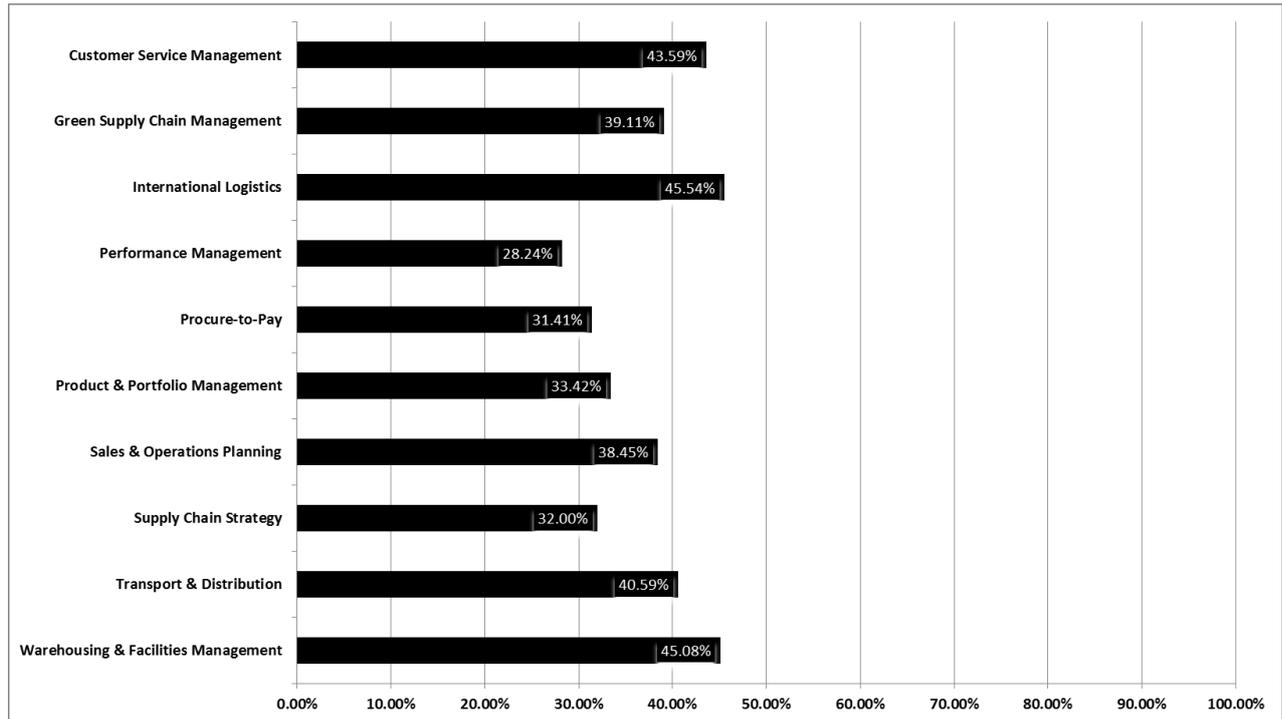
All questions with a huge to a medium discrimination capability were retained in the assessment, thus a total of 1895 questions were retained for further analysis. A total of 1 693 questions were excluded, taking into account the first two tests. This equates to 56 percent of the total questions of 3 000 being excluded from any further analyses. The detail of the results is attached in Appendix E.



**Figure 8.4: Overall competency scores**

#### 8.6.2.4. Calculating the competency scores

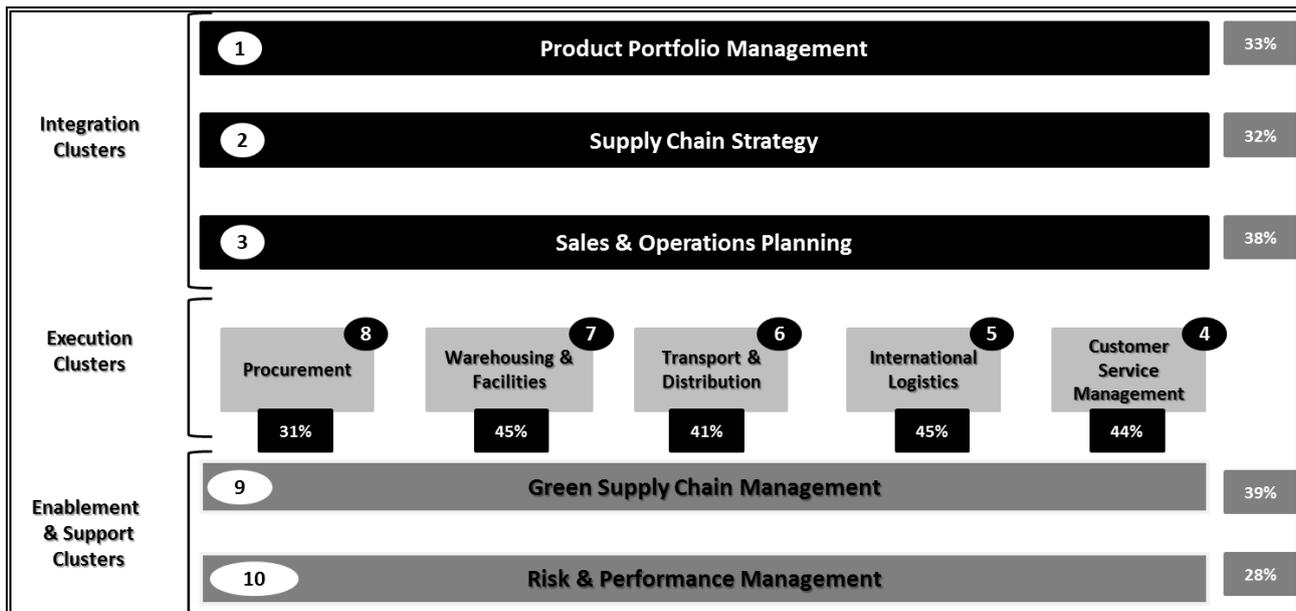
The competency scores were calculated after the assessment questions were adjusted based on the results explained in the previous section. The outcome of the results for the overall competency for the total group of respondents is outlined in Figure 8.4.



**Figure 8.5: Competency scores by meta-competency**

The average competency level across the group is 43.62 percent with 46.48 percent of respondents scoring more than 50 percent. The target competency level that was set by the executive team of the company was 70 percent, which implies that the competency gap of the group is 26 percent. The competency gap provides an indication of the investment in competency development that is required. Figure 8.5 relates the competency scores back to the competency model.

The competency scores can also be presented consistent with the structure of the competency model. This is depicted in Figure 8.6.



**Figure 8.6: Competency scores based on the competency model**

The competency results were not analysed at a level lower than the meta-competency level due to the unequal distribution of responses. Analysing data at consolidated level the potential limitation of response distribution was avoided. The following potential conclusions can be drawn from the competency scores by competency cluster:

- At a strategic level for the meta-competencies product and portfolio management and supply chain strategy, the scores of 33 percent and 32 percent respectively represent significant gaps compared to the target of 70 percent set by management. This should however be seen against the context of a strong representation of operational staff in the sample. A further perspective on this is that the traditional core business of the company was operational in nature, with limited focus at strategic levels.
- It is however important to note that from a dynamic capability perspective, this forms a key element of competitive advantage. This was also identified by senior management as a major source of differentiation.
- Sales and operations planning, meta-competency 3, with a score of 38 percent, is a concern as this is a key driver of operational integration. A significant competency gap in this area can have an adverse impact on both the internal operations of the company and the level of supply chain integration with customers and suppliers.
- Meta-competencies 4-7, the traditional operational competencies with scores in the mid-forties, would be a major concern, as this is the traditional core business of the company. It could be argued that these competency scores were adversely affected by the type of

assessment as it was new to the respondents and the scores would improve as they got used to computerised assessments.

- Green supply chain management is a new area in the field of supply chain and the score of 39 percent could be seen against that background.
- The last meta-competency, performance improvement, scored the lowest at 28 percent. This can potentially be a major source of performance improvement as it might indicate a low level of performance improvement focus and competency.

Although the competency assessment instrument is in its infancy and needs significant further improvement, it provides a basis to work from. The learnings and conclusions are discussed in the last section of the chapter.

## **8.7. CONCLUSIONS**

Based on the application of the competency model to the case study, the following potential conclusions can be drawn.

### **8.7.1. The research strategy selected**

- The case-study research strategy selected was the best option to achieve the research objectives. Survey research as an alternative would not have achieved the objectives, as the potential differences between different companies would have been too significant. This strategy is also consistent with the best practices for competency modelling based on the work of Campion *et al.* (2011) and Shippmann *et al.* (2011).
- Survey research would also have limited the extent to which the model could have been tested. Only selected parts of the model could be tested with survey research.
- The geographical reality of the supply chain industry in South Africa offers a further challenge. If, for example, a specific job profile and its supporting competency profile were to be tested, generating the required sample of that job position in South Africa would have been a significant challenge.

### **8.7.2. Competency assessment requirements**

- The job profiles provided a basis for translating job requirements into competency requirements. The job profiles were developed with the input of not only job incumbents but also a team of internal experts. Based on the methodology of Lewis *et al.* (2005) and Siddhartha (2009), construct and content validity was achieved through this process. Based on the case-study methodology from Yin (2008), using multiple sources of evidence in a well-documented and structured approach proves the reliability of the outcome.

The same process was followed with the development of competency profiles and the outcome in terms of construct validity and reliability as per the previous paragraph can be assumed for the competency profiles as well.

- The development of job and competency profiles also complied with the best practices identified in the research of *Campion et al.* (2011), *Shippmann et al.* (2011) and *Singh* (2008).
- The limitation of this part of the research is that the job- and competency profiles cannot be generalised across different companies.

### **8.7.3. The competency assessment instruments**

The objective with the competency assessment was to complete an exploratory assessment based on the methodology of *Lewis et al.* (2005).

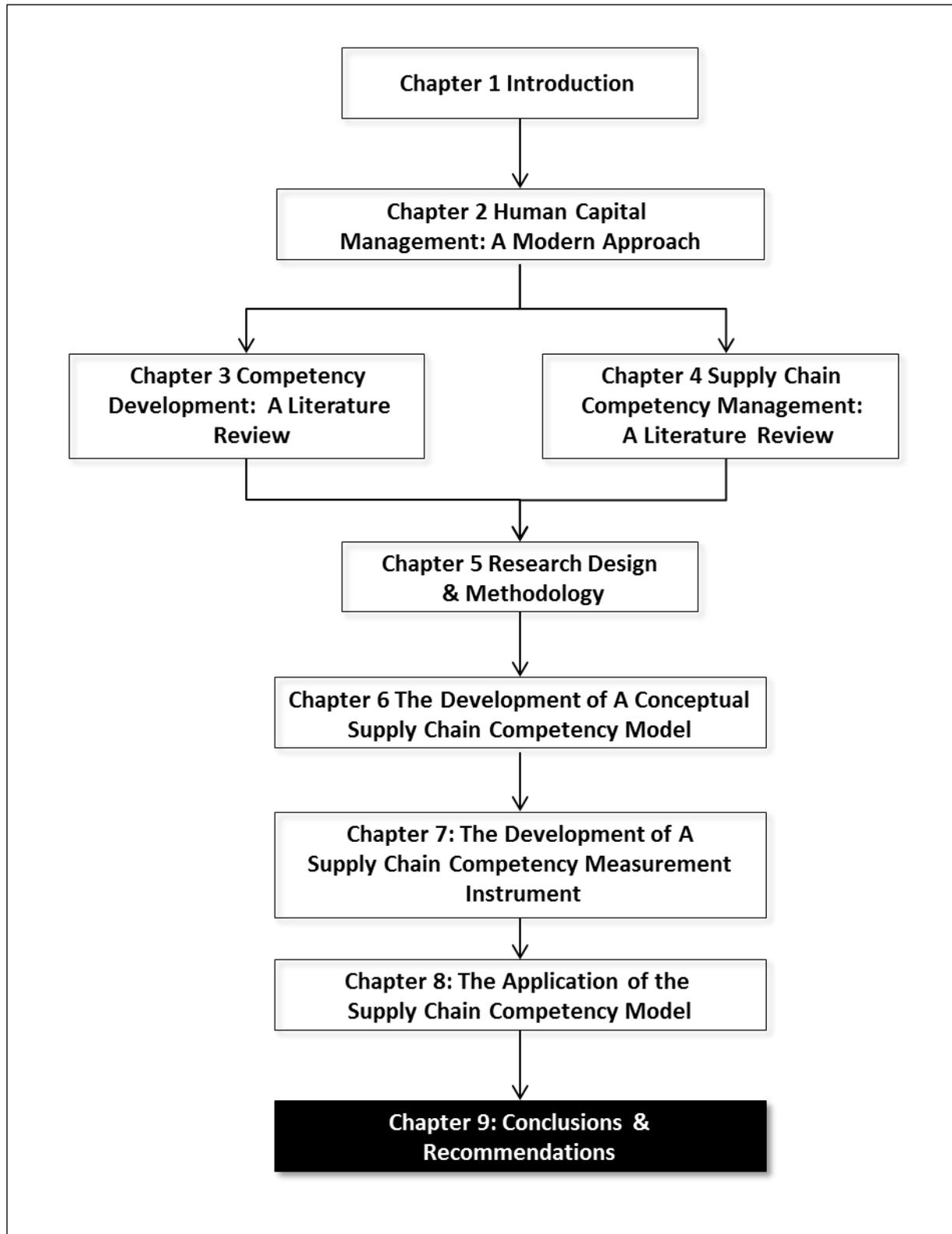
- A significant number of questions could not be verified in the first round of assessment due to the requirement of on-going assessments as part of competency development. Random selection of questions from a question pool is part of the application requirement and could not be avoided. This can only be achieved through multiple assessment cycles during future research.
- Although techniques such as factor analysis could not be applied, construct and content validity was achieved through the involvement of different teams of experts (*Lewis et al.*, 2005). Reliability could be proven based on the use of the case-study methodology of *Yin* (2008) by means of multiple sources of evidence and pattern matching.
- Based on the research from *Baartman et al.* (2006), the outcome of the research complied with the majority of the guidelines. An example would be the reliability of the outcome; the measurement instrument would produce a similar outcome if repeated because no human intervention would influence the outcome of a repeated assessment.
- A limitation for reliability analysis of the items or individual questions is that classical research methods such as item response theory or Cronbach alpha analysis could not be applied. These techniques require a consistent response from all respondents.
- The duration of the assessment was still too long, with the effect that job incumbents would be discouraged to take multiple assessments. The ideal is that the duration of the assessment should be practical, for instance an hour or an hour and a half, then incumbents will take repeated assessments to guide the improvement of their competency levels.
- The scenario-based approach achieved good results; the emphasis on practical application worked well.

- A limitation of the research is that the competency scores could not be linked with a performance score across all candidates. This will be a key requirement in future research to ensure getting the maximum results of competency assessment through establishing a direct link between job performance and competency assessment.

The conclusions from the study and the implications for future research will be discussed in the following chapter.

## CHAPTER 9

### CONCLUSIONS AND RECOMMENDATIONS



## 9.1. INTRODUCTION

The objective of this chapter is to provide conclusions from the research and discuss recommendations for future research. This will be done by reviewing the research problem and objectives and then providing conclusions and recommendations for each of the research objectives.

## 9.2. RESEARCH PROBLEM

The problem statement is based on the conclusions from the literature review that was presented in Chapters 2 to 4. A short summary of the findings from the literature review thus provides verification of the problem statement or research requirement.

The following conclusions were reached from the review of the literature:

- The increased importance of human capital as a strategic resource to achieve business success and the challenge of managing global talent pools in an environment of severe skills shortage was confirmed.
- The transition from a traditional approach of managing human capital to a strategic competency-based approach was identified. The strategic importance of global competency development is evident from the research reviewed. Competency models as a core mechanism for competency development are central in the process of competency development.
- A best practice model for competency modelling was developed which provided a framework for developing and evaluating competency models. This was used as the basis for evaluating existing supply chain competency models and competency research.
- The review of the supply theory indicated that a number of different models for supply chain management are being used. However, these models are not integrated and provide for a degree of fragmentation.
- A review of the previous research on the use of competency models in supply chain indicated that no integrated competency model currently exists. Various competency models exist, but every model has limitations if evaluated against the best practices for competency modelling. None of the current models includes the definition of proficiency levels, without which measurement of competency levels would not be possible.
- The measurement of supply chain competency is unexplored territory. Limited research is available on the development of supply chain competency assessment instruments and it is not part of any of the existing supply chain competency models.

- Limited research is available regarding the challenges and experiences with the application of competency models in supply chain.

Based on these conclusions, the research problem formulated for this research study was twofold:

- No integrated competency model inclusive of the various models of supply chain is currently available in the public domain. This puts a constraint on the further development of supply chain competency management.
- Research on the challenges and complexities with the application of a supply chain competency model including competency assessment is limited, which adversely affects the progress of the field of supply chain competency management.

The research problem provided the basis for the formulation of the research objectives and a methodology to achieve those objectives.

### **9.3. RESEARCH OBJECTIVES:**

Based on the research problem identified in the previous section, the following research objectives were formulated:

- To develop a supply chain competency model that integrates various supply chain models into a single model, and complies with the best practices for competency modelling. The focus of the competency model is on functional supply chain competencies and not personal traits or characteristics;
- To develop a measurement instrument for measuring functional supply chain competency in line with the competency model;
- To implement the competency model and complete an exploratory assessment to better understand the challenges, complexities and possible solutions during the implementation of a competency model.

Supporting objectives were developed to provide a more detailed understanding of the research objectives.

The development of a **supply chain competency model** further required the following supporting objectives:

- Integrate the different models of supply chain management into a single model to provide the basis for a competency model.
- Apply the best practice framework for competency modelling in the development of a supply chain competency model.

For the **development of a measurement instrument** for measuring supply chain competency the following supporting objectives were relevant:

- Develop competency profiles to provide the basis for competency assessment.
- Develop a competency assessment instrument for the measurement of competency levels.

For the **application of the competency model and the measurement instrument**, the following supporting objectives were relevant:

- Formulate an appropriate research approach for the application of the models.
- Apply the best practice guidelines for competency modelling to the application.
- Document the learnings, conclusions and recommendation for future research.

The research design outlined in Chapter 5 provided detail on the research methodology and techniques applied to achieving these objectives. The next section of the chapter provides a review of the results achieved, the limitations and the implications for future research.

## **9.4. CONCLUSIONS, LIMITATIONS OF THE RESEARCH AND IMPLICATIONS FOR FUTURE RESEARCH**

### **9.4.1. A best practice framework for developing competency models**

The development of a best practice framework for competency modelling that can be used for developing a supply chain competency model was an essential part of the literature study. It provided a set of guidelines that were used firstly to evaluate the existing supply chain competency research and models, and secondly provided the design guidelines for developing an integrated supply chain competency model. The literature on competency modelling originates primarily from other fields of knowledge such as human capital management. This literature was integrated with literature on dynamic capabilities as an explanation of business strategy. The following results were achieved:

- The research from Campion *et al.* (2011) which was used as a basis for the framework can be regarded as a benchmark study because it combines the inputs of various experts who were consulted over an extended period. This same framework was used by the Human Resource Society in the United States, one of the biggest human capital industry associations, as a guideline to develop its own competency model. This research was augmented by the work of Shippmann (2000), Dai and Liang (2012), Bonder *et al.* (2011), Bergman, Yassine and Roemer (2004) and Athey and Orth (1999).
- The concept of dynamic capabilities was integrated to improve the strategic alignment of the existing framework. Research from various authors like Stalk *et al.* (1989), Ali *et al.* (2012)

and Fuchs, Mifflin, Miller and Whitney (2012) was used as a basis. Linking dynamic capabilities and competencies in a competency model is an addition to the competency modelling best practice.

The framework developed is outlined in Table 9.1 for further detail.

**Table 9.1: Best practices for competency modelling**

<p><b><u>Identification of required competencies:</u></b></p> <ul style="list-style-type: none"> <li>• Consider the organisational context</li> <li>• Regard dynamic capabilities as the core driver of competencies</li> <li>• Link competency models to organisational goals and objectives</li> <li>• Start at the top, involve executive management</li> <li>• Use core business processes as driver</li> <li>• Use rigorous job analysis methods to develop competencies</li> <li>• Consider future-orientated job requirements</li> <li>• Use additional unique methods</li> </ul>
<p><b><u>Organising and presenting competency information:</u></b></p> <ul style="list-style-type: none"> <li>• Defining the anatomy of a competency (the language of competencies)</li> <li>• Defining the levels of proficiency on competencies</li> <li>• Using organisational language</li> <li>• Including both fundamental (cross-job) and technical (job-specific) competencies</li> <li>• Using competency libraries</li> <li>• Achieving the proper level of granularity (number of competencies and the amount of detail)</li> <li>• Using diagrams, pictures and heuristics to communicate models to employees</li> </ul>
<p><b><u>Using competency information:</u></b></p> <ul style="list-style-type: none"> <li>• Using organisational development techniques to ensure competency modelling acceptance and use</li> <li>• Using competencies to develop HR systems (hiring, appraisal, promotion, compensation)</li> <li>• Using competencies to align HR systems</li> <li>• Using competencies to develop a practical “theory” of effective job performance tailored to the organisation</li> <li>• Using information technology to enhance the usability of competency models</li> <li>• Maintaining the currency of competency over time</li> <li>• Using competency modelling for legal defensibility (e.g. test validation)</li> </ul>

Source: Adapted from Campion *et al.* (2011) and various other sources.

As the objective was not to test the framework empirically, the only applicable measures of research quality that could be applied were construct and content validity. Based on the research of Lewis *et al.* (2005) and Riege (2003), using multiple sources from various authors through a process of content analysis is an acceptable means of achieving construct and content validity.

The limitation of this framework is that it was not tested empirically to determine reliability and predictive capability for achieving best results. A further limitation is that the different practices are

not compared in terms of relative importance and as such are all treated as equally important. Given the application of the framework for the purpose of theory development which will be tested in any case, these limitations were not seen as material.

#### **9.4.2. Development of an integrated supply chain competency model**

The development of an integrated supply chain competency model was based on the methodology of Lewis *et al.* (2005), combined with the principles of developing theory from Wacker (2008) and the guidelines for competency modelling from Campion *et al.* (2011) and Shippmann *et al.* (2000). With this research as basis, the following was achieved:

- A literature research was completed to review all relevant research and theory on supply chain competency models. Various models of supply chain were evaluated with the best practice framework as a basis. Research on supply chain talent management and best practices was also reviewed. Content analysis was applied for the comparison of the different models and previous research completed. This process provided the basis for achieving construct validity (Lewis *et al.*, 2005).
- An integrated supply chain competency model was developed which complied with the basic requirements from the Lewis *et al.* (2005) methodology Stage 1. The components of the model are easily accessible from the theory; the level of analysis was defined as functional competency of individuals; and the purpose and constraints were defined. In terms of the philosophy of knowledge, the dimensions of the construct of supply chain competency were clearly identified and broken down further into item stems and ultimately individual items.
- The model development used two phases of Delphi research, with the first phase the use of internal experts to the company employed as the case study, and the second phase Delphi using external experts from various industries. A level of a concordance of .72 was achieved during the second round of Delphi research, which is acceptable for achieving agreement between the experts. The Delphi technique is recommended for use during model development (Lewis *et al.*, 2005). Construct validity was further improved through the Delphi technique and the acceptable level of agreement achieved. Karoulis and Pombortsis (2006) also found that expert evaluations were as valid as empirical methods.
- Based on the work of Wacker (2008), the key requirements for model development were applied. This required clear definitions of concepts, supporting these definitions from previous research, and a clear definition of relationships between constructs, both conceptually and graphically. New insights were identified which provided the basis for possible predictions and recommendations for future research.

- The competency model was further enhanced through detailed definitions for each dimension extracted from previous research and existing theory. This further enhanced the construct and content validity of the model and provided further application of the criteria for model development.
- The best practice for competency modelling from Campion *et al.* (2011) and Shippmann *et al.* (2000) was applied to the format of the competency definitions and the creation of a competency library. Further construct validity was provided through the application of these guidelines.

Lewis *et al.* (2005) state that the development of a model of this nature, using a recommended methodology and techniques, can be regarded as an acceptable research result on its own without further testing. A limitation of not developing the model further would be that it would remain only a theoretical model that provided the basis for further development.

#### **9.4.3. The development of a measurement instrument for measuring supply chain competency**

The development of a measurement instrument for measuring supply chain competency was documented in detail in Chapters 7 and 8. The methodology used during this process was a combination of the research from the work of various authors: the revised Bloom taxonomy (Florida International University, 2014.) was used for developing levels of proficiency, Yin (2008) provided the case-study methodology, while the construct development methodology was applied from the work of Lewis *et al.* (2005). Baartman *et al.* (2006) provided the guidelines for competency assessment which were also applied. The following was achieved:

- The development of levels of proficiency is an essential next step towards the development of a measurement instrument. The revised taxonomy of Bloom (Florida International University, 2014) was used as a basis for developing the levels of proficiency. This taxonomy can be regarded as the leading work on the levels of learning and development and as such provided a sound foundation for this development. Testing proficiency statements and definitions presents a particular challenge: the classical approach of survey research cannot be used due to the quantity and extent of detail. A strong theoretical basis was provided by existing research and theory. Combined with the use of the Bloom taxonomy, this provided some basis for construct and content validity.
- Further development of the measurement instrument required empirical input and application. The case-study research methodology was applied and an appropriate case study was selected for this purpose. The alignment of competency modelling with the business strategy and unique challenges of a specific company as a requirement for

successful competency modelling (Campion *et al.*, 2011) and Shippmann *et al.* (2000) provided motivation for the use of case-study research.

- A case-study protocol based on Yin (2008) and Riege (2003) was employed, with the requirements for achieving reliability and validity dictating the techniques being used. Multiple sources of evidence were used for collecting data. Company documents were analysed, with job incumbents and two teams of experts providing input into the development. Theoretical propositions were applied and both qualitative and quantitative techniques were used in the analyses of the data.
- To establish measurement targets for the measurement of supply chain competency, a set of job profiles was developed. Each job profile was developed with the input of a selection of job incumbents and signed off by a team of supervisors and company experts. The same process was followed for the development of competency profiles that defined the competency requirements for each job profile. The process that was followed provided a basis for both construct validity and reliability based on the work of Yin (2008) and Riege (2003). Construct validity and reliability was further improved through the application of the guidelines for job analysis and competency modelling from Champion *et al.* (2011) and Shippmann *et al.* (2000).
- The assessment approach, an on-line assessment which was enabled through specifically developed web-based software, was derived from the research by Baartman *et al.* (2010). Specific criteria for achieving reliability and good quality of assessment were applied.
- The development of the assessment questions was based on the methodology of Lewis *et al.* (2005). A question bank of 3 000 questions was developed with the input of a team of job incumbents and supervisors. Each question was evaluated in terms of its content and its importance with the concept of supply chain competency which provided the basis for construct validity and reliability. The question bank was further enhanced with the development of short scenarios to improve the real-life focus of the questions. Each scenario was also evaluated by the team of experts.
- Pre-testing of the measurement instrument was done with a selected group of individuals to test the format of the application, the process followed and the duration of the assessment. A key learning from this was that the assessment was too long; as a result, adjustments were made to reduce the duration.

#### **9.4.4. The application of the competency measurement instrument**

An exploratory assessment was completed consistent with the construct development methodology of Lewis *et al.* (2005). The following was achieved:

- Due to the nature of questions being randomly selected for each assessment, a significant number of questions could not be tested. Questions with no responses were automatically excluded from the analysis. Questions with low response levels were also excluded from the analysis. An evaluation of the quality of questions was done to determine the discrimination capability of questions. Only questions with an acceptable level of discrimination were retained.
- A limitation of the research is the fact that different question sets are asked during different assessments, hence various techniques such as factor analysis could not be used. The underlying structure of the competency model and more advanced analysis of construct validity and reliability with techniques such as confirmatory factor analysis and Cronbach coefficients could thus not be calculated. This is an inherent constraint of on-line assessments which allow job incumbents the opportunity for multiple assessment as a means towards competency development. The relative contribution of each competency or sub-competency towards the total construct could thus also not be determined.
- Job performance did not form part of the assessment as the data was not available; consequently, no correlation between competency and job performance could be tested.
- The adverse impact of a first experience for many respondents during the assessment could not be quantified.
- The number of questions that could be used for analysis was not fully representative of the competencies; results could thus only be quantified at the level of meta-competency.
- The quality of the assessment was adversely affected by the length of the assessment. This also had a negative impact on the practical use of the assessment.

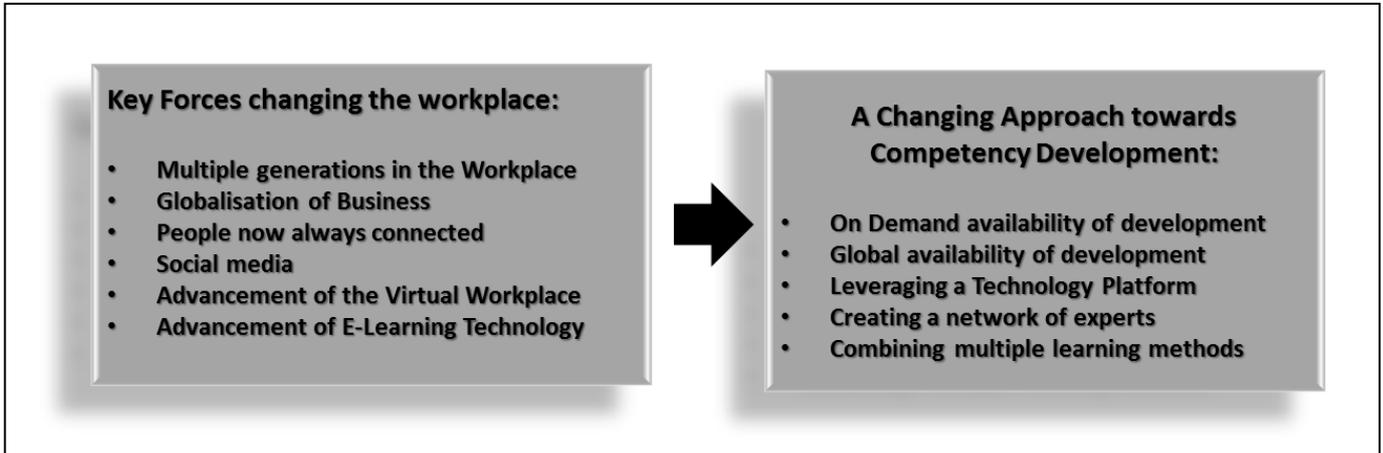
Based on the research outcomes, the implications for future research are the following:

- Various research phases will be required to test the quality of all the questions in a test bank when not all questions are used all the time.
- Job performance needs to be included in the assessment of competency to determine the correlation between competency and job performance.
- The random selection of questions cannot be used for testing the contribution of individual competencies and the underlying structure of the model.

## **9.5. IMPLICATIONS FOR FUTURE RESEARCH**

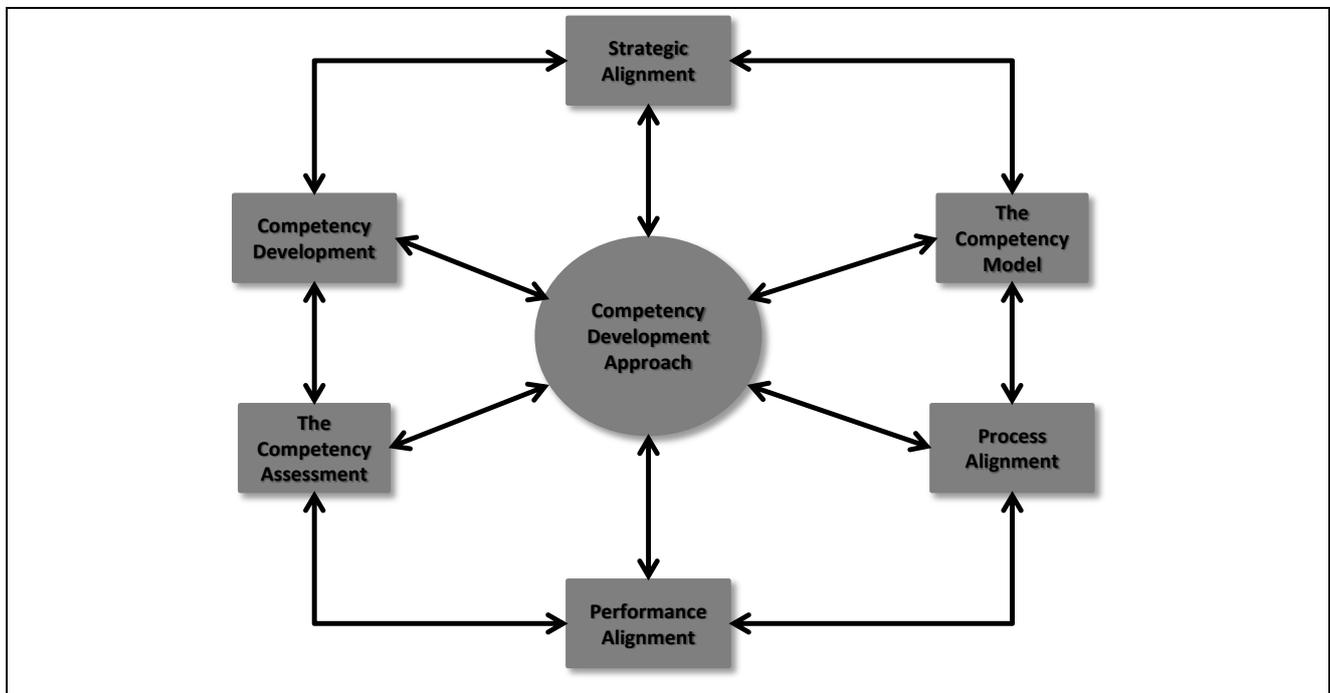
Competency assessment as a driver of competency development and ultimately talent management could not be developed in isolation. In developing a future-orientated approach towards the development of supply chain competency, a number of key global forces changing the

workplace should to be taken into account. These forces will have significant impact on how human capital will work, interact and thus develop competency. Some of the forces that were identified in Chapter 2 are outlined in Figure 9.1.



**Figure 9.1: A different approach towards competency development**

Given these challenges, a more integrated approach towards competency development needs to be adopted in future. An example of such an approach is provided in Figure 9.2.



**Figure 9.2: An integrated approach towards supply chain competency development**

An integrated approach towards competency development would include:

- Strategic alignment: The concept of dynamic capabilities as strategy was introduced in Chapter 2 and integrated with supply chain capabilities in Chapter 4. The core principle behind dynamic capabilities is their dynamic nature, which implies that they will constantly change. Given this dynamic nature, the required capabilities will change over time, which will require changes to the competency model. This principle is supported in the research of Lorentz, Töyli, Solakivi and Ojala (2013). As supply chain structural properties continue to change in the future as a result of, for example, such continued trends as outsourcing of production, shift from push to pull, and internationalisation, this research has provided insight into what the implications may be in terms of competency development priorities. Beske (2012) provides further support of this concept.

Further application of this concept is from the work of Gattorna (2006), which differentiates between different types of supply chains. The same principle was also further developed by the work of Lee (2002), which also differentiated between different types of supply chains. The competency thus needs to be aligned with the type of supply chain as well as with the changes in that specific supply chain over time.

- The requirement for an integrated competency model forms the basis of this research. The requirement for a single model for supply chain talent management was also supported by the work of the Supply Chain Academic Initiative under the auspices of the Supply Chain Council (2014).
- Process alignment: Processes form the basis for the SCOR model from the Supply Chain Council. Integration between supply chain processes and supply chain competencies is thus a key requirement. Although the SCOR model (Supply Chain Council, 2014) identifies different skills requirements, these skills requirements are not aligned with proficiency levels or with competency profile linked job profiles. Linking job profiles and competency profiles to the SCOR model is the missing link in competency development.
- Performance integration: Competency development would be a theoretical exercise if it did not achieve the outcome of performance improvement of job incumbents. The link between supply chain capability and financial performance was confirmed again in the recent work of Ellinger *et al.* (2012), where the financial impact of the top 25 supply chains in the world was compared.
- Competency assessment: The key requirement for competency assessment in future will note *ad hoc* assessments of individuals from time to time. Increased globalisation and skills shortages will require a continuous process of competency assessment. This will require technology enablement and the capability to support on-demand competency assessments

on-line by any person at any time. This can only be achieved with the kind of model and platform that was developed in this research.

- Competency development: Competency development needs to be integrated with on-line assessments that generate individual competency development plans. A blended approach towards competency development should allow job incumbents to develop their competency at a time of their choice, using a development method of their choice at a place of their choice. Social media and the growth in mobile devices will enable this process.

Unless supply chain competency development is driven in future from a different paradigm as described in this section, closing the skills shortage in global supply chains will remain an ideal. The cost of human capital in supply chain management is one of the highest cost components, and yet no research in supply chain has ever provided benchmarks on the cost of human capital relative to the other cost components. Getting the maximum return from this investment will require a different approach towards competency development.

## **9.6. INTEGRATING THE SUPPLY CHAIN COMPETENCY MODEL INTO A BROADER COMPETENCY MODEL**

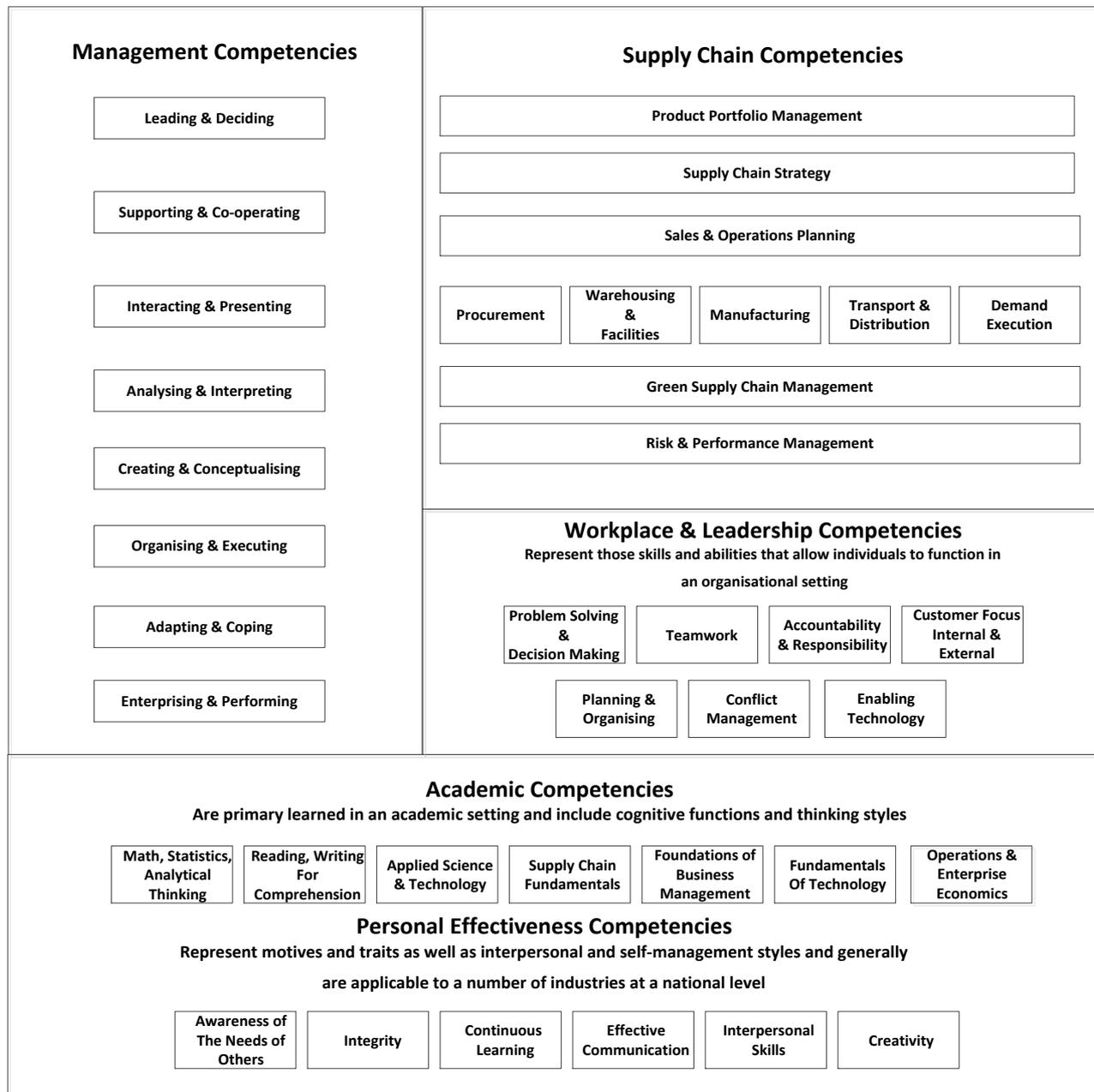
Although the focus of this study was the development of a supply chain competency model, with the functional competencies being verified through the Delphi research, the model can now be positioned in terms of the broader competencies which will include personal and management competencies.

The competency model from the Career One Stop (2013) serves as a reference for including the broader competencies. This model was combined with the SHL Leadership Model in 2013 which includes the key management competencies. The integration of these models with the supply chain competency model developed in this chapter is depicted in Figure 9.3.

The different competency clusters that are included in the integrated model are:

- Foundation competencies: These competencies are a combination of personal effectiveness and academic competencies that are required for an individual to operate in any work environment (adapted from Career One Stop, 2013).
- Workplace competencies: This includes competencies specific to a workplace environment such as teamwork or customer focus. The relative focus on these competencies will differ between different work environments (adapted from Career One Stop, 2013).
- Supply chain competencies: These are the required functional supply chain competencies for a specific supply chain function. These competencies are made up from the different supply chain models and functions already outlined in the previous section.

- Management competencies: These are required to perform management functions and differ from organisation to organisation (Bartram, 2011).



**Figure 9.3: An integrated competency model – Detailed**

Source: Adapted from APICS, 2013, Bartram, 2011 and Career One Stop, 2013.

## REFERENCES

- Accenture Supply Chain Academy. 2013. *Integrated model*. [Online] Available: <https://www.accentureacademy.com/p/pages/integrated-approach.html> [2013, November 15]
- Accenture. 2012. *Accenture technology vision*. [Online] Available: <http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Technology-Vision-2012.pdf> [2012, September 15]
- Adachi, B., Helfrich, D., Gretscko, M. & Schwartz, J. 2012. *Human Capital Trends 2012: Leap ahead*. [Online] Available: [http://www.hreonline.com/pdfs/04012012Extra\\_DeloitteStudy.pdf](http://www.hreonline.com/pdfs/04012012Extra_DeloitteStudy.pdf) [2013, February 2]
- Aiken, L.R. 2003. *Psychological Testing and Assessment*. 11<sup>th</sup> Edition. Boston, MA: Allyn & Bacon.
- Akkermans, H.A., Bogerd, P., Yucatan, E. & Van Wassenhove, L.N. 2003. The impact of ERP on supply chain management: Exploratory findings from a European Delphi Study. *European Journal of Operational Research*, **146**(2), 284-301.
- Alderson, J.C. & Wall, D. 1993. Does washback exist? *Applied Linguistics*, **14**(2), 115-129.
- Ali, S., Peters, L. & Lettice, F. 2012. An organizational learning perspective on conceptualizing dynamic and substantive capabilities. *Journal of Strategic Marketing*, **20**(7), 589–607.
- American Educational Research Association (1999). *Standards for Educational and Psychological Testing*. Washington, DC: AERA.
- American Production and Inventory Control Society (APICS). 2013. *Competency Model*. [Online] Available: extracted from <http://www.apics.org/industry-content-research/publications/ombok> [2013, December 13]
- Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J. & Wittrock, M.C. 2000. *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives*. New York: Longman.
- Aquino, D. & Draper, L. 2008. Supply chain talent: State of the discipline. *AMR Research Report*, April.
- Athey, T.R. & Orth, M.S. 1999. Emerging competency methods for the future. *Human Resource Management*, **38**(3), 215-25.

Baartman, L., Bastiaaens, T., Kitschner, Van Der Vleuten, P. & Cees, P. 2006. The Wheel of Competency Assessment: Presenting Quality Criteria for Competency Assessment Programs. *Studies in Educational Evaluation*, **32**(2), 153-170.

Ballou, R.H. 2004. *Business logistics/supply chain management*. 5<sup>th</sup> Edition. Upper Saddle River, NJ: Pearson Education.

Bartram, D. 2011. *The SHL Universal Competency Framework*. [Online] Available: <http://ceb.shl.com/assets/resources/White-Paper-SHL-Universal-Competency-Framework.pdf> [2014, January 11]

Bergman, S., Yassine, A. & Roemer, T. 2004. Competencies Development Framework Based on Best Practices. *Information Knowledge Systems Management*, **4**, 35-53.

Beske, P. 2012. Dynamic capabilities and sustainable supply chain management. *International Journal of Physical Distribution & Logistics Management*, **42**(4), 372-387.

Biggs, J. 1999. *Teaching for quality learning at university*. Buckingham, UK: SRHE and Open University Press.

Biggs, J. 1996. Enhancing teaching through constructive alignment. *Higher Education*, **32**(3), 347-364.

Bingham, T. 2008. The talent factor: Know-how is the true competitive advantage, and managing talent is taking on new dimensions centred on learning and development. *The Public Manager*, **37**(3), September.

Bloom, B.S., Engelhart, M.D., Furst, E.J., Hill, W.H. & Krathwohl, D.R. 1956. *Taxonomy of educational objectives: The classification of educational goals*. Handbook I: Cognitive domain. New York: David McKay Company.

Bonder, B.A., Bouchard, C. & Bellemare, G. 2011. Competency-based management: An integrated approach to Human Resource Management in the Canadian Public Sector. *Public Personnel Management*, **40**(1), 1-11.

Bowersox, D.J., Closs, D.J. & Stank, T.P. 1999. *21<sup>st</sup> century logistics: Making supply chain integration a reality*. Oak Brook, IL: Council for Logistics Management.

Bowman, R.J. 2005. *Supply chain 2020*. [Online] Available: [http://esd.mit.edu/Headline/-glscs/supply\\_chain\\_2020.html](http://esd.mit.edu/Headline/-glscs/supply_chain_2020.html) [2013, August 1]

Bratton, J. & Gold, J. 1999. *Human Resource Management: Theory and practice*. 2<sup>nd</sup> Edition. London: Macmillan Press.

Briggs Myers, I. 2000. *Introduction to type*. 6<sup>th</sup> edition. Oxford: The British Psychological Society Testing Centre. [Online] Available: [http://www.psychtesting.org.uk/downloadfile.cfm?file\\_uuid=648F1A9C-CF1C-D577-94EB-E0B28414B0F4&ext=pdf](http://www.psychtesting.org.uk/downloadfile.cfm?file_uuid=648F1A9C-CF1C-D577-94EB-E0B28414B0F4&ext=pdf) [2014, October 20]

Brockhoff, K. 1975. The performance of forecasting groups in computer dialogue and face-to-face discussion. In Linstone, H.A. & Turloff, M. (eds), *The Delphi Method: Techniques and Applications*. Reading, MA: Addison-Wesley, 291-321.

Burt, D.N., Petcavage, S.D. & Pinkerton, R.L. 2010. *Supply management*. 8<sup>th</sup> Edition. Boston, MA: McGraw-Hill.

Campion, M.A., Fink, A.A., Ruggeberg, B.J., Carr, L., Phillips, G.M. & Odman, R.B. 2011. Doing competencies well: Best practices in competency modelling. *Personnel Psychology*, **64**(1), 225-262.

Career One Stop. 2013. *Transportation, distribution, and logistics Competency Model*. [Online] Available: <https://www.careeronestop.org/competencymodel/competency-models/transportation.aspx> [2013, September 16]

Cearley, D. & Smith, D.M. 2012. *Five Cloud Computing trends that will affect your Cloud strategy through 2015*. [Online] Available: [http://www.gartner.com/DisplayDocument?ref=g\\_search&id=1920517&ref=g\\_noreg](http://www.gartner.com/DisplayDocument?ref=g_search&id=1920517&ref=g_noreg) [2012, December 21]

Cecere, L., Hofman, D, Martin, R. & Preslan, L. 2005. *The Handbook for Becoming Demand Driven*. Boston: AMR Research, Inc.

Cervera, C.M. & Flores, J.L.M. 2012. A conceptual model for a green supply chain strategy. In *Global Conference on Business & Finance Proceedings*, **7**(2), 269-273. Hilo: Institute for Business & Finance Research.

Chien, S.Y. & Tsai, C.H. 2012. Dynamic capability, knowledge, learning, and firm performance. *Journal of Organizational Change Management*, **25**(3), 434–444.

Christopher, M. 2005. *Logistics and Supply Chain Management Creating Value-Adding Networks*. 3<sup>rd</sup> Edition. London: Prentice-Hall.

- Chui, M., Manyika, J., Bughin, J., Dobbs, R., Roxburgh, C., Sarrazin, H., Sands, G. & Westergren, M. 2012. *The social economy: Unlocking value and productivity through social technologies*. s.l.: McKinsey Global Institute.
- Council for Supply Chain Management Professionals (CSCMP). 2014. *Glossary of terms*. [Online] Available: Extracted from <http://cscmp.org/resources-research/glossary-terms> [2014, January 8]
- Council for Supply Chain Management Professionals (CSCMP). 2010. *Minimum supply chain benchmarks standards*. Lombard, IL: CSCMP.
- Cox, D.R. 1972. The Analysis of Multivariate Binary Data. *Journal of the Royal Statistical Society Series C*, **21**(2), 113-120.
- Cravens, D.W. 2000. *Strategic marketing*. 6<sup>th</sup> Edition. Boston: McGraw-Hill.
- Crum, C. & Palmatier, G.E. 2003. *Demand management best practices: Process principles and collaboration*. Boca Raton, FL: J Ross Publishing.
- Dai, G. & Liang, C. 2012. Competency modelling research and practice in China: A literature review. *Journal of Chinese Human Resource Management*, **3**(1), 49-66.
- Davenport, T.H. & Patil, D.J. 2012. Data scientist: The sexiest job of the 21<sup>st</sup> century. *Harvard Business Review*, **90**(10), October, 70-76.
- Day, G.S. 2011. Closing the marketing capabilities gap. *Journal of Marketing*, **75**(4), July, 183-195.
- Defee, C. & Fugate, B. 2010. Changing perspective of capabilities in the dynamic supply chain era. *The International Journal of Logistics Management*, **21**(2), 180-206.
- Dierick, S. & Dochy, F.J.R.C. 2001. New lines in edumetrics: New forms of assessment lead to new assessment criteria. *Studies in Educational Evaluation*, **27**(4), 307-329.
- Dochy, F., Moerkerke, G. & Martens, R. 1996. Integrating assessment, learning and instruction: Assessment of domain-specific and domain-transcending prior knowledge and progress. *Studies in Educational Evaluation*, **22**(4), 309-339.
- Dooley, L. 2002. Case Study Research & Theory Building. *Advanced in Developing Human Resources*, **4**(3), 335-354.
- Eisenhardt, K. 1989. Building Theories from Case Study Research. *The Academy of Management Review*, **14**(4), 532-550.

- Eisenhardt, K.M. & Graebner, M. 2007. Theory Building from Cases: Opportunity and Challenges. *Academy of Management Journal*, **50**(1), 25-32.
- Ellinger, A., Shin, H., Northington, W.M., Adams, F.G., Hofman, D. & O'Marah, K. 2012. The influence of supply chain management competency on customer satisfaction and shareholder value. *Supply Chain Management: An International Journal*, **17**(3), 249–262.
- Errin, E. 2004. Technological Intelligence and Competitive Strategies: An application study with Fuzzy Logic. *Journal of Intelligent Manufacturing*, **15**(4), 417-429.
- European Logistics Association. 2013. *Competency standards*. [Online] Available: [http://www.elalog.eu/sites/default/files/downloadables/ELAQF\\_Qualification\\_Standards\\_2014.pdf](http://www.elalog.eu/sites/default/files/downloadables/ELAQF_Qualification_Standards_2014.pdf) [2013, November 6]
- Fawcett, S.E., Ellram, L.M. & Ogden, J.A. 2007. *Supply chain management from vision to implementation*. Upper Saddle River, NJ: Prentice Hall.
- Fernandez-Araoz, C., Groysberg, B. & Nohria, N. 2011. How to hang on to your high potentials. *Harvard Business Review*, **89**(10), October, 76-82.
- Florida International University. 2014. *Bloom's Taxonomy*. [Online] Available: <http://online.fiu.edu/faculty/teachingtools/bloomstaxonomy> [2014, February 4]
- Frazelle, E. 2002. *Supply chain strategy: The logistics of supply chain management*. New York: McGraw-Hill.
- Friedman, B.A. 2007. Globalization implications for human resource management roles. *Employee Responsibilities and Rights Journal*, **19**(3), 157-171.
- Frischia, T., Marah, K., Hofman, D. & Souza, J. 2009. The AMR research supply chain top 25 for 2009. *AMR Research*, 28 May.
- Fuchs, P.H., Mifflin, K.E., Miller, D. & Whitney, J.O. 2000. Strategic Integration: Competing in the age of Capabilities. *California Management Review*, **42**(3), 118-147.
- Gattorna, J. 2015. *Dynamic supply chains how to design, build and manage people-centric value networks*. 3<sup>rd</sup> Edition. Kindle version. Financial Times Publishing.
- Gattorna, J. 2006. *Living supply chains*. London: Prentice-Hall.
- Gattorna, J. 1998. *Strategic supply chain alignment: Best practices in supply chain management*. Hampshire: Gower Publishing.

- Gay, L.R., Mills, G.E. & Airasian, P.W. 2005. *Educational Research: Competencies for Analysis and Application*. 8<sup>th</sup> Edition. New York, NY: Pearson Higher Education.
- Gilgor, D. & Holcomb, M. 2012. Understanding the role of logistics capabilities in achieving supply chain agility: A systematic literature review. *Supply Chain Management: An International Journal*, **17**(4), 438-453.
- Grobler, P., Wörnich, S., Carrell, M.R., Elbert, N.F. & Hatfield, R.D. 2006. *Human resource management in South Africa*. London. Cengage Learning.
- Gubbins, E.J. 2008. *Managing transport operations*. 3<sup>rd</sup> Edition. London: Kogan Page.
- Gulikers, J.T.M., Bastiaens, T.J. & Kirschner, P.A. 2004. A five-dimensional framework for authentic assessment. *Educational Technology Research & Design*, **52**(3), 67-87.
- Guthridge, M., Komm, A.B. & Lawson, E. 2008. Making talent management a strategic priority. *McKinsey Quarterly*, **1**(1), 49-59.
- Hambleton, R.K. 1996. Advances in assessment models, methods and practices. In Berliner, D.C. & Calfee, R.C. (eds), *Handbook of educational psychology*, 899-925. New York: MacMillan.
- Handfield, R.B. & Nicols, E.L. 2002. *Supply chain redesign*. New Jersey: Prentice Hall.
- Handfield, R.B., Monczka, R.M., Giunipero, L.C. & Patterson, J.L. 2009. *Sourcing and supply chain management*. 4<sup>th</sup> Edition. Mason, OH: Cengage Learning.
- Harper, A. 2008. Psychometric tests are now a multi-million-pound business: What lies behind a coach's decision to use them? *Journal of Evidence Based Coaching and Mentoring International*, **4**(2), 1-7.
- Harris, J.G., Craig, E. & Egan, H. 2010. *Counting on analytical talent*. [Online] Available: [http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture\\_Counting\\_on\\_Analytical\\_Talent.pdf](http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Counting_on_Analytical_Talent.pdf) [2012, December 17]
- Hofman, D., Aronow, S. & Nilles, K. 2013. The 2013 supply chain top 25: Learning from leaders. *Supply Chain Management Review*, **17**(5), 12-21.
- Howard, S. 2008. Testing times. *Accountancy Age*, March, 19. VNU Business Publications.
- Hugo, W.M.J., Badenhorst-Weiss, J.A. & Van Biljon, E.H.B. 2004. *Supply chain management: Logistics in perspective*. Pretoria: Van Schaik.

- Ireland, R.K. & Crum, C. 2005. *Supply Chain Collaboration: How to Implement CPFR and Other Best Collaborative Practices*. Florida: J. Ross Publishing Inc.
- Jacobs, F.R., Berry, W., Whybark, D.C. & Vollman, T.E. 2001. *Manufacturing planning and control for supply chain management*. Kindle version. New York: McGraw-Hill.
- Jacquez, R. 2013. *The mobile learning revolution*. [Online] Available: <http://rjacquez.com/5-key-mobile-learning-takeaways-from-mary-meekers-2013-internet-report-slides/html> [2014, January 11]
- Kak, A. & Sushil. 2002. Sustainable Competitive Advantage with Core Competence: A Review. *Global Journal of Flexible Systems Management*, **3**(4), 23-38.
- Kapoor, B. 1996. *Impact of globalization on human resource management*. Unpublished research paper. Fullerton: Information Systems & Decision Sciences, California State University.
- Karoulis, A.D. & Pombortsis, A. 2006. Comparison of expert-based and empirical evaluation methodologies in the case of a CBL environment: The Orestis experience. *Computers and Education*, **47**(2), 172-185.
- Kim, T. & Kass, A. 2012. *Using social collaboration tools to promote peripheral awareness between adjacent teams*. [Online] Available: <http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Using-Social-Collaboration-Tools-Peripheral-Awareness.pdf> [2012, December 17]
- Lambert, D.M., Stock, J.R. & Ellram, L.M. 1998. *Fundamentals of logistics management*. Boston: Irwin/McGraw-Hill.
- Langley, C.J., Coyle, J.J., Gibson, B.J., Novack, R.A. & Bardi, E.J. 2008. *Managing supply chains: A logistics approach*. Boston: Cengage Learning.
- Lee, C.B. 2003. *Demand chain optimization: Pitfalls and key principles*. Unpublished research report. [Online] Available: <https://www.gsb.stanford.edu/scforum/publications/articles.html> [2013, December 15]
- Lee, H.L. 2002. Aligning supply chain strategies with product uncertainties. *California Management Review*, **44**(3), 105-119.
- Lewis, B., Templeton, G. & Byrd, T. 2005. A methodology for construct development in MIS research. *European Journal of Information Systems*, **14**(4), 388-400.
- Lewis, R.E. & Heckman, R.J. 2006. Talent management: A critical review. *Human Resource Management Review*, **16**(2), 139-154.

- Linn, R.L., Bakker, J. & Dunbar, S.B. 1991. Complex, performance-based assessment: Expectations and validation criteria. *Educational Researcher*, **20**(8), 15-21.
- Linstone, A. & Turoff, M. 1975. *The Delphi method: Techniques and applications*. Reading, MA: Addison-Wesley.
- Lorentz, H., Töyli, J., Solakivi, T. & Ojala, L. 2013. Priorities and determinants for supply chain management skills development in manufacturing firms. *Supply Chain Management: An International Journal*, **18**(4), 358-375.
- Lucia, A.D. & Lepsinger, R. 1999. *The art and science of competency models pinpointing critical success factors in organisations*. San Francisco, CA: Jossey-Bass Pfeiffer.
- Mansfield, R.S. 1996. Building competency models: Approaches for HR professionals. *Human Resource Management*, **35**(1), 7-18.
- Manuj, I. & Mentzer, J.T. 2008. Global supply chain risk management. *Journal of Business Logistics*, **29**(1), 133-155.
- McAfee, A. & Brynjolfsson, E. 2012. Big data: The management revolution. *Harvard Business Review*, **90**(1), October, 61-67.
- McDowell, L. 1995. The impact of innovative assessment on student learning. *Education and Training International*, **32**(4), 302-313.
- McHenry, R. 2003. *How to use psychometrics effectively*. [Online] Available: <http://www.opp.eu.com/public/media/pdfs/Using%20psychometric%20tools%20effectively.pdf> [2014, November 15]
- Meister, J.C. & Willyerd, K. 2010. *The 2020 workplace: How innovative companies attract, develop, and keep tomorrow's employees today*. New York: Harper-Collins.
- Melnyk, S.A., Lummus, R., Vokurka, R.J. & Sandor, J. 2006. *Supply chain management 2010 and beyond: Mapping the future of the strategic supply chain*. Alexandria, VA: APICS E&R Foundation.
- Messick, S. 1994. The interplay of evidence and consequences in the validation of performance assessments. *Educational Researcher*, **23**(2), 13-23.
- Moberg, C.R., Vitasek, K., Stank, T.L. & Pienaar, A. 2008 *Time to remodel*. *Council for Supply Chain Management Professional's Supply Chain Quarterly*, **2**(3), 36-48.

- Mullen, P.M. 2003. Delphi: Myths and reality. *Journal of Health Organization and Management*, **17**(1), 37-52.
- Mutingi, M. 2013. Developing green supply chain management strategies: A taxonomic approach. *Journal of Industrial Engineering and Management*, **6**(2), 525-546.
- Narula, R. & Hagedroon, J. 1999, Innovation through strategic alliances: Moving towards international partnerships and contractual agreements. *Technovation*, **19**(5), February, 283-294.
- O'Marah, K. & Souza, J. 2004. DDSN: 21st Century Supply on Demand. AMR Research Report 1, August, 1-10.
- Ogunyomi, O.P., Shadare, A.O. & Chidi, O.C. 2011. Current trends and future directions of human resource management practices: A review of literature. *European Journal of Economics, Finance and Administrative Sciences*, **29**, 19-25.
- Okoli, C. & Pawlowski, S. 2004. The Delphi Method as a research tool: An example, design considerations and applications. *Information and Management*, **42**(1), 15-29.
- Parry, S. 1996. The quest for competencies. *Training*, **33**(7), 48-56.
- Patton, M.Q. 2002. *Qualitative research and evaluation methods*. 3<sup>rd</sup> edition. Thousand Oaks, CA: SAGE Publications.
- Pavlou, P.A. & El Sawy, O.A. 2011. Understanding the elusive black box of dynamic capabilities. *Decision Sciences*, **42**(1), 239-273.
- Peppers, D. & Rodgers, M. 2004. *Managing customer relationships: A strategic framework*. Hoboken, NJ: John Wiley & Sons.
- Pienaar, W.J. & Vogt, J.J. 2009. *Business logistics management: A supply chain perspective*. 3<sup>rd</sup> Edition. Cape Town: Oxford University Press.
- Prahalad, C.K. & Hamel, G. 1990. The core competence of the corporation. *Harvard Business Review*, **68**(3), 79-93.
- Pranjalee, T. 2013. *Top 10 e-learning trends for 2013*. [Online] Available: <http://www.upsidelearning.com/blog/index.php/2013/07/24/top-10-elearning-industry-trends-for-2013/html> [2014, January 11]
- Prodromou, L. 1995. The backwash effect: From testing to teaching. *ELT Journal*, **49**(1), 13-25.

- Ptak, C.A. 2000. *ERP tools, techniques, and applications for integrating the supply chain*. Boca Raton, FL: CRC Press.
- Remenyi, D. 2012. *Case Study Research*. Kindle version. UK: Academic Publishing International. UK.
- Riege, A.M. 2003. Validity and reliability tests in case study research: A literature review with "hands-on" applications for each research phase. *Qualitative Market Research*, **6**(2), 75-86.
- Rodriguez, D., Patel, R., Bright, A., Gregory, D. & Gowing, M.K. 2002. Developing competency models to promote integrated human resource practices. *Human Resource Management*, **41**(3), 309-324.
- Sanghi, S. 2008. *The handbook of competency mapping: Understanding, designing and implementing competency models in organisations*. 3<sup>rd</sup> edition. Thousand Oaks, CA: SAGE Publications.
- Sauber, M.H., McSurely, H.B. & Tummala, V.M.R. 2008. Developing supply chain management program: A competency model. *Quality Assurance in Education*, **16**(4), 375-391.
- Scheele, D.S. 1975. Reality construction as a product of Delphi interaction. In Linstone, M. (ed.), *The Delphi Method: Techniques and Applications*. Addison-Wesley, Boston, MA, 37-71.
- Schmidt, R.C. 1997. Managing Delphi surveys using nonparametric statistical techniques. *Decision Sciences*, **28**(3), 763-774.
- Schonberger, R.J. & Knod, E.M. 1994. *Operations management continuous improvement*. 5<sup>th</sup> Edition. Burr Ridge, IL: Richard Irwin.
- Schoonover, S.C. & Schoonover, H., Nemerov, D. & Ehly, C. 2000. *Competency Based HR Applications: The Results of a Comprehensive Survey*. Falmouth, MA: Schoonover, Arthur Andersen & SHRM.
- Schuwirth, L.W.T. & Van der Vleuten, C.P.M. 2004. Changing education, changing assessment, changing research? *Medical Education*, **38**(8), 805-812.
- Seifert, D. 2003. *Collaborative planning, forecasting and replenishment – How to create a supply chain advantage*. New York: American Management Association.
- Seuring, S. & Müller, M. 2008. From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, **16**(15), 1699-1710.

- Sheskin, D.J. 2004. *Handbook of parametric and nonparametric statistical procedures*. 3<sup>rd</sup> Edition. Boca Raton, FL: Chapman & Hall.
- Shi, V.G., Koh, S.C., Baldwin, J. & Cucchiella, F. 2012. Natural resource based green supply chain management. *Supply Chain Management: An International Journal*, **17**(1), 54-67.
- Shippmann, J.S., Ash, R.A., Battista, M., Carr, L., Eyde, L.D., Hesketh, B., Kehoe, J., Pearlman, K., Prien, E.P. & Sanchez, J.I. 2000. The practice of competency modelling. *Personnel Psychology*, **53**(3), 703-740.
- Siddhartha, S. 2009. Assessment of Construct Validity in Management Research. *Journal of Management Research*, **9**(2), 59-71.
- Siegel, S. 1988. *Nonparametric statistics for the behavioural sciences*. New York: McGraw-Hill.
- Silvers, A. 2012. The blueprint for social learning. *Training and Development*, **66**(1), January, 34-39
- Simms, J. 2007. Recruitment guide: Psychometrics – Test match. *Human Resources*, March, 15. Haymarket Press.
- Singh, P. 2008. Job analysis for a changing workplace. *Human Resource Management Review*, **18**(2), 87-99.
- Sireci, S.G. 1998. *Evaluating content validity using multidimensional scaling*. Paper presented at the American Educational Research Association Annual Meeting, AERA, San Diego, CA, April 15.
- Society for Human Resource Management (SHRM). 2013. *Competency model*. [Online] Available: <https://www.shrm.org/HRCompetencies/Pages/Model.aspx> [2013, November 14]
- Soderquist, K.E., Papalexandris, A., Loannou, G. & Prastacos, G. 2010. From task-based to competency-based: A typology and process supporting a critical HRM transition. *Personnel Review*, **39**(3), 325-346.
- Spencer-Cooke, B. 1989. Conditions of participation in rural, non-formal education programs: A Delphi study. *Educational Media International*, **26**(2), 115-124.
- Stalk, G., Evans, P. & Shulman, L.E. 1989. Competing on capabilities: The new rules of corporate strategy. *Harvard Business Review*, **70**(2), 57-69.
- Supply Chain Council. 2014. *SCOR reference model*. [Online] Available: <https://supply-chain.org/our-frameworks> [2014, January 15]

- Taylor-Powell, E. 2002. *Quick tips collecting group data: Delphi technique*. [Online] Available: <http://www.uwex.edu/ces/pdande/resources/pdf/Tipsheet4.pdf> [2014, January 15]
- Teece, D., Pisano, G. & Shuen, A. 1997. Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, **18**(7), 7-115.
- Tillema, H., Kessels, J. & Meijers, F. 2000. Competencies as building blocks for integrating assessment with instruction in vocational education: A case from the Netherlands. *Assessment & Evaluation in Higher Education*, **25**(3), 265-278.
- Tompkins, J.A. & Harmelink, D. 1994. *The distribution handbook*. New York: McGraw-Hill.
- Trott, P. 2012. *Innovation management and new product development*. 5<sup>th</sup> Edition. London: Prentice Hall.
- Uhlenbeck, A.M. 2002. *The development of an assessment procedure for beginning teachers, of English as a foreign language*. Unpublished PhD-dissertation. Leiden: University of Leiden, ICLON Graduate School of Education.
- Ulrich, D., Brockbank, W., Yeung, A.K. & Lake, D.G. 1995. Human resource competencies: An empirical assessment. *Human Resource Management*, **34**(4), 473-495.
- Van der Vleuten, C.P.M. & Schuwirth, L.W.T. 2005. Assessing professional competence: From methods to programmes. *Medical Education*, **39**(3), 309-317.
- Van Marrewijk, M. & Timmers, J. 2003. Human capital management : New possibilities in people management. *Journal of Business Ethics*, **44**(2), 171-184.
- Wacker, J.G. 2008. A conceptual understanding of requirements for theory-building. *Journal of Supply Chain Management*, **44**(3), 5-15.
- West, B.T., Welch, K.B. & Galecki, A.T. 2006. *Linear mixed models: A practical guide using statistical software*. London: CRC Press.
- Willyerd, K. & Pease, G. 2011. How does social learning measure up? *Training & Development*, **65**(1), 32-37.
- Wisner, J.D., Tan, K.C. & Leong, G.K. 2008. *Principles of supply chain management: A balanced approach*. Mason, OH: South Western Cengage Learning.
- World Economic Forum (WEF) & Accenture. 2011. *Advancing cloud computing: What to do now? Priorities for industry and governments*. [Online] Available:

[http://www3.weforum.org/docs/WEF\\_IT\\_AdvancedCloudComputing\\_Report\\_2011.pdf](http://www3.weforum.org/docs/WEF_IT_AdvancedCloudComputing_Report_2011.pdf) [2013, June 16]

Wright, P.M. & McMahan, G.C. 2011. Exploring human capital: Putting “human” back into strategic human resource management. *Human Resource Management Journal*, **21**(2), 93-104.

Yin, R.K. 2008. *Case study research: Design and methods*. 4<sup>th</sup> Edition. Thousand Oaks, CA: SAGE Publications.

## APPENDIX A: DETAIL INFORMATION ON THE COMPETENCY MODEL OF THE COMPETENCY CLEARINGHOUSE

### Tier 4—Industry-Wide Technical Competencies

Industry-Wide Technical Competencies						
Logistics, Planning & Management	Warehousing & Distribution	Transportation Operations & Maintenance	Technology Applications	Regulations & Quality Assurance	Customer Relationship Management	Health, Safety & Environment

Logistics Planning and Management: The planning, management, and control of the efficient and effective physical distribution of materials, products, and people to meet customer's requirements.

#### Critical Work Functions

Relates the multidimensional impact of transportation on the economy, public systems, national and local infrastructure, and the environment.

Understands and evaluates the transportation systems' political, regulatory, and legal issues.

Describes and assesses the strengths and weaknesses of the major modes of international transportation.

Applies systems analysis to the elements, relationships, and functions in the supply chain

Develops plans including routes and schedules for transporting people and goods

Adjusts transportation and distribution plans in response to changing conditions

Implements security measures to minimise loss

Ensures that cargo arrives at the right location, on time, and in the safest, most economical manner

Maintains information on the movement of people/goods according to planned routes and schedules

#### Technical Content Areas

##### Planning

Forecasting

Contracting

Risk factors

Scheduling and monitoring

Security

Documentation

## Routes and Schedules

- Local Delivery
- Long-Distance
- Special Handling
- Hazardous Materials

## Warehousing & Distribution

Activities related to the operation of transportation and distribution facilities including ports, terminals, and warehouses.

## Critical Work Functions

- Describes warehousing as part of the total supply chain process
- Processes incoming products including unloading, receiving, checking, marking/identification and transporting to storage pick-up areas, work stations, or outbound staging areas and storing products for order-picking
- Process outbound shipments including order-picking, sorting and checking; packaging, sealing, weighing, and manifesting; and loading and load balancing and shipping
- Completes shipping papers and other appropriate labels and documentation
- Recognises and identifies proper marking, labelling, and placarding
- Ships products on time and in the most cost-effective manner
- Tracks, sorts, labels, and load cargo accurately and safely
- Traces lost shipments and maintains loss and damage claim records

## Technical Content Areas

### Warehouse Operations

- Shipping and receiving
- Packaging
- Product stacking requirements
- Security and loss prevention systems
- Warehouse records and documentation
- Automated material handling systems
- Distribution and information systems
- Bar-coding, racking, labelling, and cross-docking

### Supply Chain Logistics

- Supply chain elements
- Inventory management
- Customs and export control

Logistics outsourcing

## Transportation Operations & Maintenance

Activities related to the movement of people, materials, and products by road, air, rail, and water

### Critical Work Functions

Explains the role of transportation in the economy, the demand for transportation, and the role of government in regulating the industry

Drives or operates transportation equipment

Maintains and repairs transportation equipment

Dispatches or coordinates schedules of transportation equipment

Implements transportation plans and schedules

Demonstrates understanding of activities related to dispatching, routing, and tracking transportation vehicles

Recognises universal signs and symbols such as colours, flags, stakes to function safely in the workplace

Signals and observes directions or warnings to and from co-workers

Examines vehicles to detect malfunctions, damage, or maintenance needed

Updates maintenance records and logs according to company policies and procedures and government regulations

## Technical Content Areas

### Modes of Transportation

Air Transportation – transportation of passengers and/or cargo using aircraft, such as airplanes and helicopters

Rail Transportation – transportation of passengers and/or cargo using railroad rolling stock

Water Transportation – transportation of passengers and cargo using watercraft, such as ships, barges, and boats

Truck Transportation – over-the-road transportation of cargo using motor vehicles, such as trucks and tractor-trailers

General freight transportation – handles a wide variety of general commodities, generally palletized, and transported in a container or van trailer

Specialised freight transportation – transportation of cargo that require specialised equipment due to inherent characteristics (size, weight, shape)

Public transportation infrastructure (e.g. highways, airports, train terminals, ports, commercial space launching facilities, inter-modal facilities)

Intermodal Transportation – transportation of passengers or freight using multiple modes of transportation

## Operation

- Traffic flow: hubs, facilities, staging areas
- Transportation routes and schedules
- Dispatch
- Signalling
- Scheduling
- Tracking

## Maintenance

- Equipment operation
- Equipment/machinery maintenance services
- Maintenance plans and schedules
- Maintenance logs

## Technology Applications

Maintaining awareness of technological advances and applying appropriate technology to transportation, distribution, and logistics processes.

## Critical Work Functions

- Stays informed of technological advances that impact TDL activities
- Awareness of the benefits associated with implementing new technologies
- Application or use of various technologies that impact TDL activities

## **Technical Content Areas**

### Information Systems

- Geographic Information Systems (GIS)
- Electronic Data Interchange (EDI)
- Global Logistics Systems (GLS)
- Intelligent Transportation Systems (ITS)
- Advanced Traveller Information Systems (ATIS)
- Transportation Management Systems (TMS)
- Warehouse Management Systems (WMS)
- Vehicle Monitoring Systems (VMS)

### Technology

- Radio Frequency Identification (RFID)
- Auto ID Technologies

Materials handling technologies (e.g. voice-directed order picking technology)

## Regulations & Quality Assurance

Compliance with relevant local, state, federal, and international laws and regulations that impact the transportation, distribution, and logistics industry. Application of industry standards to ensure quality service.

## Critical Work Functions

Understands the roles and functions of government agencies (e.g. Federal Aviation Administration) in regulating and supporting TDL organisations

Complies with local, state, federal, and international laws

Maintains logs and other required documents

Monitors processes to ensure they are effective

Inspects facilities or equipment for regulatory compliance

Ensures materials and processes meet quality specifications

Ensures equipment is operating to prescribed standards

Raises and reports quality issues in a timely manner

Suggests and/or implements continuous improvement actions such as business process reengineering and performance improvement strategies

## Technical Content Areas

### Standards

International Organization for Standardization (ISO) standards

Tariff and trade regulations

Labelling regulations

Environmental regulations

OSHA regulations

### Quality Assurance

Total Quality Management (TQM)

Enterprise Lean

Six Sigma methodology

### Customer Relationship Management

Marketing/selling transportation services and providing customer service to consumers of transportation services.

## Critical Work Functions

- Follows plans to meet sales goals with existing products and services
- Sells logistics and transportation products and services
- Determines customer needs and requirements
- Processes customer orders and purchases
- Greets customers, guests, visitors, or passengers in a professional manner
- Provides on-going customer service to both internal and external customers
- Responds to customer problems, complaints, and questions

Tracks status of customer orders/purchases, transportation arrangements, and schedules

## Technical Content Areas

### Sales & Marketing Operations

- Economic/market trends
- Competition
- Transportation, distribution, and logistics products and services
- Sales/marketing plans
- Sales/order documentation

### Customer Service

- Internal and external customers
- Company policies and procedures
- Confidentiality
- Handling questions, problems, complaints
- Educating the customer
- Customer satisfaction and commitment to product or service

### Health, Safety, and Environment

Assessing and managing risks associated with safety and environmental issues

## Critical Work Functions

- Understands and follows relevant safety rules, regulations, and laws
- Follows organisational policies and procedures to maintain a safe work area
- Identifies and describes workplace hazards
- Wears personal protective equipment (PPE) as appropriate
- Follows emergency procedures
- Completes safety training on pertinent equipment and applies safe operating procedures
- Correctly identifies hazardous materials and substances

Handles/transport hazardous materials in accordance with government regulations and health standards

Reports health, safety, and environmental problems

Maintains documentation of compliance with health, safety, and environmental management systems

Stays up to date on environmentally-friendly trends in the industry

Practices sustainability by using processes that are non-polluting, conserving of energy and natural resources, economically efficient, and safe for workers, communities, and consumers

Follows organisational procedures to reduce emissions, increase energy efficiency, and reduce the organisation's carbon footprint

## Technical Content Areas

### Rules and Regulations

OSHA regulations

HAZMAT regulations

Personal Protective Equipment

Health, safety, and environmental risks

### Environmental Concerns

Hazardous Materials

Green issues impacting TDL industry

- Greenhouse gas emissions
- Energy efficiency
- Carbon footprint
- Fuel-saving technologies
- Air/water quality

### Safety Procedures

Protective Gear

Safety Practices

Workplace Hazards

Emergency Preparedness

Investigations and Audits

Documentation

## APPENDIX B: BEST PRACTICES IDENTIFIED FROM THE SCOR MODEL AND THE PROCESS STANDARDS FROM THE COUNCIL FOR SUPPLY CHAIN MANAGEMENT

Process area:	Best practice:
<b>Stock management</b>	<ul style="list-style-type: none"> <li>• Tools to support balanced decision-making (e.g. trade-off between service level and inventory investment)</li> <li>• Standard inventory policy to determine excess</li> <li>• Removal of obsolete capital assets</li> <li>• Removal of obsolete stock</li> <li>• Obsolete inventory is reviewed at the part number level</li> <li>• Off-peak stocking</li> <li>• Matching shelf stock to expectations</li> <li>• Inventory allocation exception process is clearly defined and jointly owned by manufacturing and sales</li> <li>• Inventory is planned at the part level, based on supply and demand variability</li> <li>• Inventory performance is measured at the dollar and unit levels</li> <li>• Inventory targets are reviewed and adjusted frequently</li> <li>• Ideal stock position based on days/weeks of supply</li> <li>• First in - first out</li> <li>• Establish designated processes for scheduling and receiving excess inventory</li> <li>• Dynamic deployment based on constraint based planning and optimal scheduling</li> <li>• Defined stocking levels and criteria</li> <li>• Categorise 100% of total inventory (active, usable, excess, obsolete) for appropriate action</li> <li>• Automated registry of inventory return locations by item to speed identification of proper return location</li> <li>• Automated replenishment of back stock based on minimum stocking levels</li> <li>• ABC classification</li> </ul>
<b>Performance improvement</b>	<ul style="list-style-type: none"> <li>• Convergence of SCOR, six sigma and lean methodology</li> <li>• Total preventative maintenance programme</li> <li>• Supply/Demand process is highly integrated from customer data gathering to order receipt, through production to supplier request</li> <li>• Standard operating procedures and methodology</li> <li>• Standards and measurements aligned to maximise supply chain performance</li> <li>• Sound project management process and methodology</li> <li>• SKU rationalisation</li> <li>• Single data source for decision support and business rules</li> <li>• Review batch records by exception</li> <li>• Review product profitability</li> <li>• Review transfer cycle time trends and determine if equipment capacity is properly balanced with projected usage</li> <li>• Responsiveness and flexibility are emphasised by developing expertise in making business processes re-programmable, re-configurable and continuously</li> </ul>

Process area:	Best practice:
	<p>changeable</p> <ul style="list-style-type: none"> <li>• Reliable continuous improvement process and methodology.</li> <li>• Reduce chances of operator error</li> <li>• Reduce work-in-process (WIP) product handling</li> <li>• Reduce non-value added activities, including queue, move, and set-up times</li> <li>• Electronic data collection of completion, quality, lot trace ability, scrap, and labour data</li> <li>• Reduce non-value added paperwork while still measuring process metrics</li> <li>• Real time package tracking</li> <li>• Real time performance measurement reporting systems</li> <li>• Real time quality control techniques</li> <li>• Real time return anticipation</li> <li>• Real time shipment tracking (via internet)</li> <li>• Real time statistical control techniques</li> <li>• Postponement</li> <li>• Postponement and pre-kitting of accessories into modular packages that allow flexibility while maintaining control</li> <li>• Posted performance results</li> <li>• Performance results that are compared to benchmarks (i.e. capacity, scheduling) and readily available to employees</li> <li>• Periodic review of metrics and strategy with comparisons to industry benchmarks</li> <li>• Periodic review of standards</li> <li>• Paperless order tracking and customer visibility of orders</li> <li>• Paperless production control</li> <li>• Paperless production order and inventory tracking</li> <li>• Organise to enhance flexibility: Few job classifications, self-directed work force, flat management structure, cross-functional work teams</li> <li>• Outsource if not a core competency</li> <li>• Operations and network analysis</li> <li>• MRO scheduling identifies next destination (stores or repair station) on return authorisation</li> <li>• Multi-country export/import documentation compliance</li> <li>• Minimise capital assets required and maintenance costs</li> <li>• Minimise operator induced errors</li> <li>• Minimising work-in-progress (WIP) product</li> <li>• Minimum product handling</li> <li>• Maximise data integrity and system accuracy by ensuring 99%+ accuracy of BOM configuration, inventory levels and schedule requirements</li> <li>• Maintain data and system integrity by ensuring production data, inventory levels and schedule requirements are 99+% accurate</li> <li>• Maintaining repository of current regulatory requirements</li> <li>• Manage information across 100% of shipments</li> <li>• Maintain accurate lot/batch history information</li> <li>• Link individual performance to organisational and divisional goals</li> <li>• Long-term return agreements / partnerships</li> <li>• Long-term supplier agreements/partnerships</li> <li>• JIT environment</li> </ul>

Process area:	Best practice:
	<ul style="list-style-type: none"> <li>• Joint service agreements (JSA)</li> <li>• Integrated facility management</li> <li>• Integrated order management, warehouse management and transportation management systems view for analysis for all orders and shipments the following data: Logistics, product, cost, GL charging</li> <li>• Genealogy tracking</li> <li>• Goals / Performance plans</li> <li>• Enable real-time visibility into backlog, order status, shipments, scheduled material receipts, customer credit history and current inventory positions</li> <li>• Enterprise level policies/rules with local execution</li> <li>• EDI links between manufacturing and distributor to achieve visibility of complete finished goods inventory and expected shipments</li> <li>• EDI links integrate supplier resource information (inventory, capacity availability, etc.) with own resources</li> <li>• Efficient and effective benchmarking process leveraging cross industry metrics and definitions</li> <li>• Efficient consumer response (ECR); quick response</li> <li>• Electronically track shipment from customer to service provider</li> <li>• Electronic catalogues/malls</li> <li>• Electronic commerce (customer visibility of stock availability, use of hand-held terminals for direct order entry, confirmation, credit approval), on-line stock check and reservation of inventory</li> <li>• Electronic data interchange can be used to send requests for information or proposals and technical information to and from potential suppliers to determine supplier capability to fulfil requirements so that they may be added to supplier network</li> <li>• Electronic data interchange is used to send technical information to and from potential suppliers</li> <li>• Electronic documentation and imaging</li> <li>• Electronic generation and download of shipping documents</li> <li>• Electronic manifest and electronic billing</li> <li>• Electronic matching between POS data and store inventory (shelves and back room)</li> <li>• Electronic material move transactions</li> <li>• Electronic reminders of possible scheduled maintenance</li> <li>• Electronic sourcing and negotiation</li> <li>• Electronic transfer of shipment information to finance</li> <li>• Digital links (XML based, EDI, etc.) among supply chain members</li> <li>• Direct connection to customs clearance</li> <li>• Direct ship from factory to customer/channel</li> <li>• Direct transfer of documents to recipient and forwarder</li> <li>• Data accessibility across the enterprise for visibility by discrete business units</li> <li>• Cross-docking</li> <li>• Consignment agreements are used to reduce assets and cycle time while increasing the availability of critical items</li> <li>• Consolidate orders by customer, source, traffic lane, carrier etc.</li> <li>• Consolidate shipments through cross docking - Coordinate with other shipments</li> <li>• Consolidation of carriers</li> </ul>

Process area:	Best practice:
	<ul style="list-style-type: none"> <li>• Consolidation of inbound and outbound requirements</li> <li>• Consolidation of return carriers</li> <li>• Continuous improvement</li> <li>• Continuous improvement and development is driven and measured through the performance review process</li> <li>• Continuous improvement is planned through process reviews and customer feedback</li> <li>• Continuous replenishment programmes; vendor managed inventory, telemetry to automatically communicate replenishment of chemicals</li> <li>• Cost accounting system to determine the best return process to follow from a cost of business perspective</li> <li>• Cost reduction and or cost avoidance opportunities are identified, implemented and measured on a periodic basis</li> <li>• Confirm asset return condition codes are clearly understood by all employees, especially those who are new to the process</li> <li>• Confirm changes in condition code policies are promptly communicated to all employees and supply chain partners.</li> <li>• Complete lot history</li> <li>• Changeover reduction / continuous improvement programme</li> <li>• Bar coding is used to minimise handling time and maximise data accuracy</li> <li>• Business intelligence (BI)</li> <li>• Automatic generation and submission of conformance documents</li> <li>• Automatic identification</li> <li>• Automatic label and seal verification</li> <li>• Alignment of strategic and business plans with long-term capacity and resource planning</li> <li>• All functions and organisations understand their impact on supply/demand balancing, including sales, marketing, product management, manufacturing, customer, suppliers, materials management and product development</li> <li>• All key participants in the supply chain, including strategic partners, have full visibility of the demand/supply plan</li> <li>• Supply chain is designed to have supply flexibility equal to demand volatility</li> </ul>
<b>Buy</b>	<ul style="list-style-type: none"> <li>• Co-located procurement representatives</li> <li>• Suppliers share responsibility for balancing supply and demand through joint service agreements</li> <li>• Supplier replaces defective material at customer's facility with good product as required</li> <li>• Supplier performance assessment system</li> <li>• Supplier managed inventory of parts</li> <li>• Supplier development programmes are used to get local suppliers to invest in developing new technologies</li> <li>• Supplier delivery to production process at point of use</li> <li>• Supplier "cost of non-conformance" data is collected, analysed and used in performance reporting</li> <li>• Supplier and material rationalisation</li> <li>• Supplier certification programmes are used to reduce (skip lot) or eliminate receiving inspection</li> <li>• Supplier certification programmes can reduce the cycle time for certifying existing suppliers to provide new technologies</li> </ul>

Process area:	Best practice:
	<ul style="list-style-type: none"> <li>• Supplier certification programmes can reduce the cycle time for initial certification of new suppliers or certifying existing suppliers that wish to provide new technologies</li> <li>• Supplier delivers directly to point of use</li> <li>• Supplier delivers directly to point of use - (dock to line or end destination)</li> <li>• Strategic safety stock of selected materials, items, or sub-assemblies to decouple sourced product issuance cycle time from supplier lead time</li> <li>• Receivers on the dock communicate directly with the buyer to efficiently resolve any discrepancies</li> <li>• Pre-certify supplier capability to send or return products correctly to minimise the need for receipt verification</li> <li>• Performance expectations and business rules are clearly communicated prior to the initiation of business with the supplier</li> <li>• Pay on receipt</li> <li>• Optimised supply chain processes, optimised supplier count, supplier and part rationalisation</li> <li>• Online RFQ processes linked into the document management process reduces cycle time and product management costs</li> <li>• On-line rule base</li> <li>• Online document management and automated supplier approval processes can reduce the cycle time and costs associated with managing supplier evaluations and get them into the supplier network faster</li> <li>• Online access and notification of tooling and equipment information</li> <li>• On-line availability of supplier financials to determine potential supplier viability to be added to supplier network</li> <li>• On demand access of supplier/source data</li> <li>• Utilise web-based collaboration to identify potential new repair sites prior to their selection</li> <li>• Utilise concurrent engineering with suppliers to allow them to provide engineering and product performance test data</li> <li>• Utilise concurrent engineering with suppliers to allow them to provide engineering and product performance test data to qualify as part of potential supplier network</li> <li>• Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product</li> <li>• Joint service agreements to document acceptable service levels in terms of installation costs, installation cycle time, etc.</li> <li>• Joint service agreements with source suppliers to share responsibilities and costs of returns</li> <li>• Joint service agreements with suppliers define the levels of “flexibility” or resource upside available within stated lead times and agreed upon conditions</li> <li>• Establishment of criteria to rank suppliers</li> <li>• Evaluate supplier network for duplicates</li> <li>• Evaluate the benefits of out-sourcing the excess material return process</li> <li>• Enterprise level spend analysis</li> <li>• Distinct and consistent linkages exist to ensure disruptions and opportunities in material resources are quickly and accurately communicated and acted upon</li> <li>• Create and maintain multiple suppliers and multiple supplier sites to record information about individuals and companies from whom you want to purchase catalogue goods and services</li> <li>• Consideration of supplier's material availability in company's supply resources</li> </ul>

Process area:	Best practice:
	<p>(including supplier's production plans &amp; capability, inventory, and delivery plans)</p> <ul style="list-style-type: none"> <li>• Comparative analysis of supplier performance is used in sourcing decisions</li> <li>• Blanket purchase orders cover period requirements</li> <li>• Automated update of supplier performance information</li> <li>• Allow source suppliers full visibility into the current return situations and the forecasted return activity</li> </ul>
<b>Store</b>	<ul style="list-style-type: none"> <li>• Storage and configuration management for release and revision control of final documents</li> <li>• Wave picking</li> <li>• Use of speed racks for automated material handling</li> <li>• Two-bin floor stock located at work centre for “b” and “c” components - controlled by operators and replenished when one bin is empty</li> <li>• Statistical test count</li> <li>• Stocking is completed in zones</li> <li>• Storage location zoning</li> <li>• Short move paths</li> <li>• Optimise packing</li> <li>• Item/shelf scanning upon put-a-way</li> <li>• Items are relieved from inventory when item is removed from shelf</li> <li>• Dynamic location assignment including lot control, zoned picking, quality assurance</li> <li>• Dynamic return restocking management</li> <li>• Dynamic simulation of picking requirements optimised for labour, cost, and time</li> <li>• Download P.O. &amp; advanced ship notices for automated receiving and put away</li> <li>• Automated pick list</li> <li>• Automated data entry</li> <li>• Automated directed picking</li> </ul>
<b>Make</b>	<ul style="list-style-type: none"> <li>• Migrate from build to stock to configure to order; build subassemblies to forecast at the highest generic level in the bill of material/recipe/formula</li> <li>• Automatic link to recipe management, plc program, cnc program systems, etc., to deliver new manufacturing documentation</li> <li>• Real time feedback from production, raw materials, and finished goods inventory and test activities</li> <li>• Real time data on current status</li> <li>• Rapid replenishment, VMI, EDI</li> <li>• Production level loading</li> <li>• Production reporting/status</li> <li>• Produce products to unique customer requirements</li> <li>• Predictive maintenance monitoring (heat, noise, lubrication composition &amp; vibration)</li> <li>• Pre-defined manufacturing design rules</li> <li>• Packaging operation is an integral part of the overall production process</li> <li>• On-demand access of production information</li> <li>• Measuring process metrics and feedback to operators</li> <li>• Master production scheduling reflects management of capacity and/or supply constraints</li> <li>• Labour scheduling that matches product flow</li> </ul>

Process area:	Best practice:
	<ul style="list-style-type: none"> <li>• Lead times updated monthly</li> <li>• Lean manufacturing</li> <li>• Build subassemblies/products to forecast at highest generic level to minimise make cycle time</li> <li>• WIP product handling rules</li> <li>• Identification of suppliers who will participate in Kanban programmes</li> <li>• Identification of suppliers who will participate in procurement split (two or more suppliers sharing purchase requirements) programmes</li> <li>• Identification of suppliers who will participate in vendor managed inventory programmes</li> <li>• Excess products scheduling identifies next destination (source, make, or deliver) on return authorisation</li> <li>• Facility and equipment environmental / safety audit system</li> <li>• Facility master plan</li> <li>• Factory floor electronic decision-making information system</li> <li>• Distinct and consistent linkages exist to ensure that disruptions and opportunities in production are quickly and accurately communicated and responses made</li> <li>• Demand-pull mechanisms; Kanban replenishment signals from stockroom, intermediate products, or subassembly area</li> <li>• Design/upgrade production equipment to maximise flexibility and avoid line stoppages</li> <li>• Demand-pull manufacturing, including active reduction of manufacturing systems time and WIP through the use of demand-pull mechanisms and visual controls</li> <li>• Cellular and demand pull manufacturing</li> <li>• Cellular manufacturing</li> <li>• Build load in stop sequence</li> <li>• Build sub-assemblies to forecast at highest generic level in bill of material; maintain flexibility while minimising cycle time and inventory position</li> <li>• Automatic generation / configuration of tooling / set-up instructions</li> <li>• Automated statistical process control (SPC)</li> <li>• Automated notification of laboratory regarding sample availability</li> <li>• Automated disposition instructions for returns based on data interchange with strategic providers</li> <li>• Automated documentation for international shipments</li> <li>• Authorise each operation to assess the quality of the previous operations</li> <li>• Automated configuration management</li> <li>• Automated conformance monitoring and control</li> <li>• Assessing export/import requirements during time of product development/manufacture</li> <li>• Ability to track component/sub-component manufacturing country of origin</li> <li>• Accurate and approved process plans, routings, specifications and procedures</li> <li>• Accurate and approved process plans/specifications</li> <li>• Accurate and approved work instructions/process plans</li> <li>• Accurate and low cost batch/configuration records for warranty and regulatory tracking</li> <li>• Accurate and low cost batch records for regulatory compliance</li> <li>• Additional capacity for overflow demand</li> </ul>
<b>Sales &amp;</b>	<ul style="list-style-type: none"> <li>• Use of cross-functional teams to execute the process of developing long-term</li> </ul>

Process area:	Best practice:
<p><b>operations planning</b></p>	<p>capacity and resource plans</p> <ul style="list-style-type: none"> <li>• Use demand planning</li> <li>• To address conditions which cannot be adequately satisfied during the current planning period, each functional area develops prioritised recommendations for the subsequent planning period</li> <li>• The demand plan is updated frequently to reflect actual consumption or customer forecast information</li> <li>• Systems support accurate on-line visibility of full-stream demand requirements and priorities</li> <li>• Systems support accurate on-line visibility of full-stream demand requirements and priorities as well as resource utilisation and availability</li> <li>• Supply chain advance planning system</li> <li>• Strategic sales and operations planning process in place and managed at the executive level</li> <li>• Specific changes to the plan are agreed to cross-functionally, according to defined business rules</li> <li>• Schedule reflects current plant status (equipment availability, other jobs and resource availability) online</li> <li>• Schedule optimises use of shared resources such as tooling and production equipment</li> <li>• Schedule includes preventative maintenance programme</li> <li>• Schedule minimises changeover costs between products</li> <li>• Sales and operations planning (S&amp;OP)</li> <li>• Sales and operations agree to limits of short-term flexibility</li> <li>• Re-planning process exists in multi-levels of the supply chain between business enterprises</li> <li>• Re-planning process links the supply chain operation with the business strategy and the marketing strategy</li> <li>• Receiving equipment and packaging materials to transfer product are planned for in advance and readily available when needed</li> <li>• Re-balancing of full-stream supply/demand on a daily basis, including source-make-deliver resources and requirements from “customers” customer to suppliers' supplier”</li> <li>• Push-based forecasts are replaced with customer replenishment “pull-based” signals</li> <li>• Provide scheduling output back to material and labour planning systems</li> <li>• Priority-based inventory reservations, for key customers, with first-in-first-out (FIFO) allocation for all others</li> <li>• Plans which do not violate business rules are communicated openly and cross-functionally for execution</li> <li>• Planning and forecasting outsourced return process</li> <li>• Planogram flexibility for seasonal/promotional changes</li> <li>• plans that violate business rules (e.g. joint service agreements) are addressed cross-functionally, considering total business impacts (revenue, cost, quality, customer service etc.)</li> <li>• On-line visibility of all supply chain demand requirements and resources, both currently available and committed (pegged)</li> <li>• Notification of existing/future event or promotions</li> <li>• New items introductions are part of the sales and operations planning process at the general management business team level</li> </ul>

Process area:	Best practice:
	<ul style="list-style-type: none"> <li>• Integrated demand and supply planning</li> <li>• Integrated business and supply chain planning processes where cross-functional input is leveraged to set business rules</li> <li>• Incorporates leading practices such as efficient consumer response, collaborative planning, forecasting, and replenishment, vendor managed inventory, and real time point of consumption reporting</li> <li>• Forecasts are replaced with actual customer replenishment signals and orders where possible</li> <li>• Drum-buffer-rope scheduling technique</li> <li>• Demand planning, demand flow leadership</li> <li>• Demand priorities reflecting strategic customer relationships as business policies Are automatically followed in allocating resources; FIFO is utilised as the default scheduling priority</li> <li>• Collaboration among operations strategy team</li> <li>• Collaborative planning, forecasting, replenishment (CPFR)</li> <li>• Collaborative planning/scheduling</li> <li>• Combine consolidation needs with other products/divisions/companies</li> <li>• Change in the demand signal instantaneously “reconfigures” the production and supply plans</li> <li>• Capability to run “simulated” full-stream supply/demand balancing for “what-if” scenarios</li> <li>• Capability to run multiple “simulated” full-stream supply/demand balancing against long-term capacity plans and scenarios</li> <li>• Capability transfer to customer</li> <li>• Capability transfer to organisation</li> <li>• Capacity and supply constraints are balanced against demand during the planning cycle</li> <li>• Automatic reservation of inventory and dynamic sourcing of product for single shipment to customer</li> <li>• Available-to-promise (ATP)</li> <li>• Back flush material at order completion</li> <li>• Attribute-based process planning</li> </ul>
<b>Deliver</b>	<ul style="list-style-type: none"> <li>• Electronic data collection of completion, quality, lot traceability, scrap and labour data</li> <li>• View for analysis for all orders and shipments the following data: logistics, product, cost, GL charging</li> <li>• Vendor managed inventory</li> <li>• Utilise invoice-less freight payment</li> <li>• Utilise internet-based freight bidding built around shared shipping volume projections</li> <li>• Delivery plan</li> <li>• Transportation modelling and rate analysis</li> <li>• Staging based on in-store zones</li> <li>• Stage product or service adoption</li> <li>• Shipment tracking</li> <li>• Shipment tracking and tracing</li> <li>• Select carriers by least cost per shipment and rate using actual rates prior to release to billing</li> </ul>

Process area:	Best practice:
	<ul style="list-style-type: none"> <li>• Scan displays for promotion conformance</li> <li>• Real-time optimised shipment method selection (air parcel, ground parcel, ltl, etc.) Based on customer service requirements</li> <li>• Push product on trailer arrival</li> <li>• Note and communicate shelf life requirements carefully before shipping</li> <li>• Multiple locations throughout store</li> <li>• Merge-in-transit</li> <li>• Limit the number of carriers, treat them as partners and build a strong relationship with each one geared toward continually improving service and lowering cost</li> <li>• Involve other supply chain partners if possible to leverage transportation throughout the chain</li> <li>• Integrated transportation visibility</li> <li>• Full visibility of credit history by shipping personnel</li> <li>• Dunnage control</li> <li>• Drive deliveries directly to stock or point-of-use in manufacturing to reduce costs and cycle time</li> <li>• Document control</li> <li>• Documents generated automatically during shipment preparation</li> <li>• Develop proactive transit damage programmes</li> <li>• Deliveries are balanced throughout each working day and throughout the week</li> <li>• Delivery schedules are collaboratively developed with customers</li> <li>• Confirm all documentation and inspection requirements before shipping</li> <li>• Clarify in advance hazardous material packaging, labelling and shipping requirements</li> <li>• Capture and maintain mode specific data</li> <li>• Carrier/route optimisation based on continuous movement and consolidation/pooling</li> <li>• Carrier agreement</li> <li>• Carrier selection based on performance criteria at least cost</li> <li>• Backhaul trading exchange</li> <li>• Appointment scheduling for pickup and delivery of customer shipments</li> <li>• Arrange for shipping insurance in case of in-transit loss or damage</li> <li>• Advanced ship notices allow for tight synchronisation between source and make processes</li> <li>• Advanced shipping notice</li> <li>• Advanced shipping notices &amp; UCC128 container labelling</li> </ul>
<b>Customer service management</b>	<ul style="list-style-type: none"> <li>• Value pricing based on “cost to serve”; EDLP; cost plus pricing</li> <li>• Utilise web-based collaboration between customer and service provider on in-bound return forecasts and asset tracking</li> <li>• Utilise web-based collaboration between asset manager and repair sites regarding capacity and scheduling</li> <li>• Use an exchange system where customer is issued a serviceable item upon submitting an unserviceable item</li> <li>• Up and cross selling and/or substitution</li> <li>• Unplanned orders are accepted and scheduled only when there is no detrimental impact on overall product</li> <li>• Substitution</li> </ul>

Process area:	Best practice:
	<ul style="list-style-type: none"> <li>• Single point of contact for all order inquiries (including order entry)</li> <li>• Service provider utilises web-based communicate to identify new and discontinued repair sites to customers</li> <li>• Remote (sales, customers) order entry capability</li> <li>• Quote capability, without reserving inventory, which can be converted into an order in a single step</li> <li>• Quote capability, without reserving inventory, which can be converted into an order, but does not generate build signal or reserve inventory capacity</li> <li>• Provide visibility to and quickly escalate delinquent accounts for resolution</li> <li>• Provide single source of information on the customer (single group / owner responsible for accuracy / quality of customer data)</li> <li>• Proactive education of customers to set expectations and encourage close working relationships (knowledge of long-lead items, visibility to supply resources, agreement on levels of flexibility)</li> <li>• Order entry is organised by customer segment</li> <li>• Online real-time customer entry and edit</li> <li>• On-Demand access to ATP, production schedules and inventory status by internal operations and customers</li> <li>• Measurement of carrier performance for on-time delivery and completeness</li> <li>• measure customer service</li> <li>• Measured and compared with same activity previous period</li> <li>• Measurement, monitoring and adjustment of service or product installation</li> <li>• loyalty card data</li> <li>• JIT demand flow techniques</li> <li>• Internet exchanges</li> <li>• Internet ordering</li> <li>• Rating &amp; routing</li> <li>• Integrated edit at order entry time</li> <li>• Integrated credit checking</li> <li>• Enable customer-service representatives to complete the bill of lading for the customer including carrier routing, weight, description and class to minimise guesswork &amp; wrong estimates</li> <li>• Eliminate “special deals” sales to reduce returns and improve forecast accuracy (reduces uncertainty, lowers safety stock requirements, cheaper to administer)</li> <li>• Digital linkage (EDI, XML, etc.) is used to provide real-time demand information and handle routine transactions</li> <li>• Customer relationship management (CRM)</li> <li>• Customer sends receiving advanced shipment notification prior to shipment</li> <li>• Customer service data validation including geo-coding</li> <li>• CRP/VMI</li> <li>• CRP &amp; VMI loads optimised for utilisation</li> <li>• Customer access to online tracking of order status and shipping information</li> <li>• Customer initiated package tracking</li> <li>• Customer profile drive recognition upon checkout</li> <li>• Customer relationship information and digital linkages</li> <li>• Comprehensive history of customer interactions including order history, claims, problems, etc.</li> <li>• Compare local customs requirements to your process procedures to ensure all</li> </ul>

Process area:	Best practice:
	<p>requirements are accounted for before shipping</p> <ul style="list-style-type: none"> <li>• Communicate with customer before the return to establish what types of returns are acceptable</li> <li>• Business rules are clearly communicated with the customer</li> <li>• Automatic multi-level credit checking: dollar limits; days sales outstanding; margin testing</li> <li>• Automatic notification when to begin and when to complete</li> <li>• Automatic customer payment</li> </ul>
<b>Training</b>	<ul style="list-style-type: none"> <li>• Utilise real-world cases in employee training</li> <li>• Provide continuous formal training to employees</li> <li>• Provide product or service training to employees or FAQs online</li> <li>• Implement employee involvement programmes</li> <li>• Cross training/certification</li> </ul>
<b>Technology</b>	<ul style="list-style-type: none"> <li>• Utilise enterprise information systems</li> <li>• Utilise EDI transactions to reduce cycle time and costs</li> <li>• Utilise electronic data interchange (EDI) and electronic funds transfer (EFT) for payment to speed closing of receivables and to reduce processing costs</li> <li>• Up-to-date shop packet/specifications</li> <li>• Up-to-Date shop packet/specification for each unique production event/demand</li> <li>• Unique identifier tag for each repairable asset</li> <li>• RFID and other tagging</li> </ul>
<b>Product development</b>	<ul style="list-style-type: none"> <li>• Use of platform teams in the new product development process</li> <li>• Use of CAD applications to simulate design, cost and manufacturing process</li> <li>• Partnership with outside design firms to provide skills and capacity, as needed</li> <li>• Design for production</li> <li>• Concurrent engineering is used to tightly link sourcing into the product development process make/buy decision process (outsourcing vs. in sourcing)</li> <li>• Automated links to existing CAD information</li> </ul>
<b>Returns management</b>	<ul style="list-style-type: none"> <li>• Use historical based return rate forecasts</li> <li>• Set up electronic or pre-authorised returns</li> <li>• Segregate in-bound carcass return cost from other transportation costs</li> <li>• Return process electronically tracks transfer from station to station</li> <li>• Rapid, dynamic reconfiguration of return process to meet demand</li> <li>• Rapid reconfiguration of return capacity</li> <li>• Publish return policy</li> <li>• Integrate return planning with maintenance and inventory planning to optimise the system</li> <li>• Full internal (and external if source suppliers share in the return process responsibilities) visibility to return plans</li> <li>• Drive returns directly to return stock point of disposition to reduce cost and cycle time</li> <li>• Develop and clarify mutually understood cycle times to process return authorisations</li> <li>• Develop local receiving process close to repair</li> <li>• Defective products scheduling identifies next destination (source, make, or deliver) on return authorisation</li> </ul>

<b>Process area:</b>	<b>Best practice:</b>
	<ul style="list-style-type: none"><li>• Clarify in advance if the product to be returned requires specific, formal authorisation from the service provider per federal, state or local regulation, prior to returning</li><li>• Clarify point of contact and return location</li><li>• Automated update of customer excess material return transaction history</li><li>• Advance planning engines applied to returns</li></ul>
<b>Demand management</b>	<ul style="list-style-type: none"><li>• Proof of performance (promotion management)</li></ul>
<b>Product development</b>	<ul style="list-style-type: none"><li>• Product data management &amp; electronic document management are used to manage technical documents and requirements for engineer to order product</li><li>• Product design collaboration with customers</li></ul>

## APPENDIX C: EXAMPLE OF QUESTIONNAIRE USED FOR DELPHI STUDY IN SECOND ROUND

Supply Chain Competency Model: Delphi Assessment								
<b>Objective:</b>	To develop a supply chain competency or capability model. To identify which competencies or capabilities are required to manage a supply chain	The first question is to evaluate each of the following competencies in terms of its importance to manage an integrated supply chain.						
<b>Competency:</b>		What is the relative importance of the following competencies? Mark the importance by selecting a level from 1 to 7. Highlight the cell to indicate your choice						
<b>1. Product Portfolio Management:</b>								
<b>1.1 Product Development</b>	Influencing the product development process to improve supply chain performance during the life of the product	1	2	3	4	5	6	7
<b>1.2 Product Portfolio Management</b>	Optimising the portfolio of different product to reduce product complexity	1	2	3	4	5	6	7
<b>2. Supply Chain Strategy:</b>								
<b>2.1 The strategy formulation process</b>	The process of developing supply chain strategy	1	2	3	4	5	6	7
<b>2.2 Understanding different supply chains</b>	Understanding that different supply chains have different operating requirements	1	2	3	4	5	6	7
<b>2.3 Demand Management Strategy</b>	The strategy of selecting target markets, sales territories and service levels by market	1	2	3	4	5	6	7
<b>2.4 Developing demand fulfillment strategy</b>	Designing the supply chain to best serve the selected markets. This includes the network design.	1	2	3	4	5	6	7











## APPENDIX D: DETAIL OF THE SIZE OF INCUMBENTS BY POSITION GAUTENG REGION ONLY

Customs:		41	Regional Supply Chain		83
Adjustment Controller	2		Admin Clerk Logistics	23	
Administration Clerk – Customs	2		Claims Administrator	1	
Administration Clerk – ORT Customs	1		Logistics Coordinator	31	
Customs Manager	1		Picker Packer	9	
Customs Specialist	3		Regional Supply Chain Manager	1	
Entry Clerk	31		Supervisor Fleet Maintenance	1	
Supervisor - ORT Customs	1		Supervisor – Logistics	12	
			Supervisor – Transport	1	
Finance Disbursements		11	Transport Manager	1	
Disbursement Clerk	11		Warehouse Manager	3	
Finance Invoicing		18	Sales		12
Invoicing Clerk	7		Business Development Consultant	4	
Invoicing Quality Controller	6		Business Development Specialist	1	
Invoicing Splitting Clerk	5		Estimator	3	
			Sales and Service administrator	1	
Foreign Creditors		9	Sales Manager	1	
Foreign Creditors Recon Clerk	5		Tender Manager	1	
Foreign Creditors Supervisor	3		Trade Lane Specialist	1	
Foreign Creditors Manager	1				
			Services		13
Operations		120	Client Services Consultant	5	
Admin clerk Break Bulk	4		Client Services Manager	1	
Admin clerk Operations	6		Key Account Manager	7	
BU Manager Operations	12				
Controller	85		Supply Chain		8
Freight Desk Controller	6		Customs Executive	2	
Operations Manager	2		Logistics Engineer	2	
Supervisor Operations	5		Product and Procurement	3	
			Project Executive	1	
			<b>Total Group</b>	<b>315</b>	

## APPENDIX E:

### EXAMPLE OF JOB PROFILE

<b>JOB PROFILE</b>		
<b>Job Title</b> Logistics Engineer	<b>Department; Business Unit; Section</b> Supply Chain/Product Development	
<b>Job Purpose Summary</b> Supply Chain Optimisation through process re-engineering. Planning – strategic and tactical, designing solutions for new and existing clients and project management of implementation. Internal focus: re-engineering Supply Chain Processes		
<b>Key Responsibilities and Outputs</b> <b>7. Provide strategic direction and technical support to business to promote alignment with strategic direction</b> a. Interpret business strategy and translate into supply chain strategy. Define strategic frameworks b. Learning and development of staff, providing training, developing competence assessments in the field of Supply Chain Management. c. Attend industry related conferences / workshops and give feed back to business d. Compliance – statutory; honouring agreements with clients and providers e. Promote excellence in service delivery in line with industry best practice and OTIFNE <b>8. Optimise business processes to improve process performance and profitability, e.g. processes related to contract logistics</b> a. Continual assessment of current process performance b. Develop strategies and new process models to improve performance and profitability c. Train and develop on process best practices, e.g. trainer for the Academy d. Participate in technology implementation projects e. Support business users of selected processes f. Advise and guide management re. process improvement g. Keep process documentation updated <b>9. Design Integrated Supply Chain Solutions to enhance client’s competitiveness</b> a. Cost effective solutions; aligned with client requirements b. Plan resource needs and utilisation c. Facilitate process to consult and inform stakeholders d. The introduction of key differentiators of solutions e. Participate in the procurement of services of vendors to support the supply chain, including strategic negotiation RFI, RFQ, Contract Analysis and Sign-off f. Manage vendors in accordance with performance measures – statistical analysis of performance and compliance; capacity management g. Once the AS IS solution has been re-engineered to a TO BE solutions, model solutions in a consulting and business development environment in order to test the viability/feasibility of the solution <b>10. Render consultation service to clients to retain and secure business</b> a. Initiated, on request, and as a result of changes e.g. in technology or research results in industry best practice b. In support of Sales and Marketing, Services and Operations	<b>Pipeline position</b> Manage Self Expert/Consultant <b>Job grading</b> D- <b>Position reports to:</b> Supply Chain Director <b>Who reports to this position:</b> None <b>Working Context:</b> As part of a team, office based at Head Office, Travel from time to time	
	<b>Key Working Relationships</b> <b>Internal:</b> Business Development Manager, Sales and Servicing team, Operational staff, IT staff, Customs staff <b>External</b> Third Party Service Providers, Supply Chain related bodies and forums, Clients	

<p><b>11. Secure profitable new business</b></p> <ul style="list-style-type: none"><li>a. In cooperation with other members of own team, Sales and Marketing, and Operations</li><li>b. Commercial and legal reviews for more complex client specific solutions</li><li>c. Identify opportunities, take action to secure, enable and support Operational staff and Key Account Managers to secure business</li></ul>	
<p><b>Performance Indicators/Measures</b></p> <ul style="list-style-type: none"><li>7. Contribution to increased profitability of new and existing client accounts</li><li>8. Number of new initiatives successfully introduced into the business, contribute to enhancing performance (i.r.o. OTIFNE) towards strategic business objectives, e.g. process improvement</li><li>9. Adherence/compliance in design and modelling of supply chain solutions</li><li>10. Successful implementation of projects as measured against project deliverables, on time and in budget</li><li>11. Delivering on specific skills development initiatives, e.g. mentoring, coaching, training</li><li>12. Internal Clients express satisfaction with services, e.g. as measured through internal survey</li></ul>	

## APPENDIX F: EXAMPLE OF COMPETENCY PROFILE

Functional Competencies	N.A.	Awareness	Knowledge	Skilled	Mastery	Other competencies
1. Basic Concepts and Principles				●		Foundational Competencies
1.1 Introducing Supply Chain Management						
1.2 Understanding Supply Chain Processes						
1.3 Supply Chain Performance Management and Intelligence						
1.4 Risk Management in Supply Chain Management						
1.5 Supply Chain Collaboration and Partnerships						
1.6 Structuring Organisations for Supply Chain Management						
2. Supply Chain Planning						
2.1 Supply Chain Design (Strategic)						
2.1.1 Industry & Market Analysis				●		
2.1.2 Understanding Different Types of Supply Chains				●		
2.1.3 Market segmentation				●		
2.1.4 Developing Demand Fulfilment Strategy				●		
2.1.5 Customer Relationship Management				●		
2.1.6 Developing Innovative Customer Solutions				●		
2.1.7 Developing Supply Chain Strategy				●		
2.1.8 Network Design & Optimisation			●			
2.1.9 Supply Chain Process Design & Optimisation				●		
2.2 Sales & Operations Planning (Tactical)						
2.2.1 Demand Sensing & Shaping			●			
2.2.2 Demand Planning			●			
2.2.3 Supply Planning			●			
2.2.3.1 Inventory Planning			●			
2.2.3.2 Distribution Requirements Planning			●			
2.2.3.3 Production Planning			●			
2.2.3.4 Source Planning			●			
2.2.3.5 Materials Requirements Planning			●			
2.2.4 Demand & Supply Balancing			●			
2.3 Supply Chain Operations Planning & Scheduling (Operational)						
2.3.1 Customer Order Management			●			
2.3.2 Operational Inventory Allocation Planning		●				
2.3.3 Detail Production Scheduling			●			

Functional Competencies	N.A.	Awareness	Knowledge	Skilled	Mastery	Other competencies
2.3.4 Inventory Deployment & Replenishment Scheduling			●			
2.3.5 Facility Operations Scheduling			●			
2.3.6 Transport Operations Scheduling		●				
3. Procurement & Supply Management						
3.1 Procurement and Strategic Sourcing						
3.3.1 Strategic Sourcing		●				
3.3.2 Spend & Supply Demand Analysis		●				
3.3.3 Reducing TCO		●				
3.3.4 Supplier Identification & Qualification		●				
3.3.5 RFX Process		●				
3.3.6 Contract Management		●				Management and Leadership
3.3.7 Master Data Management	●					
3.3.8 Supplier Performance Management		●				
3.2 Supply Demand Management						
3.2.1 Supply Demand Segmentation				●		
3.2.2. Developing Supply Demand Fulfilment Strategy				●		
3.2.3 Supply Demand Planning			●			
3.2.4 Requirements Planning			●			
3.2.5 Supply Order Execution Management			●			
3.3 Warehousing and Materials Management						
3.3. 1 Network Design and Optimisation			●			
3.3.2 Facility Design, Layout and Optimisation			●			
3.3.3 Optimising TCO			●			
3.3.4 Implementation of Facilities Outsourcing			●			
3.3.5 Facilities Operational Management		●				
3.3.6 Reverse Logistics			●			
3.3.7 Inventory Management				●		
4. Manage Outbound Supply Chain						
4.1 Customer Order Management						
4.1.1 Order Execution Management & Customer Service				●		
4.2 Facilities Management (Warehousing & Distribution Centres)						
4.2.1 Facility Design & Layout				●		
4.2.2 Implementation of Facilities Outsourcing	●					
4.2.3 Facilities Operational Management		●				
4.3 Transport Management						
4.3.1 Bulk Logistics Management			●			
4.3.2 Break Bulk Logistics Management			●			
4.3.3 Dangerous Goods			●			

Functional Competencies	N.A.	Awareness	Knowledge	Skilled	Mastery	Other competencies
4.3.4 Perishable Cargo			●			
4.3.4 High Value Cargo			●			
4.3.5 Marine Logistics			●			
4.3.6 Pipeline Logistics			●			
4.3.7 Out of Gauge or Abnormal Logistics			●			
4.3.8. Rail Logistics			●			
4.3.9 Road Logistics			●			
4.3.10 Reverse Logistics Management			●			
4.3.11 Import and Export Logistics			●			
4.3.12 Developing Multi-Modal Solutions			●			
4.3.13 Implementation of Transport Outsourcing		●				
4.3.14 Fleet Management		●				
4.3.15 Transport Operational Management						
4.3.16 Logistics SHERQ (Safety, Health, Environmental, Risk and Quality)			●			
<b>5. International Logistics</b>						
5.1 International Trade			●			
5.2 Airfreight Forwarding			●			
5.3 Surface Freight Forwarding			●			
5.4 Customs			●			
5.5 Insurance			●			
<b>6. Supply Chain Enablement &amp; Improvement</b>						Computer skills MS Outlook: Intermediate MS Internet Explorer: Intermediate MS Word: Basic MS Excel: Advanced MS PowerPoint: Intermediate MS Visio: Intermediate MS Project: Intermediate
6.1 Understanding different Supply Chain Models			●			
6.2 Developing Supply Chain Management Strategies			●			
6.3 Business Process Optimisation in Supply Chain Management			●			
6.4 Compliance & Risk Management in Supply Chain Management		●				
6.5 Supply Chain Intelligence & Reporting			●			
6.6 Facilitate Organisational Learning and Development in Supply Chain Management				●		
6.7 Manage Own Learning and Development in Supply Chain Management				●		
6.8 Change Management			●			
6.9 Systems Technology Deployment				●		
6.10 Green Supply Chain Management			●			

**APPENDIX G:****RESULTS OF QUALITY ASSESSMENT OF QUESTIONS**

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question1811_B	6.241818568	huge
question1811_D	6.241818568	huge
question1658	5.733388924	huge
question1617	5.702317552	huge
question376	5.2451965	huge
question1879_C	5.021166876	huge
question1707	4.636619568	huge
question390	4.212056493	huge
question393	4.050642484	huge
question1599	3.958702441	huge
question1060	3.905700439	huge
question1715	3.812436395	huge
question1438	3.648523088	huge
question1481	3.437553862	huge
question1492	3.434403418	huge
question1844	3.379170375	huge
question1081	3.363829629	huge
question1243	3.216546208	huge
question1377	3.213852753	huge
question1055	3.159473129	huge
question611	3.125828707	huge
question1056	3.11802952	huge
question1811_C	3.080803358	huge
question607	3.064214751	huge
question395	3.056045618	huge
question359	3.029500082	huge
question422	3.000476199	huge
question133	2.988400207	huge
question579	2.965458953	huge
question1446	2.905648822	huge
question1718	2.902996873	huge
question1724	2.767092671	huge
question827	2.760235611	huge
question818	2.706051822	huge
question1901_A	2.682567911	huge
question1047	2.682449985	huge
question1092	2.667617571	huge
question1602	2.663994477	huge
question201	2.663936154	huge
question1710	2.625231088	huge

Question	Effect size	Effect size class
question679	2.614995394	huge
question173	2.611089177	huge
question261	2.609875275	huge
question530	2.580535246	huge
question1879_D	2.551099688	huge
question1678	2.532864681	huge
question612	2.511856625	huge
question1065	2.501708065	huge
question1500	2.49655178	huge
question1878_F	2.479997302	huge
question1569	2.468005825	huge
question1309	2.466683991	huge
question1682	2.464157259	huge
question1062	2.439881392	huge
question1686	2.438579237	huge
question881	2.432578711	huge
question816	2.426618539	huge
question122	2.425244168	huge
question1598	2.424066185	huge
question1941_C	2.423955623	huge
question1206	2.420303299	huge
question373	2.409389315	huge
question1708	2.401146001	huge
question1082	2.39456994	huge
question1942	2.39288356	huge
question364	2.377851364	huge
question1811_E	2.375637015	huge
question712	2.371317064	huge
question121	2.364216594	huge
question505	2.357882287	huge
question1432	2.347894878	huge
question453	2.331218719	huge
question1909_B	2.327192067	huge
question384	2.321273748	huge
question1901_F	2.320716894	huge
question811	2.318912312	huge
question1875_D	2.318771963	huge
question1441	2.314275552	huge
question608	2.31256757	huge
question689	2.305859499	huge
question1879_E	2.30343113	huge
question360	2.296298422	huge
question154	2.283911439	huge
question1683	2.28086778	huge

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question512	2.272529778	huge
question406	2.263129012	huge
question1721	2.258002987	huge
question362	2.257106097	huge
question1692	2.254865269	huge
question181	2.254808032	huge
question1268	2.233041776	huge
question273	2.229919055	huge
question169	2.228686217	huge
question1951	2.220581647	huge
question164	2.181295095	huge
question540	2.180703998	huge
question1729	2.15289593	huge
question1717	2.148417666	huge
question557	2.147962139	huge
question124	2.145468925	huge
question542	2.141389281	huge
question1460_10	2.137504805	huge
question1460_9	2.137504805	huge
question1090	2.130756399	huge
question671	2.12933174	huge
question1952_C	2.129147028	huge
question1048	2.125582105	huge
question1002	2.123356123	huge
question1277_3	2.121752228	huge
question1498	2.120843656	huge
question823	2.099460288	huge
question1190	2.096092846	huge
question482	2.093965565	huge
question1719	2.086630761	huge
question1877_G	2.083226299	huge
question529	2.082064742	huge
question1074	2.074380522	huge
question165	2.074132131	huge
question1276	2.066374252	huge
question339	2.065664654	huge
question1460_1	2.062050412	huge
question1315	2.050971819	huge
question1199	2.05031635	huge
question836	2.049550415	huge
question1746	2.045334767	huge
question762	2.038646245	huge
question1695	2.036419511	huge
question1067	2.021833993	huge

Question	Effect size	Effect size class
question1663	2.019828984	huge
question1091	1.995129313	huge
question1460_11	1.99444547	huge
question1460_12	1.99444547	huge
question203	1.993345168	huge
question495	1.988635888	huge
question1680	1.987299688	huge
question1915_E	1.982492165	huge
question829	1.973750654	huge
question367	1.972360173	huge
question698	1.972001368	huge
question1926	1.970660153	huge
question1083	1.969753825	huge
question1433	1.969400663	huge
question558	1.968015559	huge
question1556_H	1.964785777	huge
question1297	1.959120258	huge
question552	1.953610146	huge
question366	1.95330005	huge
question353	1.951972891	huge
question1221	1.949598853	huge
question1460_18	1.946391495	huge
question767	1.941171178	huge
question820	1.940335331	huge
question1877_H	1.940109563	huge
question754_D	1.932900098	huge
question1766_C	1.930891496	huge
question1690	1.925178297	huge
question202	1.92512352	huge
question1460_15	1.920593562	huge
question780	1.920475881	huge
question1915_B	1.919853342	huge
question392	1.917818418	huge
question1909_A	1.91620248	huge
question514	1.91253958	huge
question1449_F	1.909603631	huge
question1460_13	1.909279457	huge
question1460_14	1.909279457	huge
question94	1.908899423	huge
question1460_16	1.905036984	huge
question1460_17	1.905036984	huge
question1449_L	1.903443696	huge
question615	1.901730705	huge
question438	1.899290212	huge

Question	Effect size	Effect size class
question1836	1.89799396	huge
question1556_G	1.894312741	huge
question1460_19	1.893604098	huge
question1816_B	1.889769819	huge
question1211	1.880243649	huge
question493	1.880127657	huge
question1901_E	1.879964121	huge
question1460_4	1.876089375	huge
question1460_5	1.876089375	huge
question1460_6	1.876089375	huge
question1460_7	1.876089375	huge
question1460_8	1.876089375	huge
question88	1.872332172	huge
question754_A	1.869358714	huge
question416	1.867997572	huge
question754_B	1.865091913	huge
question1766_F	1.862827446	huge
question819	1.861288953	huge
question760	1.857299759	huge
question1731_L	1.854590221	huge
question1877_F	1.84872709	huge
question260	1.848515237	huge
question1443	1.844500012	huge
question1460_2	1.842468059	huge
question1460_3	1.842468059	huge
question1052	1.841654897	huge
question1892_B	1.838986107	huge
question733	1.838309627	huge
question1915_H	1.838288732	huge
question246	1.837498937	huge
question1656_B	1.835447499	huge
question1734_B	1.832960373	huge
question1449_D	1.832032396	huge
question1665	1.827902035	huge
question518	1.819503418	huge
question1867_I	1.819048549	huge
question1449_I	1.812688253	huge
question1449_G	1.80285802	huge
question385	1.799056363	huge
question1080	1.797979278	huge
question1755_H	1.795248006	huge
question1450_E	1.792834352	huge
question1966_C	1.79255226	huge
question179	1.791014974	huge

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question1009	1.784385432	huge
question1440	1.782640251	huge
question1058	1.780201875	huge
question912_H	1.777543278	huge
question1740_A	1.775767426	huge
question233	1.775322996	huge
question831	1.774087303	huge
question1592_1	1.771080626	huge
question736	1.770571738	huge
question520	1.764439483	huge
question884	1.758320227	huge
question351	1.75685333	huge
question1322	1.756056216	huge
question1946_H	1.75301299	huge
question347	1.748567525	huge
question657_J	1.7472277	huge
question1449_E	1.746637784	huge
question1299	1.746244713	huge
question580	1.743993601	huge
question1379	1.741394222	huge
question1867_J	1.739228329	huge
question562	1.737201661	huge
question1277_2	1.732035109	huge
question1556_F	1.725750477	huge
question812	1.725388708	huge
question1001	1.725086174	huge
question174	1.723899382	huge
question1467	1.72387542	huge
question882	1.72310367	huge
question869	1.721322019	huge
question391	1.721001546	huge
question1551_A	1.720517351	huge
question172	1.718977137	huge
question1462_J	1.717348096	huge
question618	1.714117947	huge
question1891_E	1.710836212	huge
question137	1.710355749	huge
question1941_D	1.707937956	huge
question1461_M	1.707467521	huge
question1941_G	1.70576782	huge
question524	1.70407308	huge
question755_B	1.702231402	huge
question1342	1.701932896	huge
question561	1.701220459	huge

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question1681	1.698025464	huge
question719	1.697132576	huge
question349	1.696427453	huge
question1905	1.69188404	huge
question1567	1.69155824	huge
question1908_E	1.688583955	huge
question1450_A	1.688210257	huge
question1950_D	1.687974865	huge
question332	1.685256463	huge
question1449_J	1.680692731	huge
question1792_E	1.679671788	huge
question1720	1.677140397	huge
question1046	1.674726814	huge
question1928_A	1.674325488	huge
question727	1.672749433	huge
question1755_G	1.672748018	huge
question919	1.67027745	huge
question1928_B	1.668996363	huge
question1866_F	1.668836751	huge
question1021	1.665894351	huge
question1668	1.664066465	huge
question1966_F	1.663685199	huge
question849	1.663398376	huge
question1892_D	1.66129688	huge
question340	1.659954177	huge
question234	1.657725894	huge
question1458	1.657497156	huge
question1556_C	1.656823553	huge
question1952_A	1.651652388	huge
question1380	1.651005788	huge
question1731_K	1.650569016	huge
question117	1.650291791	huge
question1910_F	1.646139866	huge
question1927_B	1.646072093	huge
question866	1.645539851	huge
question1543	1.645447365	huge
question1462_I	1.644850672	huge
question491	1.644131255	huge
question1952_D	1.640949518	huge
question1928_E	1.640014116	huge
question1866_A	1.639315784	huge
question1731_E	1.637419556	huge
question834	1.636156459	huge
question1888	1.636070059	huge

Question	Effect size	Effect size class
question1462_A	1.63272572	huge
question119	1.632519351	huge
question1709	1.629522716	huge
question537	1.627353805	huge
question1460_20	1.618448331	huge
question872	1.616621434	huge
question509	1.616552738	huge
question723	1.616305276	huge
question867	1.615274128	huge
question1462_K	1.615255147	huge
question1866_D	1.612830179	huge
question1265	1.612208359	huge
question1437	1.611149275	huge
question1867_F	1.610770129	huge
question1493	1.610713109	huge
question1085	1.610513664	huge
question1595	1.610503511	huge
question1734_C	1.606662481	huge
question1867_G	1.605353566	huge
question1917_G	1.603599822	huge
question910_A	1.603425275	huge
question338	1.602472017	huge
question779	1.600681426	huge
question160	1.598378171	huge
question1910_G	1.597479087	huge
question1464_H	1.596079579	huge
question771	1.591481848	huge
question1950_I	1.591056549	huge
question1449_B	1.589764672	huge
question84_G	1.588868051	huge
question1677	1.586625278	huge
question1892_C	1.585058745	huge
question754_C	1.584544329	huge
question1488	1.582946141	huge
question394	1.582569617	huge
question657_B	1.582241565	huge
question595_J	1.58206004	huge
question672	1.577083937	huge
question1071	1.574861206	huge
question490	1.573929628	huge
question1756_C	1.573531361	huge
question1171	1.5721381	huge
question1449_H	1.567429398	huge
question1777_G	1.566979861	huge

Question	Effect size	Effect size class
question854	1.56297185	huge
question1936_C	1.562703231	huge
question1794_F	1.559954897	huge
question1422	1.556530935	huge
question1059	1.556206866	huge
question1655_A	1.556076051	huge
question1054	1.55574586	huge
question1073	1.553499205	huge
question913_A	1.551225362	huge
question1792_B	1.550925327	huge
question301_C	1.550694004	huge
question1792_D	1.54991338	huge
question1938_A	1.549546605	huge
question189_E	1.549470036	huge
question1793_A	1.544351672	huge
question1731_G	1.543569038	huge
question1462_D	1.543495079	huge
question487	1.543264224	huge
question1867_H	1.540697549	huge
question657_A	1.539774567	huge
question485	1.538638307	huge
question341	1.537882041	huge
question1491	1.53615632	huge
question1793_G	1.535686013	huge
question554	1.534434065	huge
question1908_G	1.533877974	huge
question1927_E	1.530176849	huge
question657_D	1.527881807	huge
question1928_C	1.527340724	huge
question1460_21	1.52726174	huge
question396	1.526767097	huge
question913_H	1.524295448	huge
question1731_C	1.523609577	huge
question1865_B	1.523573345	huge
question722	1.52217455	huge
question1230	1.52166597	huge
question79_I	1.519864691	huge
question1740_G	1.518119906	huge
question316	1.517863052	huge
question1950_F	1.51780617	huge
question755_G	1.51738292	huge
question1810_B	1.516901684	huge
question1600	1.515911206	huge
question1928_G	1.510551767	huge

Question	Effect size	Effect size class
question1878_C	1.51051504	huge
question87	1.509767586	huge
question1704	1.507839412	huge
question427	1.507481297	huge
question1556_I	1.507415338	huge
question575	1.505696001	huge
question1892_F	1.501141875	huge
question1731_B	1.497089509	huge
question1908_F	1.494742464	huge
question243	1.4945134	huge
question578	1.493404089	huge
question1901_D	1.493162095	huge
question190_B	1.493019619	huge
question1927_D	1.492614211	huge
question1556_D	1.490555528	huge
question200	1.490035579	huge
question136	1.48945683	huge
question1486_A	1.488270995	huge
question1722_A	1.486135851	huge
question85_A	1.484502292	huge
question1728	1.484140604	huge
question657_G	1.483624558	huge
question737	1.483416057	huge
question1586	1.480750254	huge
question1946_G	1.47987697	huge
question1740_I	1.478009724	huge
question798	1.477725091	huge
question1501	1.474855122	huge
question1461_J	1.474646553	huge
question271	1.473985123	huge
question800	1.473658302	huge
question1897_A	1.473053294	huge
question1565_J	1.472897344	huge
question1875_B	1.472136722	huge
question301_A	1.470713302	huge
question305	1.470384447	huge
question1877_D	1.470249537	huge
question1716	1.468672613	huge
question322	1.468167367	huge
question1902_C	1.466719273	huge
question300_B	1.46637034	huge
question846	1.465859515	huge
question1450_J	1.465704868	huge
question1693	1.464837073	huge

Question	Effect size	Effect size class
question1880_D	1.463715453	huge
question313	1.463702161	huge
question300_A	1.461019509	huge
question1591	1.460837307	huge
question1615	1.460681007	huge
question1187	1.459539689	huge
question1735_E	1.459336591	huge
question1761_D	1.457856873	huge
question344	1.457430073	huge
question1873	1.456303157	huge
question421	1.456219458	huge
question189_A	1.454867441	huge
question1460_22	1.454652581	huge
question1868_E	1.453125446	huge
question1747_J	1.452637374	huge
question262	1.452167873	huge
question1032	1.451881739	huge
question1732_G	1.44870984	very large
question1812_F	1.4481147	very large
question1950_J	1.446605117	very large
question1464_A	1.445919977	very large
question1908_C	1.444767557	very large
question551	1.443596491	very large
question1929_D	1.442796837	very large
question1908_B	1.44231089	very large
question304	1.44227487	very large
question1236	1.441973437	very large
question1870_A	1.441373235	very large
question1068	1.441107027	very large
question755_K	1.440668363	very large
question190_D	1.440168565	very large
question755_E	1.43948617	very large
question300_D	1.439023127	very large
question1732_C	1.438662902	very large
question793	1.435265597	very large
question1810_D	1.433974635	very large
question1183	1.432117924	very large
question1045	1.431930875	very large
question1910_E	1.431728978	very large
question1684	1.430644764	very large
question1747_H	1.429625604	very large
question1875_G	1.42925894	very large
question1869_D	1.428775067	very large
question1906	1.428594678	very large

Question	Effect size	Effect size class
question706	1.427649521	very large
question1193	1.427049476	very large
question189_F	1.425635137	very large
question649	1.425590122	very large
question186	1.423813372	very large
question301_B	1.423014313	very large
question773	1.421811847	very large
question754_F	1.421445876	very large
question437	1.420934596	very large
question1556_B	1.420792293	very large
question1450_K	1.420634921	very large
question1294	1.419870898	very large
question1504	1.4188253	very large
question1872	1.418744855	very large
question838	1.417773396	very large
question1026	1.415960889	very large
question1462_E	1.414940333	very large
question1910_B	1.41414104	very large
question1533	1.414132471	very large
question1893	1.412637852	very large
question925_F	1.412175576	very large
question1689	1.412122831	very large
question1891_D	1.409774543	very large
question1004	1.409349895	very large
question1897_B	1.409267405	very large
question1464_I	1.408659323	very large
question1944	1.408636513	very large
question79_H	1.408028368	very large
question476	1.407640143	very large
question1351_A	1.406890003	very large
question291	1.406870559	very large
question1870_B	1.40659117	very large
question1808_D	1.405798526	very large
question621	1.40345391	very large
question1731_D	1.403086737	very large
question1464_J	1.401615353	very large
question806	1.401205904	very large
question1450_C	1.401195237	very large
question1539	1.400676367	very large
question1246	1.40019914	very large
question414	1.400091166	very large
question584	1.400064277	very large
question1950_E	1.399116692	very large
question1868_D	1.398183521	very large

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question1740_F	1.394496881	very large
question1975_F	1.394320472	very large
question1966_D	1.393991439	very large
question766	1.393483478	very large
question1448	1.391637884	very large
question189_C	1.39116151	very large
question1946_B	1.38858158	very large
question417	1.388389252	very large
question709	1.38699075	very large
question79_D	1.386824459	very large
question1867_A	1.386323748	very large
question1917_E	1.385992064	very large
question797	1.385835513	very large
question595_I	1.385316404	very large
question1701_F	1.384087691	very large
question189_D	1.384072842	very large
question1777_A	1.383025147	very large
question189_G	1.380561884	very large
question799	1.379094476	very large
question595_D	1.376015398	very large
question225	1.375799883	very large
question907_A	1.373602145	very large
question195	1.373073724	very large
question1354_3	1.371523941	very large
question1308	1.371119753	very large
question190_A	1.371091004	very large
question211	1.370652588	very large
question1565_D	1.369663001	very large
question1866_E	1.36965442	very large
question497	1.366329545	very large
question1812_G	1.364412344	very large
question300_C	1.364045948	very large
question412	1.363957806	very large
question1618	1.363173426	very large
question189_B	1.362490523	very large
question1812_D	1.361886183	very large
question1762_E	1.360861203	very large
question1464_G	1.359484358	very large
question1968_F	1.358000866	very large
question1866_G	1.357584705	very large
question1866_I	1.357566916	very large
question1039	1.357446003	very large
question91	1.357258546	very large
question1892_E	1.355281419	very large

Question	Effect size	Effect size class
question543	1.354131729	very large
question1712	1.352449788	very large
question1756_E	1.352378972	very large
question907_H	1.350506839	very large
question1902_D	1.348969009	very large
question1740_C	1.348754015	very large
question513	1.34870474	very large
question381	1.348332307	very large
question1755_J	1.348155289	very large
question1497	1.345498569	very large
question1227	1.344379586	very large
question668	1.343553155	very large
question1740_B	1.341027232	very large
question1041	1.34074799	very large
question1937_A	1.339483847	very large
question84_F	1.339262352	very large
question1756_F	1.338663249	very large
question1917_A	1.337588035	very large
question1034	1.337095384	very large
question1069	1.337052049	very large
question1731_H	1.336635027	very large
question1277_7	1.336073833	very large
question625	1.334912605	very large
question657_H	1.33472448	very large
question822	1.334620338	very large
question1865_G	1.333529165	very large
question1459_K	1.332082198	very large
question1735_B	1.331551545	very large
question1962	1.330185594	very large
question1941_H	1.330183053	very large
question910_H	1.329192048	very large
question275	1.325539695	very large
question1808_A	1.324704142	very large
question1952_F	1.324247888	very large
question1731_F	1.32364978	very large
question1057	1.321881956	very large
question865	1.320934121	very large
question1542	1.320693535	very large
question1952_E	1.31985231	very large
question657_K	1.319764553	very large
question1762_D	1.319330851	very large
question1738_I	1.319094383	very large
question843	1.31903118	very large
question810	1.318377946	very large

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question1859_A	1.317637102	very large
question1464_C	1.316198096	very large
question1755_E	1.314382773	very large
question1459_M	1.313950108	very large
question755_F	1.313045449	very large
question1723_C	1.312883779	very large
question813	1.312156917	very large
question1450_H	1.308449312	very large
question1461_I	1.307880396	very large
question752_A	1.307532349	very large
question299_G	1.307453956	very large
question1756_D	1.307067752	very large
question1879_A	1.303613559	very large
question1812_A	1.303244978	very large
question1886	1.303079103	very large
question188	1.302211476	very large
question1761_F	1.302105847	very large
question670	1.300358998	very large
question1459_N	1.29880809	very large
question190_C	1.298435987	very large
question1077	1.296754848	very large
question711	1.296348538	very large
question925_D	1.294992616	very large
question1734_I	1.293795341	very large
question925_G	1.293263769	very large
question1449_K	1.293217654	very large
question739	1.290744831	very large
question378	1.290662561	very large
question1565_A	1.28829291	very large
question1460_23	1.287542611	very large
question1936_A	1.286941377	very large
question746	1.286663202	very large
question1761_B	1.285986906	very large
question1565_K	1.284374716	very large
question729	1.284137944	very large
question755_I	1.282849884	very large
question1731_I	1.282736197	very large
question1464_E	1.282722283	very large
question1565_M	1.282513311	very large
question1277_4	1.281951328	very large
question1277_5	1.281951328	very large
question1734_F	1.281906528	very large
question1917_B	1.280096075	very large
question1897_E	1.279893481	very large

Question	Effect size	Effect size class
question657_F	1.278473772	very large
question1740_H	1.278425732	very large
question1966_B	1.278230428	very large
question814	1.277966842	very large
question1865_A	1.274295129	very large
question1701_B	1.274132759	very large
question1464_F	1.273394424	very large
question1701_A	1.272147277	very large
question191_C	1.271962352	very large
question1676	1.27152609	very large
question657_E	1.270944937	very large
question844	1.269163333	very large
question1439	1.26852158	very large
question1536	1.26835213	very large
question1089	1.26789448	very large
question1620	1.266932034	very large
question1812_B	1.266554703	very large
question1449_A	1.26538936	very large
question1544	1.264400716	very large
question1352_4	1.263512154	very large
question1937_F	1.262630311	very large
question1816_H	1.262365381	very large
question1450_G	1.262285984	very large
question1655_G	1.261784096	very large
question300_F	1.26154684	very large
question691	1.260477127	very large
question1423	1.260433606	very large
question1228	1.259964937	very large
question235	1.259450016	very large
question190_F	1.259115941	very large
question245	1.259107883	very large
question92	1.258481616	very large
question180	1.257876752	very large
question1928_D	1.257522256	very large
question286	1.257370797	very large
question686	1.256937581	very large
question1578_A	1.256464111	very large
question430	1.254137436	very large
question459_8	1.253958023	very large
question1726	1.253363156	very large
question1740_D	1.253005885	very large
question315	1.251004727	very large
question1450_B	1.250125045	very large
question912_A	1.249851606	very large

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question925_A	1.248843155	very large
question1450_D	1.248497878	very large
question1585	1.246400207	very large
question583	1.246115349	very large
question922	1.245923723	very large
question272	1.245654719	very large
question553	1.244760482	very large
question138	1.244318758	very large
question1744_E	1.243628796	very large
question1880_C	1.243524691	very large
question346	1.242633484	very large
question925_H	1.242567653	very large
question1656_A	1.2417408	very large
question1450_F	1.240763053	very large
question383	1.240412382	very large
question232	1.23979569	very large
question744_2	1.23978543	very large
question85_B	1.239778747	very large
question999	1.239409689	very large
question1673	1.238263434	very large
question1461_H	1.237431607	very large
question1968_C	1.236289776	very large
question657_I	1.235852015	very large
question1891_B	1.235287618	very large
question1084	1.235233508	very large
question628	1.234854597	very large
question657_C	1.234642406	very large
question595_B	1.234460652	very large
question1468	1.234180393	very large
question735	1.232356972	very large
question1929_A	1.22976245	very large
question191_B	1.229210399	very large
question1792_C	1.229039541	very large
question258	1.228943271	very large
question565	1.22860742	very large
question1459_A	1.228169544	very large
question757_A	1.226223535	very large
question1185_E	1.225793675	very large
question1910_A	1.224634138	very large
question1277_1	1.224171246	very large
question721	1.22411419	very large
question386	1.222026994	very large
question1235	1.221139568	very large
question1909_D	1.221029242	very large

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question1877_C	1.220783529	very large
question1459_F	1.219634213	very large
question858	1.219236267	very large
question343	1.218699209	very large
question501	1.217084784	very large
question1816_D	1.212880194	very large
question299_E	1.212873988	very large
question159	1.212316214	very large
question1950_G	1.211142508	very large
question1546	1.2092378	very large
question1874_K	1.208519904	very large
question1449_C	1.207531663	very large
question410	1.207068349	very large
question1279_E	1.206599562	very large
question910_C	1.20593527	very large
question1304	1.205681252	very large
question1747_A	1.203352791	very large
question1756_G	1.203147345	very large
question1868_B	1.202498396	very large
question345	1.2023575	very large
question1271	1.200844897	very large
question1808_B	1.200006534	very large
question1706	1.19884862	very large
question1875_A	1.198069294	very large
question1968_E	1.197102917	very large
question1859_E	1.197040789	very large
question1908_A	1.196752154	very large
question730	1.195616425	very large
question728	1.194574123	very large
question191_A	1.192476487	very large
question163	1.191826	very large
question451	1.19120796	very large
question1875_H	1.190384611	very large
question1810_A	1.189469717	very large
question1535	1.188940974	very large
question759	1.188198408	very large
question500	1.187169627	very large
question1734_D	1.18495817	very large
question151	1.184713349	very large
question1867_B	1.182619245	very large
question84_D	1.182539009	very large
question1966_A	1.181937438	very large
question1909_F	1.181609408	very large
question896	1.181123738	very large

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question79_E	1.180765335	very large
question1277_6	1.177689539	very large
question1792_A	1.177174022	very large
question1744_D	1.176887424	very large
question1655_E	1.176603083	very large
question1655_F	1.176603083	very large
question1319	1.175449159	very large
question480	1.173195818	very large
question550	1.173082098	very large
question1475	1.171750991	very large
question469	1.170541069	very large
question1747_K	1.170255366	very large
question1286	1.170253167	very large
question1461_K	1.169529483	very large
question132	1.169438901	very large
question325	1.16883661	very large
question1655_D	1.166159912	very large
question84_A	1.166007925	very large
question1756_H	1.164323437	very large
question907_F	1.164206907	very large
question995	1.164069146	very large
question1865_D	1.163796765	very large
question850	1.163765081	very large
question308	1.163763814	very large
question1866_H	1.163436888	very large
question1870_D	1.1628722	very large
question878	1.162127527	very large
question299_B	1.161950122	very large
question1734_A	1.160346862	very large
question641	1.159720475	very large
question1917_C	1.1596902	very large
question408	1.158966992	very large
question1968_A	1.158233985	very large
question585	1.157911597	very large
question467	1.157617583	very large
question539	1.157280302	very large
question519	1.156744318	very large
question1212	1.155426934	very large
question732	1.155098974	very large
question925_C	1.154553106	very large
question885	1.1530836	very large
question1869_B	1.152260903	very large
question1508	1.15169312	very large
question704	1.151108563	very large

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question847	1.150942815	very large
question1909_C	1.15081138	very large
question1459_J	1.148761005	very large
question79_C	1.148343038	very large
question1435	1.148119016	very large
question89	1.147821663	very large
question903_A	1.147767669	very large
question1011	1.147651152	very large
question755_H	1.147635913	very large
question139	1.146811141	very large
question1701_G	1.145443688	very large
question1192	1.144563718	very large
question208	1.144443862	very large
question909_K	1.143877358	very large
question717	1.142232036	very large
question299_D	1.141903668	very large
question1691	1.141712795	very large
question907_J	1.141688205	very large
question1915_G	1.141144255	very large
question725	1.13986857	very large
question1898_D	1.138957959	very large
question1757_G	1.137176259	very large
question199	1.136467884	very large
question996	1.134809815	very large
question531	1.134621901	very large
question910_B	1.134374241	very large
question506	1.13428595	very large
question462_6	1.132557291	very large
question1282	1.131908989	very large
question724	1.131503552	very large
question1867_D	1.131244721	very large
question1495	1.130556763	very large
question835	1.129753041	very large
question1460_24	1.1287391	very large
question1037	1.12862218	very large
question1461_D	1.127361985	very large
question909_A	1.126658722	very large
question1747_G	1.126305666	very large
question1816_F	1.124413931	very large
question1464_B	1.123469832	very large
question464	1.121995461	very large
question1169	1.121900816	very large
question1320	1.121507533	very large
question1072	1.119319858	very large

Question	Effect size	Effect size class
question815	1.118855342	very large
question905_A	1.11849284	very large
question1381	1.11561001	very large
question1743	1.115596025	very large
question1528	1.114434865	very large
question1946_D	1.112145294	very large
question1460_26	1.111809693	very large
question1460_27	1.111809693	very large
question299_A	1.111183378	very large
question1810_C	1.111060214	very large
question886	1.110570932	very large
question1207	1.110539305	very large
question752_B	1.110389447	very large
question79_G	1.110032502	very large
question456	1.109447244	very large
question1459_I	1.108902837	very large
question1910_C	1.108425308	very large
question556	1.107576202	very large
question1565_C	1.106558887	very large
question1075	1.105654224	very large
question1275	1.10467382	very large
question903_F	1.103901055	very large
question1070	1.103650642	very large
question745	1.101963465	very large
question1565_L	1.101410983	very large
question1431	1.100528004	very large
question1459_L	1.100017193	very large
question510	1.099575487	large
question1938_C	1.098398347	large
question1461_B	1.09796301	large
question1460_25	1.097321684	large
question755_J	1.097232084	large
question1909_E	1.096853543	large
question299_C	1.096490936	large
question462_5	1.096490139	large
question1738_C	1.094298576	large
question1859_C	1.0935737	large
question1808_E	1.092332013	large
question1878_D	1.089973105	large
question1913	1.08992528	large
question582	1.089732	large
question743	1.087085884	large
question1938_E	1.08703414	large
question1928_F	1.086906831	large

Question	Effect size	Effect size class
question405	1.086478668	large
question1461_E	1.084153857	large
question1808_C	1.083846803	large
question249	1.083796476	large
question270	1.083495216	large
question647	1.083131763	large
question1761_G	1.082987559	large
question1735_G	1.082327611	large
question560	1.081087476	large
question205	1.081003319	large
question804	1.080301844	large
question1929_B	1.079514556	large
question577	1.07931425	large
question1960	1.078033693	large
question764	1.07747937	large
question419	1.076492564	large
question141	1.076397368	large
question274	1.075444011	large
question595_F	1.074172206	large
question907_K	1.074133168	large
question320	1.074030133	large
question207	1.073897559	large
question1462_O	1.073207513	large
question726	1.072801268	large
question1794_B	1.0716547	large
question1201	1.070555523	large
question1218	1.070054525	large
question418	1.069878876	large
question1510	1.069851884	large
question1616	1.067559398	large
question1355_3	1.067351172	large
question508	1.067263195	large
question334	1.06724725	large
question401	1.067142094	large
question1771_D	1.065020393	large
question328	1.064662468	large
question79_B	1.064575296	large
question415	1.06439311	large
question1747_D	1.064125915	large
question1166_E	1.064085222	large
question1734_E	1.06182773	large
question755_C	1.061221151	large
question1565_G	1.061036661	large
question1793_B	1.060794436	large

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question904_A	1.060383242	large
question1747_I	1.060062645	large
question720	1.059880971	large
question1565_F	1.059037904	large
question1885	1.058947029	large
question1859_B	1.058784198	large
question348	1.058546168	large
question616	1.058188299	large
question1870_C	1.056690048	large
question911_A	1.056251911	large
question85_C	1.055316837	large
question1279_M	1.054643768	large
question1936_B	1.053756916	large
question821	1.053467746	large
question656	1.052980902	large
question1891_C	1.052050566	large
question1936_E	1.051066106	large
question1578_C	1.050993728	large
question1506	1.049964519	large
question335	1.049944131	large
question909_H	1.049216211	large
question425	1.048401442	large
question661	1.047361429	large
question1744_G	1.047296791	large
question101	1.045018416	large
question1166_C	1.043298689	large
question1166_D	1.043298689	large
question1013	1.042815986	large
question572	1.041503138	large
question825	1.040520416	large
question100	1.040474055	large
question1739_B	1.038655304	large
question1079	1.038023717	large
question1166_F	1.037566185	large
question1845	1.037288275	large
question1952_H	1.037175024	large
question1929_H	1.037003006	large
question459_4	1.036653682	large
question770_2	1.035961038	large
question269	1.035781842	large
question84_E	1.035555515	large
question908_A	1.035263273	large
question1378	1.03472892	large
question96	1.034049583	large

Question	Effect size	Effect size class
question642	1.033942865	large
question1459_H	1.033845737	large
question1459_G	1.033594278	large
question754_H	1.032323396	large
question1866_C	1.032209492	large
question1036	1.029408956	large
question1434	1.028872358	large
question1874_J	1.02883991	large
question299_F	1.028759761	large
question1273	1.0284122	large
question1088	1.027941225	large
question1946_C	1.027533754	large
question1915_D	1.026642486	large
question915	1.026471228	large
question1703	1.02523791	large
question162	1.02499476	large
question1761_A	1.024814277	large
question1914	1.024690326	large
question1277_8	1.023541354	large
question921	1.023480309	large
question905_D	1.023315928	large
question1166_A	1.023059487	large
question1093	1.022112654	large
question903_E	1.021414668	large
question1747_C	1.019263035	large
question703	1.019129926	large
question312	1.017640417	large
question1303	1.017076517	large
question903_B	1.016810752	large
question1792_I	1.015502711	large
question1875_F	1.014560415	large
question1731_A	1.014554771	large
question84_B	1.014498341	large
question206	1.014052837	large
question1755_C	1.013443862	large
question1761_E	1.013240877	large
question1908_D	1.013010815	large
question1915_A	1.012507893	large
question1739_F	1.009911609	large
question1578_E	1.009448	large
question218	1.009306952	large
question431	1.009129832	large
question638	1.007828155	large
question1051	1.007566299	large

Question	Effect size	Effect size class
question177	1.007289523	large
question1824	1.006968445	large
question1573	1.006620852	large
question1374	1.005235793	large
question755_A	1.005148146	large
question1747_B	1.005062938	large
question319	1.003636358	large
question1867_C	1.002750155	large
question1889	1.002729903	large
question1429	1.001449122	large
question1740_E	1.00050423	large
question1952_G	0.99974755	large
question463_2	0.999271632	large
question1892_A	0.999038514	large
question624	0.998763374	large
question1462_G	0.998618002	large
question1950_C	0.998072432	large
question1460_28	0.997906619	large
question893	0.997876884	large
question1732_E	0.996923676	large
question1812_C	0.996323562	large
question1241	0.994712336	large
question1462_C	0.993589715	large
question905_C	0.993142663	large
question525	0.991118067	large
question701_2	0.990838726	large
question832	0.989927015	large
question863	0.989397131	large
question1938_D	0.987799191	large
question909_L	0.987728483	large
question699	0.987116486	large
question1808_F	0.986657065	large
question1946_A	0.985873031	large
question1866_B	0.983827247	large
question284	0.983528864	large
question1929_C	0.982125736	large
question1000	0.981905719	large
question602	0.980055131	large
question870	0.979808357	large
question281	0.979242886	large
question1792_F	0.979074068	large
question911_H	0.978829129	large
question1064	0.977728922	large
question1929_G	0.977520741	large

Question	Effect size	Effect size class
question785	0.977036855	large
question1738_A	0.976718196	large
question1541	0.9762407	large
question1808_G	0.97615528	large
question1189	0.975831723	large
question1915_C	0.973591612	large
question1290	0.973422854	large
question911_G	0.972313973	large
question1875_E	0.971945232	large
question1937_B	0.971688378	large
question744_3	0.970314833	large
question1095_1	0.970191116	large
question909_J	0.969909785	large
question1755_F	0.969528841	large
question1078	0.969200928	large
question669	0.969154521	large
question1938_F	0.969026403	large
question460_5	0.968711107	large
question912_B	0.968380563	large
question504	0.968247782	large
question754_G	0.9680513	large
question292	0.967786914	large
question1902_B	0.967355497	large
question1792_H	0.966976657	large
question1771_F	0.965783185	large
question1565_B	0.965252814	large
question1672	0.96380689	large
question1333	0.963339752	large
question429	0.962970228	large
question1723_B	0.962500025	large
question1879_B	0.962375788	large
question1929_I	0.960841657	large
question1868_A	0.960750953	large
question93	0.960683523	large
question1924	0.960174511	large
question1754_D	0.959656056	large
question1587	0.958488393	large
question1565_I	0.958089849	large
question1747_F	0.957623468	large
question472	0.957327107	large
question1747_E	0.957025035	large
question833	0.956458917	large
question1486_G	0.956088051	large
question910_F	0.955503727	large

Question	Effect size	Effect size class
question1865_C	0.954839194	large
question1612	0.95423886	large
question1514	0.952849755	large
question907_G	0.952663144	large
question998	0.951188779	large
question473	0.95068207	large
question1685	0.950506766	large
question752_H	0.94969235	large
question874	0.949307284	large
question1878_E	0.947934668	large
question1793_C	0.947057612	large
question828	0.946043374	large
question459_9	0.945004513	large
question192	0.944521794	large
question714	0.944255056	large
question1757_E	0.944045529	large
question1578_D	0.942935186	large
question1279_L	0.941575214	large
question682	0.941531866	large
question1351_L	0.941077211	large
question635	0.940745343	large
question1177	0.940525254	large
question1066	0.940077136	large
question1762_C	0.939993043	large
question752_L	0.939826231	large
question1754_A	0.939615121	large
question752_C	0.939463558	large
question903_G	0.939240816	large
question424	0.938411973	large
question1597	0.937971561	large
question1880_E	0.935850674	large
question1373	0.935837015	large
question435	0.935502115	large
question190_E	0.934878986	large
question1570	0.934819288	large
question185	0.934279133	large
question1939	0.93352606	large
question634	0.933450437	large
question1975_C	0.933246785	large
question1754_E	0.933108831	large
question648	0.932737959	large
question809	0.931905429	large
question459_3	0.931512638	large
question905_B	0.931158914	large

Question	Effect size	Effect size class
question1793_F	0.930424389	large
question997	0.930350486	large
question123	0.929703961	large
question402	0.929348406	large
question1033	0.929195784	large
question1537	0.928626193	large
question252	0.927970819	large
question673	0.92737272	large
question1975_I	0.92689291	large
question1209	0.92592269	large
question135	0.925403111	large
question765	0.92520325	large
question1855	0.924779495	large
question674	0.923899187	large
question1194	0.92263714	large
question1053	0.922533113	large
question213	0.922427976	large
question1933	0.922345275	large
question906_F	0.922035627	large
question690	0.92136592	large
question909_B	0.920985988	large
question1938_B	0.919782627	large
question925_E	0.919678832	large
question652	0.918442092	large
question752_K	0.91838183	large
question352	0.91817021	large
question399	0.91811904	large
question1259	0.917371946	large
question1424	0.916428942	large
question1929_F	0.915208605	large
question925_B	0.91510633	large
question1415	0.914505298	large
question911_B	0.913156269	large
question184	0.911826216	large
question1351_K	0.911526153	large
question238	0.911086339	large
question1810_F	0.909933939	large
question144	0.909863608	large
question198	0.908263062	large
question1754_B	0.908172874	large
question633	0.907898866	large
question1968_H	0.907224559	large
question459_2	0.90717407	large
question1414	0.906811117	large

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question851	0.906573668	large
question1762_A	0.90623854	large
question1421	0.906196916	large
question1711	0.90584839	large
question1735_C	0.905690992	large
question909_C	0.90565797	large
question1233	0.905261126	large
question231	0.904980718	large
question1725	0.903844502	large
question280	0.903604616	large
question595_C	0.903314227	large
question1880_A	0.903195056	large
question1449_M	0.901982062	large
question1722_B	0.901798271	large
question1925	0.901758572	large
question1777_H	0.901633867	large
question1345	0.899984281	large
question629	0.898428921	large
question906_E	0.897665523	large
question1756_B	0.896096271	large
question910_E	0.895501326	large
question824	0.895443668	large
question808	0.89398029	large
question1277_9	0.89314306	large
question1185_D	0.892850295	large
question830	0.892700673	large
question1461_F	0.892395807	large
question1897_F	0.892194021	large
question614	0.892164004	large
question1428	0.891680988	large
question734	0.890702324	large
question1735_H	0.890298745	large
question379	0.890133558	large
question1015	0.887446026	large
question752_G	0.887233237	large
question1880_B	0.886966453	large
question1915_F	0.886194084	large
question757_E	0.885567034	large
question318	0.8850878	large
question146	0.884801074	large
question750	0.884632531	large
question792	0.884284734	large
question758_A	0.884123912	large
question1278_3	0.883573864	large

Question	Effect size	Effect size class
question306	0.883475303	large
question196	0.882930903	large
question909_D	0.882587652	large
question1372	0.881566683	large
question79_F	0.881176453	large
question1878_A	0.880012497	large
question254	0.879575112	large
question517	0.878949838	large
question1459_E	0.878712615	large
question1466	0.877792585	large
question1755_D	0.877353644	large
question1744_B	0.876886785	large
question447	0.87502334	large
question1901_C	0.874668272	large
question1461_C	0.874385214	large
question442	0.874316006	large
question875	0.874064106	large
question277	0.873571906	large
question97	0.873396188	large
question741	0.873383267	large
question1462_N	0.871680487	large
question1874_I	0.870751525	large
question911_D	0.870270089	large
question337	0.870039972	large
question1460_29	0.869589391	large
question1975_E	0.869548917	large
question1744_F	0.868320496	large
question871	0.868125463	large
question1459_D	0.867683739	large
question1950_A	0.866197063	large
question454	0.864011273	large
question693	0.863862597	large
question1756_A	0.863473633	large
question1744_A	0.863321782	large
question1702	0.863198941	large
question910_G	0.862792237	large
question1462_M	0.862544525	large
question95	0.862024333	large
question460_10	0.861774065	large
question279	0.86096368	large
question644	0.860320696	large
question1019	0.860066886	large
question79_A	0.859834135	large
question1739_A	0.859137132	large

Question	Effect size	Effect size class
question167	0.858004835	large
question470	0.857867816	large
question147	0.857838209	large
question1910_D	0.857599724	large
question1588	0.857563273	large
question1723_A	0.857452122	large
question1489	0.857007947	large
question1929_E	0.856576401	large
question212	0.855994554	large
question1313	0.855966137	large
question1195	0.85569898	large
question1865_E	0.855308392	large
question754_E	0.855160408	large
question563	0.854768023	large
question1874_F	0.853743569	large
question1552	0.853461471	large
question1485_B	0.853327192	large
question1739_D	0.850648051	large
question131	0.850350099	large
question1621	0.849379044	large
question1937_D	0.849051362	large
question84_C	0.848959542	large
question1868_C	0.848947436	large
question908_L	0.84883877	large
question646	0.84859841	large
question1877_A	0.848345147	large
question460_9	0.84750602	large
question1881	0.847294142	large
question904_B	0.846902363	large
question1030	0.846400536	large
question1856	0.846099296	large
question701_3	0.845921001	large
question459_5	0.845640343	large
question914	0.845589614	large
question631	0.845509105	large
question731	0.845404051	large
question452	0.844045893	large
question1810_E	0.843647533	large
question769_2	0.843442157	large
question204	0.843239017	large
question1738_H	0.842777754	large
question1936_G	0.842701518	large
question1902_F	0.842127046	large
question1754_C	0.841696346	large

Question	Effect size	Effect size class
question1917_D	0.841654414	large
question805	0.840725733	large
question1532	0.840131957	large
question909_G	0.83932014	large
question1936_D	0.837225062	large
question1565_E	0.837135512	large
question906_A	0.836681092	large
question134	0.836170713	large
question1462_L	0.835167687	large
question659	0.834529432	large
question1874_B	0.834357748	large
question1166_B	0.833420421	large
question356	0.832514944	large
question483	0.831965886	large
question701_5	0.831864671	large
question1279_D	0.831415718	large
question171	0.831388131	large
question228	0.830469273	large
question256	0.829881239	large
question1184_E	0.828617373	large
question755_D	0.828467875	large
question1713	0.828415072	large
question1793_E	0.827688387	large
question241	0.826311446	large
question1790_E	0.825700427	large
question1279_B	0.825325014	large
question397	0.825190807	large
question613	0.824078237	large
question758_I	0.823340894	large
question1559	0.823265671	large
question1735_D	0.822941725	large
question636	0.821968395	large
question236	0.820719217	large
question1485_A	0.8203726	large
question178	0.820326054	large
question294	0.819894079	large
question1968_D	0.817825578	large
question413	0.817573964	large
question1237	0.814719735	large
question1031	0.814669065	large
question1891_A	0.814243	large
question605	0.813576643	large
question994	0.812631831	large
question428	0.81232337	large

Question	Effect size	Effect size class
question853	0.811822552	large
question118	0.810833933	large
question654	0.81034491	large
question904_H	0.810205029	large
question623	0.809728908	large
question1425	0.809291015	large
question1576	0.808856369	large
question604	0.808372026	large
question140	0.807115019	large
question912_D	0.805553181	large
question581	0.805421281	large
question763	0.80518635	large
question1502	0.804190892	large
question667	0.802487015	large
question778	0.802413156	large
question1461_L	0.802327816	large
question1790_A	0.802282231	large
question330	0.801779874	large
question1843	0.801248696	large
question311	0.801172157	large
question1184_F	0.800351092	large
question1186	0.800165067	large
question1247	0.800143432	large
question626	0.799780977	large
question157	0.799596956	large
question1937_E	0.799347123	large
question1044	0.796808369	large
question1499	0.793921665	large
question1790_D	0.792197029	large
question911_F	0.791205809	large
question916	0.791091412	large
question244	0.790695493	large
question1063	0.790294833	large
question1442	0.790147021	large
question909_I	0.790144445	large
question1946_E	0.789988693	large
question150	0.789605061	large
question903_I	0.788795171	large
question1760	0.78868902	large
question912_C	0.788542163	large
question752_I	0.787251882	large
question329	0.786411002	large
question1461_A	0.785223687	large
question1459_C	0.784025369	large

Question	Effect size	Effect size class
question1351_O	0.783932505	large
question619	0.783767213	large
question1731_J	0.782908756	large
question1461_G	0.782425232	large
question276	0.781981616	large
question757_I	0.781832944	large
question290	0.781334429	large
question400	0.780721799	large
question1565_H	0.780716308	large
question1739_C	0.780615815	large
question1574	0.78059071	large
question1744_C	0.779802639	large
question1735_A	0.779378785	large
question688	0.777485051	large
question1790_B	0.774071461	large
question1266	0.773180296	large
question758_C	0.772887248	large
question758_K	0.772704333	large
question1351_G	0.772611712	large
question1351_E	0.772247803	large
question223	0.771904911	large
question1679	0.771509009	large
question1305	0.770786803	large
question1590	0.770372164	large
question1738_G	0.770333591	large
question1524	0.770186801	large
question595_A	0.768495579	large
question924	0.768356619	large
question1426	0.765621765	large
question441	0.765566862	large
question1801_B	0.764480782	large
question752_J	0.764411084	large
question1880_F	0.764386542	large
question324	0.763352021	large
question1534	0.762738488	large
question1902_G	0.762663848	large
question1956	0.762510529	large
question1897_D	0.761060154	large
question1874_C	0.758281333	large
question239	0.757415922	large
question1769	0.756508089	large
question1529	0.755558557	large
question617	0.754310952	large
question1739_E	0.753738593	large

Question	Effect size	Effect size class
question1447	0.751697043	large
question1578_B	0.751688815	large
question555	0.751593573	large
question904_G	0.750378623	large
question1450_I	0.750010085	large
question744_4	0.746877985	medium
question176	0.746608645	medium
question1512	0.746453154	medium
question801	0.745953826	medium
question1568	0.745719905	medium
question1722_C	0.744234969	medium
question1464_D	0.744169301	medium
question913_C	0.743958003	medium
question707	0.743422946	medium
question913_D	0.74327548	medium
question463_3	0.742903206	medium
question1790_C	0.742462941	medium
question541	0.742392479	medium
question599	0.741891168	medium
question903_C	0.740862125	medium
question864	0.740569623	medium
question899	0.740505175	medium
question645	0.739881807	medium
question757_K	0.739257713	medium
question697	0.739148091	medium
question1566	0.738954798	medium
question660	0.738629427	medium
question1216	0.738553882	medium
question593_4	0.738434239	medium
question293	0.738238429	medium
question1950_B	0.738232395	medium
question701_4	0.738026216	medium
question566	0.736340713	medium
question1877_B	0.734893348	medium
question426	0.733321798	medium
question222	0.732338362	medium
question873	0.729277357	medium
question1922	0.728764699	medium
question694	0.728513274	medium
question1351_M	0.727619151	medium
question904_E	0.726754108	medium
question130	0.726319292	medium
question752_E	0.725846704	medium
question632	0.724795118	medium

Question	Effect size	Effect size class
question1917_F	0.72409749	medium
question593_2	0.724023377	medium
question411	0.723384381	medium
question923	0.72194096	medium
question1025	0.72176468	medium
question1793_D	0.721566314	medium
question913_F	0.721385666	medium
question595_G	0.720710764	medium
question1010	0.72062219	medium
question903_D	0.719570573	medium
question365	0.719260762	medium
question434	0.716951156	medium
question1874_D	0.716814101	medium
question1875_C	0.71671676	medium
question909_F	0.716580601	medium
question1907	0.716134361	medium
question289	0.715983103	medium
question1968_G	0.715735743	medium
question216	0.715181745	medium
question1316	0.715139318	medium
question1735_F	0.715137803	medium
question149	0.714595109	medium
question747	0.713432124	medium
question787	0.712867937	medium
question681	0.712533402	medium
question1267	0.712437782	medium
question462_8	0.711830371	medium
question1556_E	0.710717361	medium
question99	0.70971794	medium
question350	0.708255036	medium
question1278_8	0.706863827	medium
question1003	0.705792089	medium
question1867_E	0.705465616	medium
question744_5	0.705443839	medium
question380	0.70529256	medium
question738	0.705256565	medium
question1417	0.704356185	medium
question387	0.703660121	medium
question266	0.7016198	medium
question217	0.701515386	medium
question242	0.700250205	medium
question912_G	0.699034328	medium
question908_D	0.697900681	medium
question593_3	0.697831607	medium

Question	Effect size	Effect size class
question1229	0.69768562	medium
question908_K	0.696691962	medium
question321	0.696382054	medium
question98	0.695389994	medium
question288	0.694907518	medium
question1278_6	0.694819688	medium
question1023	0.694529198	medium
question597	0.694272892	medium
question459_6	0.693404587	medium
question388	0.692308389	medium
question868	0.691927849	medium
question327	0.691479797	medium
question1234	0.691413584	medium
question653	0.691319503	medium
question1812_E	0.691180985	medium
question1816_C	0.691003946	medium
question1462_F	0.690545691	medium
question1188	0.6905007	medium
question460_8	0.68976503	medium
question744_10	0.68949011	medium
question1355_4	0.689399948	medium
question1763	0.688838832	medium
question1020	0.688027637	medium
question115	0.687519638	medium
question1874_A	0.686580055	medium
question1430	0.686060798	medium
question1043	0.685583156	medium
question224	0.684446976	medium
question229	0.684445671	medium
question904_F	0.684196689	medium
question523	0.681389247	medium
question263	0.680999381	medium
question153	0.680316817	medium
question1734_G	0.680057787	medium
question662	0.679845901	medium
question193	0.679399027	medium
question219	0.678602985	medium
question283	0.678373176	medium
question358	0.678227115	medium
question1445	0.678017457	medium
question752_D	0.674794027	medium
question465	0.673566725	medium
question310	0.669498352	medium
question182	0.669119332	medium

Question	Effect size	Effect size class
question1351_N	0.668420299	medium
question462_9	0.668110579	medium
question126	0.667718886	medium
question655	0.666636321	medium
question90	0.666448922	medium
question1874_H	0.666040818	medium
question1321	0.665528288	medium
question166	0.665299364	medium
question603	0.665001176	medium
question852	0.664102307	medium
question1353_2	0.662358401	medium
question471	0.66213866	medium
question1752	0.661767943	medium
question1166_G	0.661063695	medium
question1755_A	0.660445275	medium
question1279_J	0.66035815	medium
question1354_4	0.660022394	medium
question993	0.659307638	medium
question905_E	0.657695157	medium
question156	0.657403376	medium
question620	0.656558792	medium
question403	0.656492197	medium
question1511	0.656251964	medium
question567	0.655620326	medium
question1571	0.655517495	medium
question1572	0.654210654	medium
question1583	0.652637597	medium
question547	0.651209133	medium
question1278_7	0.649264887	medium
question1040	0.648949261	medium
question460_7	0.648460782	medium
question1279_C	0.64727117	medium
question1738_D	0.64697271	medium
question666	0.645156613	medium
question1755_B	0.644968564	medium
question152	0.644251711	medium
question752_F	0.643595766	medium
question1242	0.643541821	medium
question1937_C	0.64311117	medium
question1444	0.641431722	medium
question622	0.640636668	medium
question463_4	0.640430162	medium
question908_G	0.639820057	medium
question168	0.639246248	medium

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question161	0.639118209	medium
question1762_F	0.639107088	medium
question1184_A	0.637772935	medium
question757_J	0.635336462	medium
question1203	0.633518736	medium
question848	0.631849639	medium
question1734_H	0.631619971	medium
question462_7	0.630516166	medium
question1775	0.630120869	medium
question595_H	0.628770899	medium
question407	0.628390476	medium
question917	0.627418676	medium
question1181	0.62738466	medium
question1513	0.627067578	medium
question1871	0.626752774	medium
question1096_4	0.626399455	medium
question569	0.625949889	medium
question856	0.624854298	medium
question1462_H	0.624655391	medium
question226	0.623498112	medium
question718	0.622907188	medium
question757_F	0.62236603	medium
question1753	0.621183585	medium
question460_6	0.620745826	medium
question757_H	0.61962023	medium
question904_D	0.618544422	medium
question593_5	0.616368275	medium
question1279_H	0.61631468	medium
question240	0.615613071	medium
question595_E	0.614911225	medium
question1024	0.614319434	medium
question127	0.613506274	medium
question1865_F	0.612514734	medium
question1416	0.611109402	medium
question1022	0.61038188	medium
question515	0.610000434	medium
question692	0.609500965	medium
question1868_F	0.608474088	medium
question278	0.606945058	medium
question1006	0.606420905	medium
question906_B	0.605734992	medium
question251	0.60568317	medium
question744_6	0.6050906	medium
question257	0.604384803	medium

Question	Effect size	Effect size class
question601	0.604351728	medium
question1486_C	0.603679674	medium
question889	0.603448533	medium
question1182	0.602722583	medium
question237	0.6009691	medium
question912_F	0.600592653	medium
question1809	0.600002767	medium
question713	0.597594737	medium
question904_I	0.59531532	medium
question1289	0.593374679	medium
question1950_H	0.59323315	medium
question1869_C	0.5920966	medium
question466	0.59188365	medium
question1859_D	0.591504431	medium
question450	0.591395305	medium
question1005	0.591281105	medium
question748	0.590152348	medium
question528	0.589756806	medium
question1522	0.588442855	medium
question918	0.586812748	medium
question253	0.585330862	medium
question596	0.58529495	medium
question1887	0.584180624	medium
question1419	0.583780994	medium
question913_B	0.583753835	medium
question695	0.583479994	medium
question1520	0.582700182	medium
question1176	0.582671796	medium
question897	0.579703557	medium
question227	0.578851462	medium
question1592_2	0.578466907	medium
question1807	0.578170518	medium
question758_J	0.576467192	medium
question761	0.576023909	medium
question1279_O	0.575173754	medium
question1076	0.574951082	medium
question1948	0.57383355	medium
question1485_C	0.573210971	medium
question1462_B	0.569427306	medium
question845	0.569372015	medium
question1007	0.568948361	medium
question701_6	0.568193006	medium
question440	0.568122013	medium
question1278_5	0.567382577	medium

Question	Effect size	Effect size class
question911_C	0.566889968	medium
question1017	0.566091151	medium
question749	0.56574908	medium
question463_6	0.562339835	medium
question1857	0.562020648	medium
question576	0.560506232	medium
question1738_B	0.560428533	medium
question913_G	0.56018555	medium
question705	0.559801608	medium
question702	0.559794632	medium
question323	0.558886296	medium
question600	0.55715629	medium
question1284	0.555178573	medium
question1314	0.554678605	medium
question1738_F	0.550387396	medium
question128	0.549157663	medium
question221	0.547716442	medium
question1839	0.547505607	medium
question758_E	0.546482134	medium
question142	0.54563076	medium
question640	0.543106019	medium
question1584	0.542944962	medium
question789	0.542723237	medium
question861	0.542353417	medium
question158	0.542245273	medium
question742	0.538977637	medium
question1606	0.533421602	medium
question1270	0.532575969	medium
question593_6	0.5324095	medium
question1008	0.531371796	medium
question901	0.527909947	medium
question606	0.525558142	medium
question876	0.525557502	medium
question913_E	0.522349767	medium
question1916_A	0.522190785	medium
question898	0.515725892	medium
question1801_D	0.514114125	medium
question433	0.512952389	medium
question664	0.512327852	medium
question250	0.511573176	medium
question463_5	0.511480268	medium
question696	0.509685072	medium
question1507	0.508665733	medium
question1351_F	0.507612105	medium

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question1278_4	0.507588548	medium
question817	0.507035096	medium
question663	0.505301837	medium
question230	0.505279998	medium
question857	0.503950144	medium
question687	0.503083865	medium
question675	0.50114488	medium
question837	0.498958795	medium
question1772	0.498925875	medium
question892	0.498585503	medium
question1509	0.498170271	medium
question887	0.496389461	medium
question598	0.495538636	medium
question1418	0.495332988	medium
question210	0.495243837	medium
question459_7	0.494570854	medium
question1279_I	0.490844049	medium
question758_G	0.490813501	medium
question1762_B	0.489837244	medium
question1936_F	0.486864374	medium
question1505	0.48589393	medium
question1966_E	0.484278044	medium
question1727	0.484004177	medium
question586	0.483992726	medium
question1675	0.483626754	medium
question1028	0.480864561	medium
question1029	0.480132405	medium
question758_L	0.480010181	medium
question905_G	0.479437187	medium
question772	0.478213256	medium
question1490	0.478043939	medium
question859	0.476750178	medium
question1920	0.47645131	medium
question479	0.474791523	medium
question448	0.47441876	medium
question758_D	0.474396471	medium
question116	0.473685373	medium
question912_E	0.472011704	medium
question463_7	0.471944397	medium
question420	0.470015857	medium
question639	0.469370246	medium
question439	0.466516973	medium
question197	0.46641498	medium
question1575	0.466118416	medium

Question	Effect size	Effect size class
question907_D	0.464488888	medium
question1279_K	0.462829569	medium
question571	0.46045098	medium
question803	0.459584259	medium
question1260	0.459055621	medium
question1486_E	0.455922641	medium
question758_F	0.453237898	medium
question194	0.452584591	medium
question209	0.452192416	medium
question770_1	0.451203895	medium
question609	0.450851428	medium
question570	0.450681862	medium
question925_J	0.449785204	medium
question1279_N	0.44796276	medium
question1927_A	0.44788883	medium
question1042	0.44663027	medium
question1185_A	0.445627892	medium
question589_7	0.444625761	medium
question589_8	0.444625761	medium
question1902_E	0.441889442	medium
question1375	0.43964736	medium
question573	0.436361211	medium
question1225	0.436279708	medium
question637	0.433941937	medium
question708	0.430440916	medium
question446	0.430091923	medium
question906_C	0.428518384	medium
question1485_D	0.421589026	medium
question314	0.421019273	medium
question768	0.420719414	medium
question1761_C	0.420409474	medium
question1231	0.419763689	medium
question1771_C	0.419690487	medium
question559	0.419272902	medium
question925_I	0.418802236	medium
question676	0.415881964	medium
question1094_2	0.415854565	medium
question1208	0.415771724	medium
question744_7	0.41446879	medium
question143	0.413865575	medium
question715	0.410339898	medium
question170	0.410312285	medium
question259	0.409899027	medium
question685	0.409442985	medium

Question	Effect size	Effect size class
question1916_B	0.406662174	medium
question610	0.405329476	medium
question744_8	0.403089121	medium
question463_8	0.402916846	medium
question1427	0.401317216	medium
question1027	0.400948041	medium
question710	0.399518068	small
question187	0.398132333	small
question1801_E	0.397589845	small
question802	0.396775129	small
question175	0.396458815	small
question862	0.396081567	small
question643	0.395876109	small
question1771_E	0.395841858	small
question1943	0.395676214	small
question826	0.39463299	small
question908_I	0.391912285	small
question1902_A	0.388103199	small
question1927_C	0.384374773	small
question449	0.382319593	small
question307	0.378612648	small
question1376	0.377855626	small
question593_11	0.377708732	small
question129	0.37454843	small
question1771_B	0.37046768	small
question593_7	0.369959046	small
question309	0.366716214	small
question593_8	0.362853791	small
question1589	0.361454603	small
question1248	0.359332932	small
question860	0.358486489	small
question1095_2	0.358432264	small
question285	0.357539516	small
question423	0.354528517	small
question1269	0.351395791	small
question1175	0.351310397	small
question1351_B	0.351047599	small
question183	0.350031709	small
question1515	0.349426309	small
question145	0.348821447	small
question148	0.348168175	small
question1582	0.347420049	small
question1555	0.34499212	small
question564	0.344320276	small

Question	Effect size	Effect size class
question1530	0.342209159	small
question264	0.342134101	small
question1038	0.340850842	small
question120	0.339875434	small
question807	0.339648306	small
question1519	0.337917024	small
question1279_F	0.336830635	small
question502	0.331447255	small
question155	0.327632496	small
question463_9	0.327462332	small
question593_9	0.322314376	small
question894	0.321744881	small
question1476	0.320762602	small
question302	0.319267239	small
question481	0.316364781	small
question1274	0.314683886	small
question455	0.31465913	small
question1801_F	0.314425296	small
question468	0.314145268	small
question769_1	0.305322009	small
question1531	0.300909123	small
question1896	0.299164371	small
question1353_3	0.296176281	small
question1307	0.29510548	small
question1503	0.292962339	small
question1494	0.28808804	small
question326	0.287461585	small
question1952_B	0.287225515	small
question1279_A	0.284262507	small
question1213	0.282088645	small
question303	0.281830807	small
question409	0.276885546	small
question1016	0.273455836	small
question758_H	0.272723802	small
question125	0.270544621	small
question920	0.269752731	small
question904_C	0.267019242	small
question1344	0.255460373	small
question1325	0.251620846	small
question1592_3	0.250143333	small
question1955	0.249647197	small
question568	0.248175616	small
question744_9	0.24737709	small
question1255	0.241429313	small

Question	Effect size	Effect size class
question855	0.241364516	small
question1558	0.235634204	small
question1457	0.234492656	small
question549	0.23383097	small
question220	0.233534335	small
question880	0.226635141	small
question908_F	0.225452206	small
question895	0.222186422	small
question1329	0.221214554	small
question757_C	0.217313414	small
question1801_C	0.211810167	small
question1436	0.207129302	small
question1525	0.204984498	small
question1771_A	0.200906998	small
question521	0.199910571	small
question1516	0.195554698	small
question574	0.187903156	small
question593_12	0.18508547	small
question650	0.173571055	small
question1272	0.169685344	small
question593_10	0.164100772	small
question317	0.163623983	small
question1521	0.16188039	small
question287	0.160734893	small
question587	0.157150265	small
question477	0.154806839	small
question1486_B	0.145013845	negligible
question1738_E	0.144384427	negligible
question1801_A	0.128959313	negligible
question888	0.110294202	negligible
question1018	0.108159302	negligible
question891	0.106652636	negligible
question905_F	0.102811385	negligible
question1239	0.102647065	negligible
question1311	0.099929487	negligible
question589_9	0.09918551	negligible
question627	0.097164675	negligible
question1700_2	0.090806113	negligible
question1035	0.090206294	negligible
question665	0.088237897	negligible
question740	0.087464226	negligible
question1563	0.078649263	negligible
question890	0.078317905	negligible
question680	0.075036508	negligible

<b>Question</b>	<b>Effect size</b>	<b>Effect size class</b>
question475	0.062794842	negligible
question436	0.048293725	negligible
question1527	0.045911873	negligible
question1594	0.03952377	negligible
question758_B	0.03350863	negligible
question879	0.029573991	negligible
question716	0.026191428	negligible
question902	0.025451757	negligible
question1317	0.017396716	negligible
question1285	0.015581164	negligible
question1897_C	0.013372766	negligible
question883	0.001150138	negligible