STRATEGIC BUSINESS LEVERS FOR BILATERAL DEFENCE TECHNOLOGY AND INDUSTRIAL PARTNERSHIPS BETWEEN SOUTH AFRICA AND BRIC STATES

A Thesis

Presented to the Faculty of Military Science
University of Stellenbosch

In conformity with the requirements
for the degree of Master in Military Science

by

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Supervisor: Cdr Dr K.I. Theletsane

DECLARATION

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ABSTRACT

The South African Defence Technology and Industrial Sector (SA DTIS) can be considered central to the defence and security complex, economic growth, new technology development and foreign policy of South Africa. Yet, the SA DTIS is in disrepair due to economic pressure and global defence technology and industrial market dynamics, fuelling perceptions that the SA DTIS (typically the State Owned Enterprises) is an economic, defence and security liability. Reversing this situation, from a BRICS perspective, requires a detailed understanding of the prevailing strategic defence technology and industrial business environment, policy approaches and strategic business levers used and preferred internationally and amongst the BRICS States to unlock relationship building and capability development thrust. As such, the National Development Plan (NDP) 2030 called for research on BRICS partnership building. Thus, this thesis focuses on BRICS DTIS bilateral relations, specifically - *which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States?* A qualitative research methodology and case study research approach/design, calibrated by a relativist worldview and social constructivist paradigm, was used to render rich description. Using questionnaires (open-ended inquiry) allowed eighteen DTIS-related experts participation in the study and rigour to the findings of the thesis.

The SA DTIS role in the BRICS DTIS ecosystem is described as being a gateway to the African DTIS market segments and a possible collaboration - and supply chain partner for niche technologies-, product systems- and integration services development. Bilateral collaboration was found to be the preferred level of inclusion, based on the discretionary and securitised nature of each DTIS. In the quest for self-sufficiency and/or domination, the strategic motive for bilateral DTIS collaboration is to attain competitive/comparative advantage within a competitive timeframe. The crystallisation of bilateral DTIS partnerships from multilateral alliances such as BRICS is calibrated significantly by the level of asymmetry between prospective partners, national interest, the quest for foreign policy flexibility and military autonomy, national DTIS policy objectives, technology and products niches, and preference for strategic business levers. BRICS States were found to all subscribe to liberal (at least a hybrid) DTIS development approach that allows for a dynamic mix of the facets mentioned above.

Within these dynamics possible drivers of bilateral partnerships are the adoption of an idealist approach and liberal/hybrid DTIS policy, continuous investment in the DTIS and militaries, nurturing Tier 1 and/or 2 industrial capabilities, promoting the use of strategic business levers (joint ventures (JVs), technology transfer, foreign direct investment and mergers and acquisitions), recognising the role of Government in developing the DTIS, overlapping market segments, respect for Intellectual Property Rights (IPR), amongst others. BRICS DTISs share the ambition to be self-sufficient. Some are ambitious to be dominant also. These drivers and ambitions provide short- to medium-term SA DTIS collaboration development opportunities in the quest for BRIC self-sufficiency/dominance ambitions. Bilateral partnerships barriers relates to asymmetry, differences in approaches to arms control and associated governance, funding asymmetries, a gradually deteriorating SA DTIS contrasted by a rapidly developing BRIC DTISs, divergent national policy frameworks, the short-term nature of SA DTIS opportunities, abuses of IPR (typically China) – all problematic considering the current state of the South African economy and its DTIS.

In the short- to medium-term JVs attracted preference as a strategic business lever for bilateral BRICS DTIS partnerships - primarily with Brazil and India. This said, it should not be assumed that bilateral DTIS partnerships between South Africa and the individual BRIC States will be mutually beneficial, no matter the strategic business levers employed, due to the complexity of international DTIS collaboration.

Key Words: BRICS, South African Defence Industry, Defence Industry.

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LIST OF ABBREVIATIONS AND ACRONYMS

A&D	Aerospace and Defence
AMD	Aerospace, Maritime and Defence
ARMSCOR	Armament Corporation of South Africa
ATT	Arms Trade Treaty
AVIC	Aviation Industry Corporation of China
BRI	Belt and Road Initiative
BRIC	Brazil, Russia, India and China
BRICS	Brazil, Russia, India, China and South Africa
CAATSA	Countering America's Adversaries through Sanctions Act 2017
CAGR	Compound Annual Growth Rate
CASC	China Aerospace Science and Technology Corporation
CASIC	China Aerospace Science and Industry Corporation
CETC	China Electronics Technology Enterprise
CMI	Civil-military Integration
CSGC	China South Industries Group Corporation
CSIC	China Shipbuilding Industry Corporation
CSSC	China State Shipbuilding Corporation
C SANDF	Chief of the South African National Defence Force
CSF	Critical Success Factor
CSIR	Council for Scientific and Industrial Research
DDIS 2017	Draft Defence Industry Strategy 2017
Def Com	Defence Committee
DOD	Department of Defence
DR 2015	South African Defence Review 2015
DTIB	Defence Technology and Industrial Base
DTIS	Defence Technology and Industrial Sector
ECM	Electronic Counter Measures
EU	European Union
EW	Electronic Warfare
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
G-to-G	Government-to-Government
I-to-I	Industry-to-Industry
IBSA	India, Brazil, South Africa
IC	Intellectual Capital
ICT	Information and Communication Technology
IDZ	Industrial Development Zones
IoT	Internet of Things
IP	Intellectual Property
IPR	Intellectual Property Rights
IT	Information Technology
JV	Joint Ventures
KSA	Kingdom of Saudi Arabia
M&A	Mergers and Acquisitions
MOD	Minister of Defence
MOD&MV	Minister of Defence and Military Veterans
MOR	Mixed-Ownership Reform
MRO	Maintenance, Repair and Overhaul
NDP	National Development Plan
NORINCO	China North Industries Group Corporation
OEM	Original Equipment Manufactures
ORBAT	Order of Battle
PEPCOM	Planejamento Estratégico de Promoção Comercial
PLA	Peoples Liberation Army (of the PRC)

PNEMEM	[Brazil] National Export Policy for Military Equipment
PRC	Peoples Republic of China
PRQ	Primary Research Question
PWC	PriceWaterhouseCoopers
R&D	Research and Development
RDM	Rheinmetall Denel Munition
RSA	Republic of South Africa
SA	South Africa
SA DOD	South African Department of Defence
SADC	South African Development Community
SADI	South African Defence Industry
SA DTIS	South African Defence Technology and Industrial Sector
SANDF	South African National Defence Force
Sec Def	Secretary for Defence
SIPRI	Stockholm International Peace Research Institute
SRQ	Secondary Research Question
SET	Science, Engineering and Technology
SEZ	Special Economic Zones
SOC	State Owned Company
SOE	State Owned Enterprises
SPF	(South African) Strategic Planning Framework
SRQ	Secondary Research Question
UAE	United Arab Emirates
UAV	Unmanned Aerial Vehicles
UNROCA	United Nations Register of Conventional Arms
UK	United Kingdom
USA	United States of America
4^{th} IR	4^{th} Industrial Revolution

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

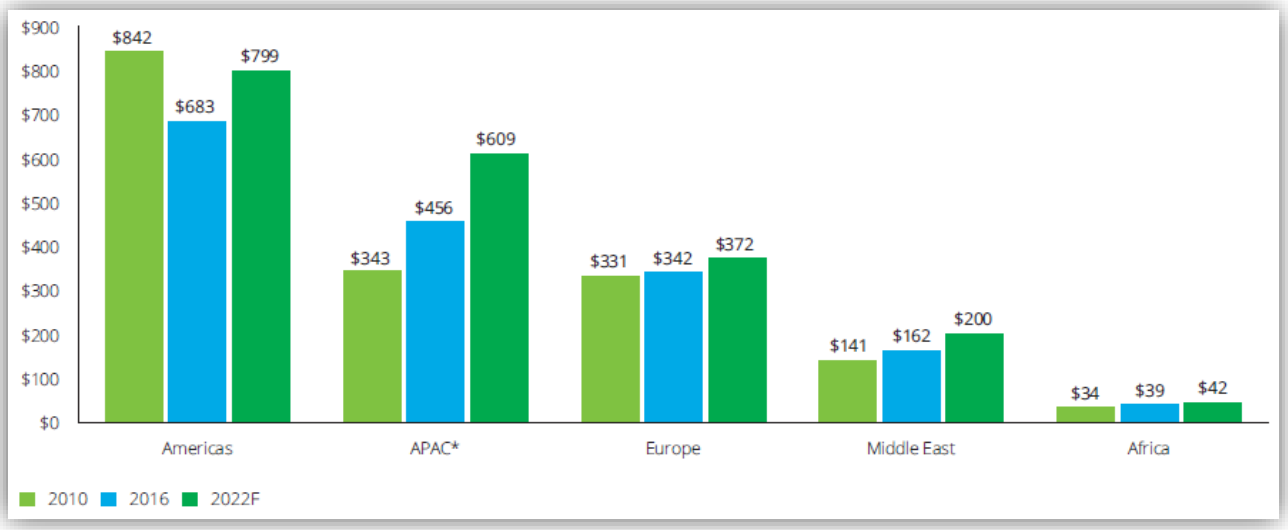
Change is everywhere – in new technologies and automation, in new markets and sectors, in new business models and connected platforms – and it is creating significant new opportunities for [DTIS] players around the world (Gates, Mayor & Gampenrieder, 2016: 1).

1.1 BACKGROUND

The international Defence Technology and Industrial Sector (DTIS) and its associated market, was the industry growth front runner in 2017 (Bret, 2017; Lineberger & Hussain, 2018a). Defence budgets and DTIS growth are closely linked (Verrue (2009). "The global aerospace & defense market[1] had total revenues of $865.6bn in 2016, representing a compound annual growth rate (CAGR) of 2.2% between 2012 and 2016. … Defense spending has increased in some countries, but for the most part developed economies have been neglecting the military budgets due to budget constraints." (MarketLine, 2018). However, emerging economies such as India and China showed increases in defence spending (Lineberger & Hussain, 2018a) and thus their DTIS is also expanding.

The international defence sector revenue growth projection is estimated at 3.6% on the back of international defence and security challenges and pursuance of national interest, thus boosting positive projections about international defence spending increases internationally up to 3% CAGR over the period 2017-2022 (Lineberger & Hussain, 2018b). The global military expenditure trends are captured by the graph in Figure 1.1, clearly showing the relative positions of the various regions and the rising defence industrial tiger on the Asian continent.

Figure 1.1: Regional Military Expenditure (US$ billion)



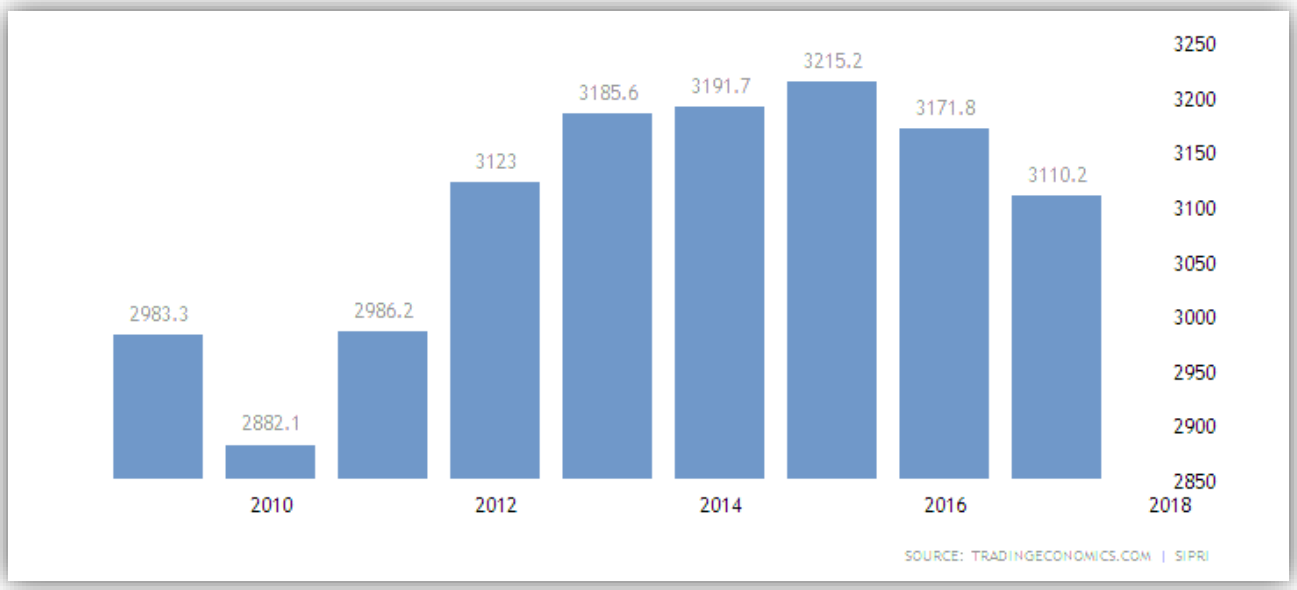
Source: Lineberger and Hussain (2018: 14)

[1] See comparison between A&D industry, defence sector, arms industry and DTIB in chapter 2 of the thesis.

With Russia, India and China included in the Asia region and in the BRICS alliance, there are clear opportunities for the South African Defence Technology and Industrial Sector (SA DTIS)[2] to establish bilateral cooperation with the BRIC States. Although not stated specifically for the BRICS States, bilateral partnerships are the preferred strategic relationship building according to the National Development Plan 2030 – "South Africa will have to develop strategic relationships across the continent and further afield. This will depend on trade negotiating capabilities, as well as the ability to leverage project finance for regional investments. Bilateral agreements are crucial." (South Africa, 2012: 129).

Within this context of projected defence sector market growth, the South Africa defence industrial sector continues to struggle because of declining SA military expenditure (Trading Economics, 2019). "Despite military expenditure increasing in sub-Saharan Africa, SIPRI found that South Africa has also seen a decrease in military expenditure." (BusinessTech, 2018). Defence spending has been on the decline since 2016 as a continuous trend.

Figure 1.2: South African Military Expenditure



Source: Trading Economics (2019)

Yet, global defence spending is increasing - "… defense spending is shifting rather than declining outright. Growth is uncertain but achievable." (Dowdy & Oakes, 2015). Within the emerging market segment, the A&DTIS projection is posited to be as follows – "… China is the leading country among the top five emerging nations, with market revenues of $97,761.1 million in 2016. This was followed by India and Brazil with a value of $27,493.9 and $9,159.9 million, respectively. … China is expected to lead the aerospace and defense industry in the top five emerging nations, with a value of $1,68,479.5 million in 2021, followed by India and Brazil with expected values of $48,048.5 and $10,820.2 million,

[2] See theoretical framework in chapter 2 of the thesis for an explanation on the use of Defence Technology and Industrial Sector (DTIS).

respectively." (MarketLine, 2018). These market values are typically driven by the fact that BRIC falls within the top 25 countries according to military expenditure for 2016. Russia (4.3%), India (2.5%) and China (1.9%) also feature in the list of top military spenders as a percentage of Gross Domestic Product (GDP) (Lineberger & Hussain, 2018b: 7). This is very favourable for the SA DTIS to capitalise on, that is, if business strategies could be identified that are relevant to the international defence business trends projected for the medium-term.

The aim of this thesis is to explore what strategic business levers are trending in the international defence technology and industrial business environment that could be considered by the SA DTIS in order to capitalise on the projected growth in the defence market over the medium-term. South Africa is part of the BRICS economic alliance. BRICS is an economic alliance with the mandate and objectives expressed on at the 10th BRICS Summit. Several principles are named in the Summit paper that express how cooperation could be achieved. No mention is made of the militaries and the DTISs of the partner States - but they are also not explicitly excluded. (BRICS, 2018). The BRICS alliance aims at multi-literalism. However, within the DTIS context, bilateral cooperation will probably be the order of the day due to security and trust concerns when it comes to defence matters and national security.

The thesis will assist with analysis and recommendations regarding which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and BRIC (Brazil, Russia, India, China) States. This research will describe the current international defence industrial landscape as well as what strategic business levers are pertinent currently. The research will then narrow the focus to the BRICS partner states. In terms of the larger stock of knowledge about the defence industry market landscape, the research will assume a protagonist disposition, endeavouring to inform the subject community about what the SA DTIS could possibly contribute (*vis-à-vis* what the SA DTIS is failing at) within bilateral defence technology and industrial partnerships with the BRIC States and which strategic levers could be considered by the SA DTIS to better facilitate these partnerships.

1.2 THE PROBLEM STATEMENT

The SA DTIS's capacity to contribute to SA national security as an instrument for economic growth and military requirements is possibly limited by an awareness deficit, evident from the limited amount of published material, on strategic business levers preferred by the BRICS States for the purpose of DTIS cooperation. As such, the National Development Plan 2030 express the urgent requirement for research on matters concerning BRICS partnership building. (South Africa, 2012: 241). There is thus an existing national policy requirement (since 2012) for research on matters concerning BRICS partnerships. However, what is concerning is the expressive void in the NDP 2030 on matters concerning the SA DTIS and which possible strategic business levers would be prudent for the future development and relations building between the SA DTIS and those of BRIC States. Thus the question - *which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States?*

The SA DTIS can be considered central to the SA defence and security complex, economic growth, new technology development and foreign policy. (South Africa, 2017a; NDIC, 2018). Yet, this South African economic sector is barely profitable, fuelling perceptions (from a BRICS multilateral perspective) that the SA DTIS has very little to offer economically and/or defence and security. The continuous renewal and development of the SA DTIS capabilities require a clear understanding of the prevailing strategic defence technology and industrial business environment, policy approaches and the strategic business levers in use and preferred amongst the BRICS States to unlock relationship building and provide thrust to capability development. This thesis will focus on bilateral relations between the SA DTIS and the BRIC States as part of the stated NDP 2030 national policy objective for research into BRICS partnership building.

1.3 CONTEXTUALISING THE PROBLEM STATEMENT

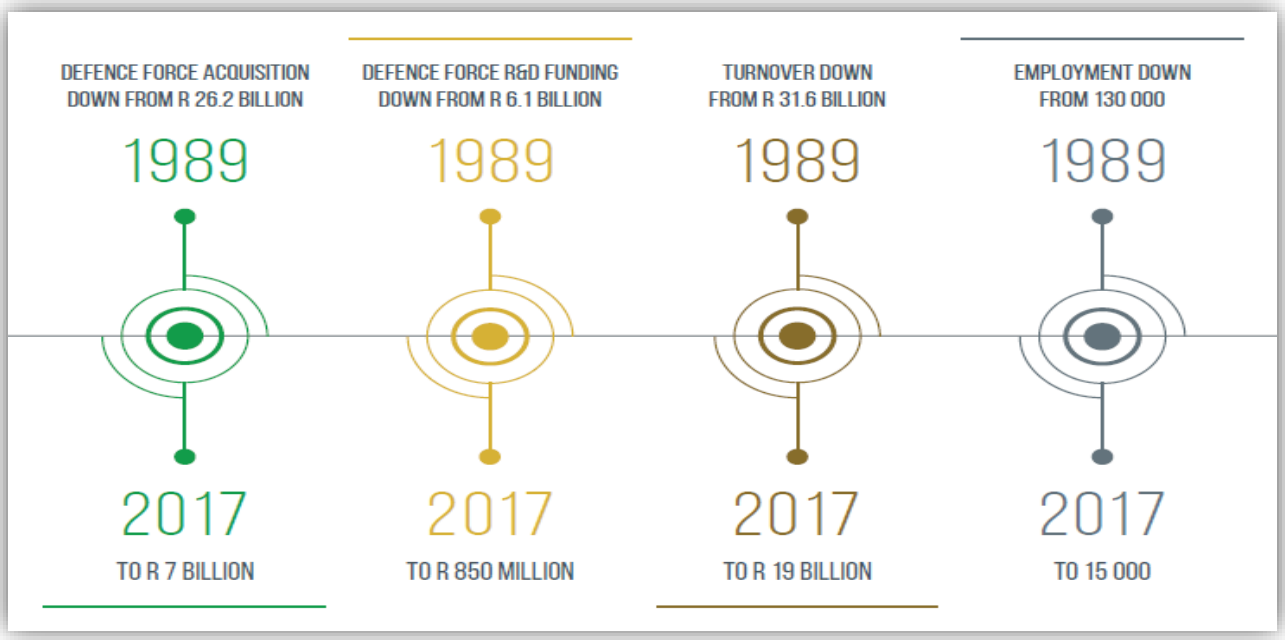
The SA DTIS has experienced significant investment and development challenges over the past decade to the extent that the Minister of Defence and Military Veterans (MOD&MV) established a National Defence Industry Council (NDIC) on 3 March 2016 (NDIC Booklet, 2018: 6) to manage the complex national requirements for defence technology and industrial performance and competitiveness. The importance of the RSA Defence Sector was outlined in a speech by President Ramaphosa at Africa Air and Defence (AAD) 2018 stating that – “For both security and development reasons, South Africa is looking after its defence industry, which is not only viewed as a Department of Defence asset. It is a national asset that has value for many departments and agencies of government. … The industry is an important employer providing 15 000 direct jobs in 120 companies. It is an incubator of our scare skills in science, technology, engineering [SET] and mathematics.” (defenceWeb, 2018b). He further commented on the value of the engineers working in this industry to the broader RSA economy. Also, the SA DTIS is regarded as an investment destination with – “unique factors”. (defenceWeb, 2018). DTIS capabilities are perceived as enablers of foreign policy when considering the opinion of Pierre in Avila, de Souza and Guedes (2017: online) – “Arms sales are a barometer of politics among nations. … Arms sales are far more than an economic occurrence, a military relationship, or an arms control challenge; arms sales are foreign policy writ large.”

Frolov (2017) writes, from a Russian perspective, that the DTIS is central to the political system, international ambition, security, sovereignty, autonomy and a primary lever for technological innovation and the associated development. Bret (2017) states that Russia reinforces its geopolitical relations by means of the arms trade (import and export). Thus the importance of a relevant SA DTIS because of its central role in South Africa and within the BRICS economic alliance. The question remains what defence technology and industrial policy, approaches and business levers could make bilateral cooperation possible between the SA DTIS and the BRIC States.

This said, the SA DTIS showed an estimated decrease of R12bn turnover and shedding an estimated 115,000 employees over the period 1990-2017 (BusinessTech, 2017; defenceWeb, 2018). Illustrating a probable correlation between defence spending and defence technology and industrial

capability; the Draft Defence Industry Strategy 2017 (DDIS 2017) (open for public comment) and echoed in the NDIC Booklet 2018, a defence and defence technology and industrial capability spiralling towards capability and capacities are last seen in the 1950s-1960s (as discussed in Chapter 3 of the thesis) – consider Figure 1.3 for these estimations –

Figure 1.3: Diminished SA DTIS Capacity



Source: NDIC Booklet (NDIC, 2018: 24) and DDIS 2017 (2017: 5 and 7).

A commensurate and considerable chasm is also developing between the SANDF operational commitments since 2001 and the ability of the SANDF to maintain and modernise its military capabilities – cycling back to a continuously deteriorating SA DTIS. The capacity of the SA DTIS dwindled (notwithstanding the financial quandary) to only an estimated "… 15 000 employees in some 120 companies", down from "… some 130 000 employees in 3 000 companies in 1990 (9% of manufacturing employment and 10% of manufacturing companies)". (South Africa, 2017a: 7; NDIC, 2018: 24).

Resulting from this decline outlined above is a diminishing national security defence capability and gradually increasing national security risk because of the increased exposure to reliance on foreign defence matériel suppliers of technology, equipment, software, logistics, and maintenance and repair capabilities. The situation gradually erodes South Africa's ability to contribute as a strategic defence technology and industrial partner to BRICS as well as increasing South African strategic dependence on the BRIC States.

Closing with a statement from the NDIC Booklet 2018 – "The priority must, therefore, be to prevent further decline, and the fundamental concept underlying this strategy is, thus, to - Secure and stabilise existing capabilities and capacities; Sustain those capabilities and capacities; and then Revitalise the industry, restoring it to its past position as a major innovative actor in the international defence sector. To be a "major innovative actor" within BRICS it is important to understand the

strategic business environment and business levers that could be employed to facilitate access to the BRIC defence technology and industrial capabilities and associated markets. (NDIC, 2018: 25).

1.4 AIM OF THE STUDY

The aim of this research is to identify and recommend possible strategic business levers which could assist in establishing SA DTIS bilateral defence technology and industrial partnerships with BRIC countries.

1.5 RESEARCH OBJECTIVES

The research objectives of this thesis, alluded to in the problem statement, was distilled from the research requirements stated in the NDP 2030. (South Africa, 2012). As such, research is required in the area of defence and thus by implication also the SA DTIS (amongst other areas proposed) as well as the "Identification of a set of strategic thrusts, including Cooperation within BRICS in identified areas of mutual and measurable benefit." (South Africa, 2012: 241). These areas for cooperation are based on the national policy objective to - "Deepen integration with Brazil, Russia, India and China as part of the BRICS group, while still promoting regional and global cooperation." (South Africa, 2012: 243).

Thus, the primary research objective is to establish which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States. Secondary to this objective are the following objectives:

- To establish what the theoretical strategic motive(s) is that make bilateral DTIS cooperation attractive.
- To establish what international DTIS facets are shaping the defence technology and industrial strategic business landscape that can be conceptualised as drivers (or barriers) to possible bilateral partnerships.
- To establish which strategic business levers are used by the DTIS of BRICS States and to what end? This aims at understanding how the BRICS States strategise to achieve their objectives. It should provide a picture of what is required and what could possibly hamper possible bilateral DTIS cooperation.
- To describe how and what the SA DTIS could contribute to the achievement of bilateral strategic objectives, using bilateral defence technology and industrial partnerships with the BRIC States. This would conclude the findings of the thesis on which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States.

1.6 RESEARCH QUESTIONS

1.6.1 Primary Research Question

To achieve the objective of this research the following Primary Research Question (PRQ) will be asked: *Which strategic business levers are prudent to establish bilateral defence technology and*

industrial partnerships between South Africa and the BRIC States? Answering this question is contingent on understanding what the BRICS DTISs consist of (context), what is the preference for inclusive relations (i.e. bi- and/or multilateral), is there a need for relationship building (motive), what strategic levers are preferred and what does the portfolio of products/services consist of that can be levered? In order to understand these aspects better four secondary research questions were asked.

1.6.2 Secondary Research Questions

In order to answer the PRQ the following Secondary Research Questions (SRQ) are asked:

- *SRQ 1: What is the theoretical strategic motive(s) that inform (bilateral) defence technology and industrial partnerships?* This question was largely answered by the literature reviews in Chapters 2 and 3.
- *SRQ 2: What international DTIS facets are shaping the defence technology and industrial strategic business landscape that can be conceptualised as drivers (or barriers) to possible bilateral partnerships?* This question was largely answered by the literature reviews in Chapters 2.
- *SRQ 3: Which strategic business levers are used by the DTIS of BRICS States and to what end?* This question was largely answered by the literature reviews in Chapters 3.
- *SRQ 4: How and what can the SA DTIS contribute to the achievement of bilateral strategic objectives, using bilateral defence technology and industrial partnerships with the BRIC States?* This question was largely answered by the literature reviews in Chapters 3 and 5.

Four research questions for the collection of primary data were formulated to expand on the findings of the literature studies (Chapters 2 and 3 of the thesis) after their conclusion. Closely related to the SRQs, the following amplifying questions were posed to the participants -

- What role can the South African defence technology and industrial sector play in the BRICS defence technology and industrial sector?
- What would be the preferred type of strategic cooperation – bilateral or multilateral, and why?
- Which strategic business levers (e.g. technology transfer, mergers & acquisitions, foreign direct investments, joint ventures, partnerships, etc.) would be prudent for consideration to establish future bilateral defence technology and industrial partnerships between South Africa and the BRIC States – and possible reasons for this?
- What are the market niches/capabilities/products/services/technology/IP that the South African defence technology and industrial sector can contribute to establishing/enhance possible role(s) in the BRICS defence technology and industrial capability?

The data collected based on the four SRQ and four related questions to the participants in the research provided a rich mix of primary and secondary data with which the researcher can confidently construct findings that calibrate a possible role (or not) for the SA DTIS in the BRICS multilateral alliance.

1.7 SIGNIFICANCE OF THE RESEARCH

Understanding the strategic fundamentals that drive a particular business sector is crucial for economic growth within that sector. Defence technology and industrial sectors are no different. Business within DTIS, however, are not 'business as usual' due to the specific demand and supply regimes and chains within these sectors and the fact that they have an immense impact on national security. These industries are also invariably on the cutting edge of technology and thus impact national Science, Engineering and Technology (SET) capacities.

1.8 THE RESEARCHER

The researcher is an appointed SA DOD Senior Staff Officer working at the Secretariat for Defence within Defence Matériel Division. The researcher has been working within this unique DOD Division since 2003. The period cover events such as the delivery of the first SA Navy Frigates from Germany, the development and approval of the SA Defence Review 2015 (DR 2015) and DDIS 2017 up to the current restructuring of the DOD as directed by the DR 2015. The researcher adds 29 years of experiences as a soldier; trained as a Marine and in naval surface and sub-surface operations, intelligence, defence matériel acquisition and technology development to the construction of this thesis. The researcher is actively engaged on a day-to-day basis in the SA defence industry development agenda from the perspective of the SA DOD requirements for this capability.

1.9 ASSUMPTIONS

The researcher assumes that the DTIS trends and strategic analysis will be captured in the latest market analysis reports of the key market analysis consulting firms internationally such as Deloitte & Touche, McKinsey & Co, KPMG, PWC, Earnest & Young, etc. The research assumes that the BRICS DTISs are willing and seeking to cooperate bi- and/or multilaterally. No assumptions are made on preference.

1.10 DELIMITATIONS

This study is not a commentary on individual DTIS related projects between the BRICS States nor is it an in-depth study of every product system and technology available in the BRICS States. The study will not attempt promoting specific bilateral relationships between any combinations of BRICS States but will provide some indications of convergence in terms of markets, policy, capability, technology development, etc. which the strategic business levers could be designed around.

The study will be limited to published literature and documents about the international DTIS and in the second part of chapter two of the thesis to BRICS countries. This is based on the fact that these countries are not monolithic and have cooperative agreements and relationships globally. Where their industrial relations are spliced with other international defence industries these strategic linkages will be considered. However, within the body of knowledge concerning the defence industry, data are

available on most of the facets of the sector, covering financial performance, segmentation, specific technologies, market trends, etc. The study will not focus on specific military platforms, weapon systems and/or components except where market strategies are illustrated by their development and trade.

This study will focus more closely on trends that could facilitate defence industrial cooperation within BRICS, if possible. This delimits the scope of the study. By focussing the study to mostly BRICS states it excludes the vast majority of countries, except for visible linkages with BRICS states. This limits possible insights that could be gained from other defence industries. However, the aim of this research is to focus closely on the BRICS States.

The thesis will not dwell on the history of international DTIS developments. In some instances, a historical fact may be pertinent to arguments, but the researcher does not aim to recall histories of the various DTIS of the relevant countries discussed in this thesis. Rather, the researcher aims at discussing current and possible future trends in strategic business strategies and what makes defence industrialisation possible, specifically from a bilateral cooperation perspective between South Africa and the BRIC States.

1.11 LIMITATIONS

The study will be limited in terms of access to possible participants. The research will be limited to questionnaires based in the Pretoria-Johannesburg metropole in South Africa. The reason for this is simply linked to logistics, time and funding. Fortunately, some of the key SA DTIS decision-makers are based in this metropole.

Another possible limitation is the inability to gain access to research data that would provide specific insight into strategic levers and CSF due to security reasons, and/or the costs associated with getting access to research reports such as MarketLine, Deloitte, pwc, Mckinsey & Co and several others and/or due to the unavailability of participants. The availability of time, which is limited by the Security and Defence Studies Programme schedule, is a severe limitation on the successful conclusion of the study.

1.12 ETHICAL CONSIDERATIONS

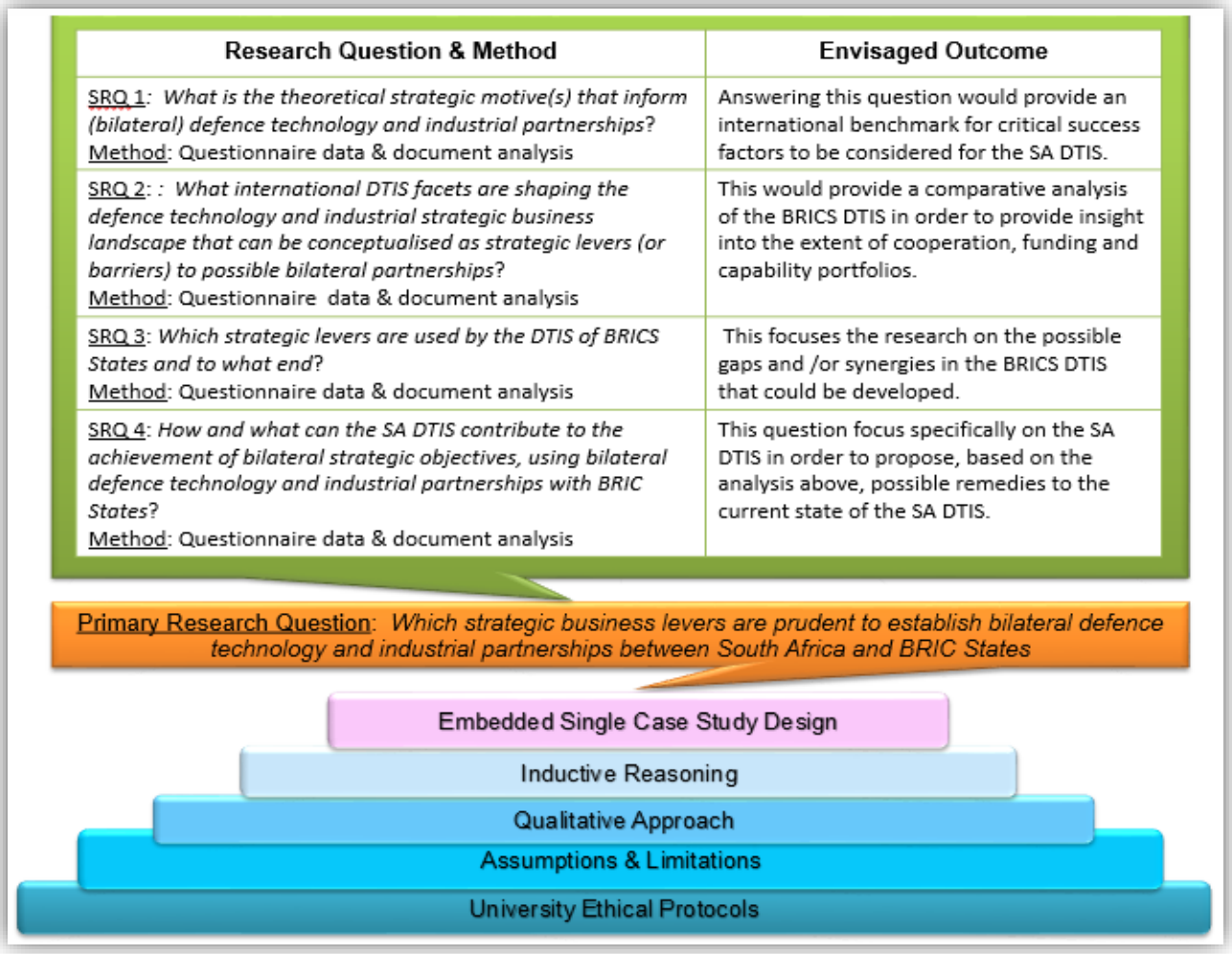
“Ethical issues are the concerns and dilemmas that arise over the proper way to execute research, more specifically not to create harmful conditions for the subjects of inquiry, humans, in the research process” (Schurink, 2005: 43). Research participants have certain rights and authors are prone to subjectivity during qualitative research approaches as well as other ethical dilemmas (Streubert-Speziale & Carpenter, 2003; McMillan & Shumacher, 2001). These issues calibrated the researcher’s ethical behaviour during the study. The study complies comprehensively with the Ethical Code of the University of Stellenbosch and the Code of Conduct of the South African National Defence Force (SANDF).

The researcher paid particular attention to issues of confidentiality, privacy, anonymity and any other rights identified of participants, whose importance are described by Babbie (2010). Participation is voluntary, also in accordance with ethical conduct in research. Participants were required to provide consent to the researcher to use their views as primary data in this thesis. At any juncture, participants retained the right to withdraw from the research.

1.13 RESEARCH CONCEPT

Conceptually the research will be based on the analysis of the international defence industrial business trends and a narrow focus on the BRICS DTIS. A graphic outline of what is envisaged by the researcher is as follows:

Figure 1.4: Outline of the Research Concept



Source: Researcher's compilation of information based on a design used in Putter (2018).

1.14 OUTLINE OF THE RESEARCH CHAPTERS

Chapter 1 (Introduction) introduces the context for the report, describing the problem statement, purpose statement and objectives of the report. Chapter 2 (Literature Study) provides a literature study of theory and conceptual issues relevant to the thesis, concluding with international facets

shaping the defence technology and industrial eco-system and a limited case study on Rheinmetall Denel Munitions (RDM) illustrating the successful application of some of these facets. Chapter 3 (Selective Analysis of the DTIS of BRICS States) provides a focussed literature study using document analysis techniques. Chapter 4 (Research Methodology) describes the research philosophy, unit of analysis and research methodology employed in this thesis. Chapter 5 (Primary Data, Analysis and Discussion) presents analysis and discussion to gain further insight into possible answers to the research questions. Chapter 6 (Findings, Recommendations and Conclusion) concludes the thesis with a synthesized view of the findings of the research; possible recommendations stemming from the findings and a statement of the contribution of the research and possible related research that could be undertaken. Chapter 2 follows with an extensive literature study of theory and conceptual issues relevant to the thesis, concluding with international facets shaping the defence technology and industrial eco-system.

CHAPTER 2: THE LITERATURE STUDY

2.1 INTRODUCTION AND CLARIFICATION OF TERMS

A literature study of the said body of knowledge is complex and dense with facts, arguments, models and theories. The researcher will focus only on those issues relevant to the research questions and objectives of this study. The aim of the literature study is to narrow down the discussion to the point where a thorough understanding exists about which strategic business levers could be prudent to establish bilateral Defence Technology and Industrial Sector (DTIS) cooperation between South Africa and the BRIC States? There are several terms that will be employed by this thesis to answer the research questions. The researcher would like to clarify the terms strategic business levers, DTIS and BRICS for the purpose of this thesis as they permeate the entire narrative. Chapter 2 will thus focus the reader's understanding around certain concepts and terms, provide a conceptual framework that positions these concepts and terms within the context of this thesis and end of with an overview of international facets that shape the DTIS eco-system. A short case study about RDM and the successful use of several of these facets is provided before the conclusion of the Chapter.

2.1.1 Strategic Business Levers

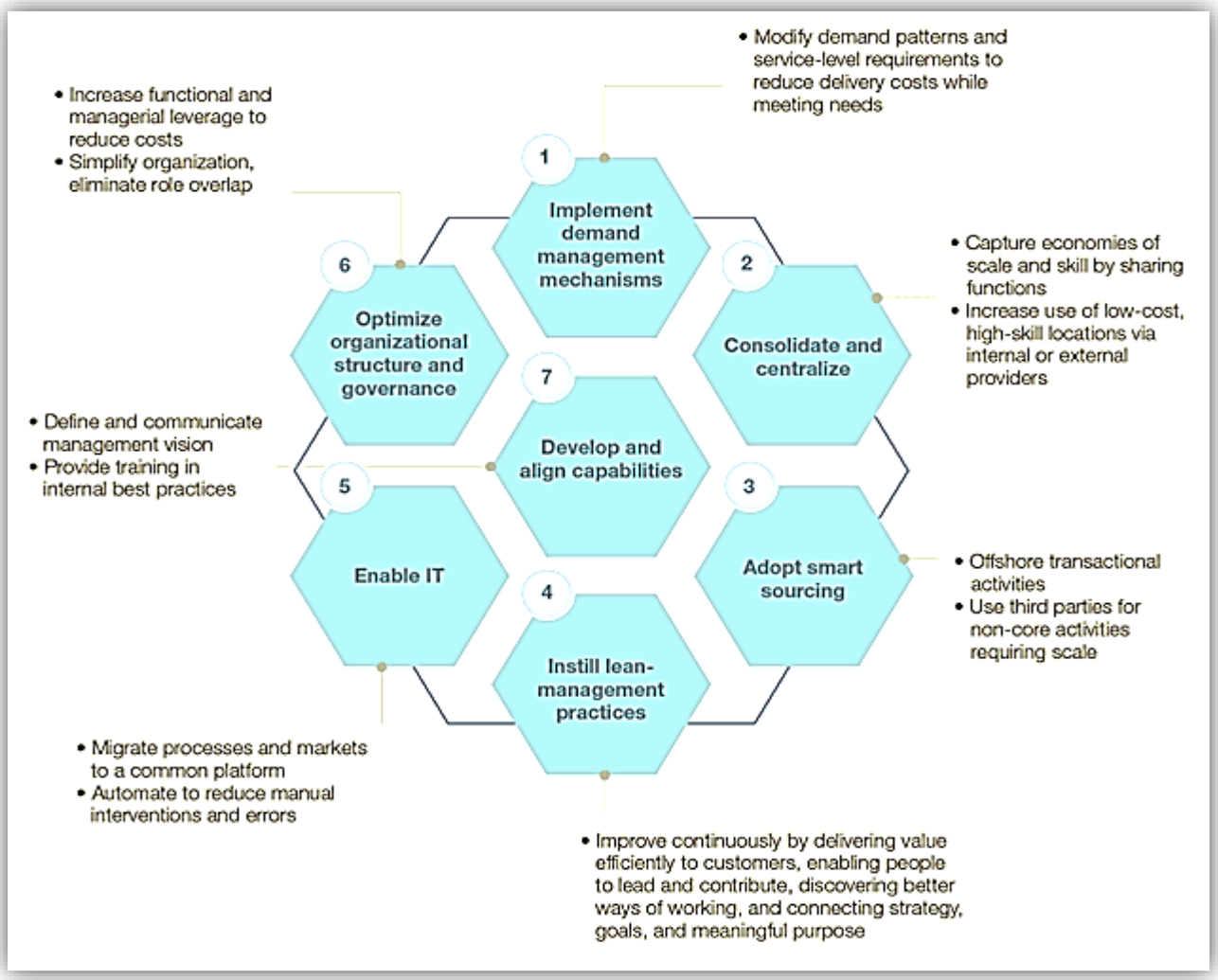
Strategic Business Levers are business constructs used to maximise profit. The Australian Government position strategic business levers to enhance or deliver capability rather than profit (although profit will typically also be a by-product of such leverage). (Australia Government, 2018: 42). For the purpose of this thesis strategic business levers will not only include profitability but also a comparative advantage. The ultimate goal is a competitive advantage – or the ability to dominate[3].

Bibhudatta, Silver and Woodcock (2014) and CORE international (2014) deem organisation design to be one such strategic lever with which to achieve the strategy. Bibhudatta, *et al*. (2014: 3) state that optimising - "… organizational structure and governance, reducing organizational complexity, aligning decision making, and strengthening ownership, with clear and effective mechanisms for resolving controversies" is critical to business performance. It is almost obvious that, globally, each business will select and craft a portfolio of these conceptual strategic business levers based on their distinct market requirements as dictated by the international business landscape. Not all these levers may be applicable to this thesis. However, consolidating and centralising, adopting smart sourcing combined with organisational structure could be associated with the formation of strategic business levers such as Joint Ventures (JV) and Mergers and Acquisitions (M&A) which are commonplace in strategic manoeuvring amongst companies in their quest for advantage. The literature study will discuss some of these strategic business levers later in this Chapter. Bibhudatta, *et al*. (2014: 3) conceptualised strategic business levers, based on 2 000 organisations internationally. Other than best practices in strategic business management, some of the salient strategic business

[3] For the purpose of this thesis, dominate include comparative and competitive advantage and acknowledge that these can be achieved as a sector or as small as a niche technology (e.g. cryptographic algorithms).

levers in their model are - consolidate, centralise, supply chain integration and optimisation (possibly through M&A) and offshoring operations (M&A and JVs) – see Figure 2.1.

Figure 2.1: Seven Strategic Business Levers

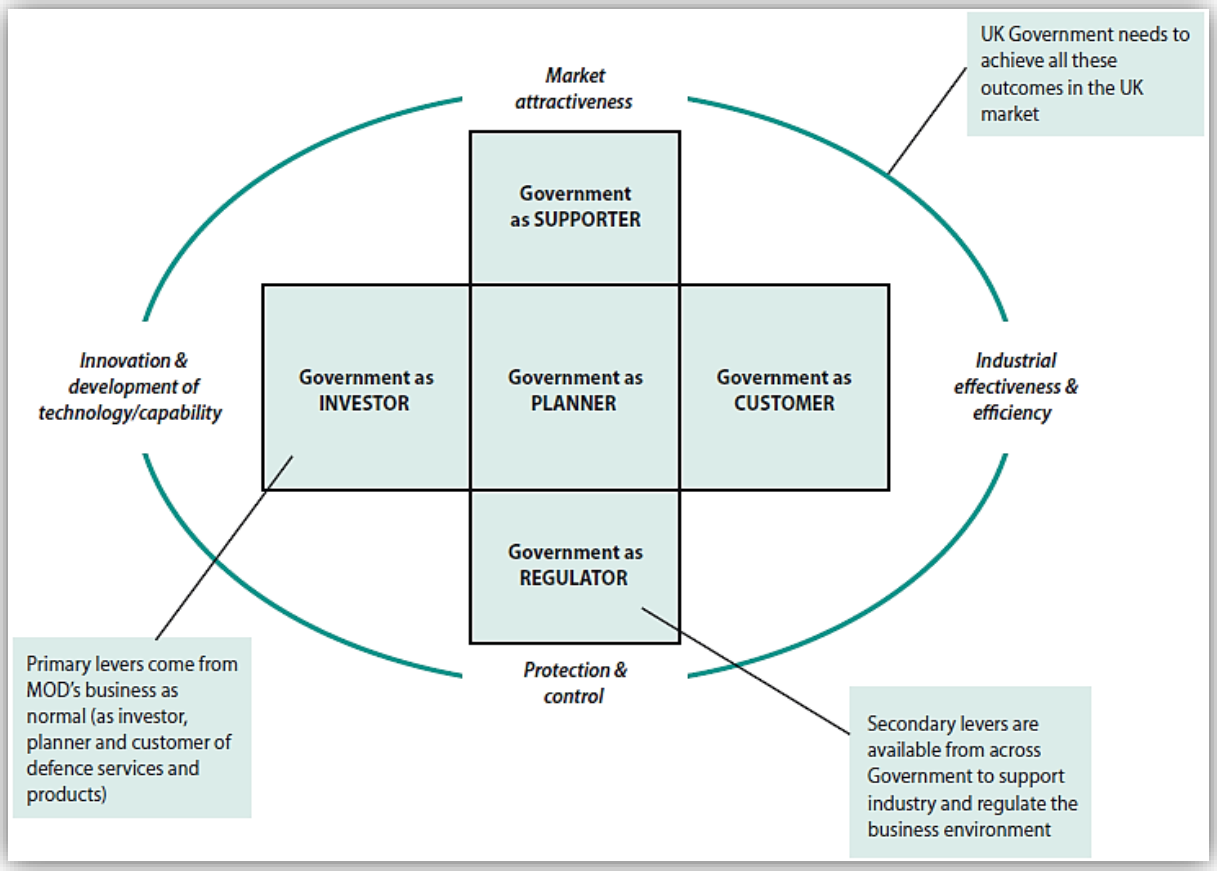


Source: Bibhudatta, *et al*. (2014: 3).

From a governmental perspective, the United Kingdom (UK) Ministry of Defence White Paper of Defence (2005) describes what they perceive as strategic levers. The UK Defence Industrial Strategy provides a brief description accompanying the illustration above. Importantly it states that - "[l]evers that affect the way governments execute their core business are the most attractive because they impact directly on defence effectiveness and relate to core processes and specific lines of activity or programmes. They also fundamentally determine the attractiveness of the domestic defence business to industry." (United Kingdom, 2005: 33). Attractiveness is of obvious importance in the quest to be relevant amongst alliance partners, such as the BRICS alliance. These strategic levers are also posited as critical to the achievement of defence industrial objectives. They can be further grouped in terms of day-to-day business activities (government as an investor, government as planner and government as a customer) and those associated with general regulatory functions of government

(government as a supporter of industry and government as a regulator of industry). These are grouped within different roles of government played in the defence technology and industrial marketplace, illustrated in Figure 2.2 –

Figure 2.2: UK Defence Industrial Strategy Perspective on Strategic Business Levers



Source: United Kingdom (2005: 32). "Five groupings of levers that can be used to achieve required defence industrial outcomes." (United Kingdom, 2005: 32).

The levers present themselves within the various roles government plays in the defence technology and industrial market place -

- Government as Investor. This role is positioned to assist States to be intelligent customers/consumers, based on investment in R&D. Other investment aims at establishing a national industrial capability, which could be achieved with investment levers focussing on technology development. "Furthermore, governments' approaches to R&D are an important factor in determining the overall attractiveness of the defence market because it impacts on risk and profitability." (United Kingdom, 2005: 32).
- Government as Planner. This planning activity of States is aimed at (amongst others) establishing and maintaining military capability and defence technology and industrial capabilities from various perspectives.
- Government as Customer. This role speaks to the ability of States to acquire services and products using various acquisition models.

- Government as Supporter of Industry. States support the DTIS both financially (as customers) as well as other activities that are typically functions and mandates of a variety of governmental departments. (United Kingdom, 2005: 32).
- Government as Regulator of Industry. This role is more concerned with "… controlling or restraining parts of industry to ensure access to, or control over, key IPR [Intellectual Property Rights], capability and capacity. Equally, governments can consider where regulations can be relaxed or removed, to increase industry's profitability and agility." (United Kingdom, 2005: 32).

Secondary levers are concerned with the stimulation of defence industrial activity by - "… reducing barriers to entry, encouraging participation, stimulating industry investment and stimulating technology transfer from international defence sources of adjacent industrial sectors; guarantee access to and control over critical technologies and capabilities where these underpin critical military capability and operational sovereignty." (United Kingdom, 2005: 33). The application of strategic business levers has context-dependent outcomes (United Kingdom, 2005: 33). Now let us consider the term Defence Technology and Industrial Sector.

2.1.2 Defence Technology and Industrial Sector (DTIS)

Several analytical market analysis documents (e.g. Gates, *et al.*, 2016; Campbell, 2017; Lineberger & Hussain, 2018b; Maiti, 2018; Starr & Jones, 2018; South African, 2017b; South Africa, 2018 and others) refer to the sector as Aerospace and Defence (A&D). This trend is probably informed by the cross-impact of commercial aviation on defence aviation and other associated manufacturing industries. For the purposes of this thesis, the focus is on the defence technology and industrial sub-sector of the A&D sector.

That said, Bret (2017: 19) refers to the defence industrial sector, albeit from a Russian perspective, as the "Defence Technology and Industrial Base" (DTIB) and Boutin (2017: 39) use the same acronym for the Chinese DTIB. Gressel (2017: 36) refers to the DTIB as "military-industrial complex". Devore (2013: 540), Van Dyk, Haines and Wood (2016: 146), and Haines (2019) uses "defence industrial base". Raska (2017: 55) provides a description of the Chinese DTIS as being – "…the Chinese defence, science, technology, innovation, and industrial base in terms of developing and manufacturing new, relatively advanced military platforms and technologies." These are very descriptive and inclusive phrases. Readers could, to a certain extent, interpret defence industrial sectors or complexes narrowly as manufacturing. The intimate relationship between technology (knowledge, design, innovation, prototyping, modelling, simulations and R&D among others) and manufacturing (as the more tangible and controllable side of the sector) are much clearer when the term 'technology' is included in the sector-description.

There are also publications referring to the arms industry (Robinson & Boutwell, 1996; Liebenberg, Manganyi & Potgieter, 2013). South African national policy referred to the industry as

follows – “The term `defence industry’ is widely used internationally, sometimes interchangeably with `armaments industry’ and ‘defence suppliers’. However, the term ‘defence-related industries’ in some ways more accurately describes the focus of this White Paper, since there is a growing tendency for companies producing defence equipment to make use of civilian technologies, or to manufacture dual-use products which can be sold to both defence and non-defence markets. There is also an increasing overlap between defence and civilian production within companies, both nationally and internationally. The defence-related industries are mainly involved in the material, mechanical, electrical, electronic and chemical sectors of the manufacturing industry and produce armaments for both domestic and international clients.” (South Africa, 1999: 2).

These are very narrowly focussed on only manufacturing. The relationship, as described above, between defence technology development and manufacturing is not visible at all. Another component that is not visible is the prevalence of dual-use technology in armament development and manufacturing. Conceptually, ‘arms industry’ is descriptively specific about military-off-the-shelf (MOTS) and/or bespoke military products without shining a light on the R&D required to establish production lines with. For the purpose of this thesis, the researcher will combine the term ‘DTIB’ with Defence Industrial Sector and arms industry to form a hybrid term - Defence Technology and Industrial Sector (DTIS), providing more visibility of the primary elements of this economic sector.

There are several publications that provide a theoretical framework for the contextualisation of defence industry subject matter. Goh and Muravska (2012) provide such a framework with which to understand what a military-owned business constitute, in contrast with what is considered a defence industry as described for example by the South African DDIS 2017. This thesis will focus on the construct DTIS, within which military-owned businesses form a subset.

The use of the term DTIS, as an inclusive term, is conceptually inclusive of military and dual-use platforms, systems, products, processes, technology and knowledge. Where publications refer to A&D, the researcher will only refer to the DTIS sub-sector to facilitate conformity of terminology throughout the thesis. A last observation – the term DTIS does not include the National Defence Forces/Militaries of the various countries. These are regarded as separate entities in order for the researcher to focus on the commercial side of the relationship between Defence Forces and associated DTIS. The researcher is well aware of the very close relationship between these entities to the extent that they are in some cases almost inseparable. For the purpose of this thesis, the term DTIS includes both privately owned and State-owned defence technology and industrial companies. Also, the researcher takes cognisance of the fact that private companies will have more latitude regarding the use of strategic business levers vs. that available (or prescribed by national policy) to State Owned Enterprises (SOE).

2.1.3 BRICS and Bilateralism

The BRICS acronym refers to the economic alliance between Brazil, Russia, India, China and South Africa and it is an inclusive acronym to describe the multilateral economic cooperation between

these countries. However, it should be noted that for the purpose of this thesis the researcher will delve into possible bilateral DTIS cooperation between South Africa and the individual BRIC States. This is based on the opinion that - "… bilateral agreements are timetested [*sic*] instruments for the involvement of the United States in European defense relations and, unlike multilateral arrangements, have a great capacity for flexibility and adaptability to the particular bilateral relationship of the two countries concerned." (Murphy, 1991: 435). Bilateralism is also underwritten by Notshulwana (2012) in a Development Bank Southern Africa policy brief as the relation-building approach in BRICS and between BRICS and Africa.

Murphy (1991) wrote, from a NATO defence agreement perspective, that bilateral agreements consist of legally binding terms and conditions that regulate its execution within the parameters set by international law between the bilateral parties. Bilateral investment agreements mitigate ("balance or bandwagoning" - Notshulwana, 2012: 8) some of the risk associated with foreign investment strategies because bilateral agreements provide safeguards. (Albino-Pimentel, Dussauge & Shaver, 2018). Albino-Pimentel, *et al*. (2018) label these agreements - supranational agreements. Bilateral agreements are typically an instrument of the State (within the context of this thesis at least) and the terms contained in these agreements are usually broad. They can include (but not limited to) "… military training, arms production, arms sales, arms reduction, [arms control], and other defense-related matters". (Murphy, 1991: 421).

Bilateral defence agreements carry different labels to illustrate scope and functionality. Some provide bilateral defence cooperation utility, others provide for mutual defence cooperation and/or facilitate defence basing agreements. (Murphy, 1991: 421). These agreements are not the focus of this thesis, although it must be noted that some of these agreements might contain elements/sections delimiting defence technology and industrial activities. The researcher thus focuses on bilateral DTIS relationships between South Africa and the individual BRIC States and strategic business levers that could assist with the establishment of attractive conditions for bilateral DTIS agreements between South Africa and the BRIC States. Other terms and concepts will be clarified throughout the thesis where relevant. The following section discusses theories that have relevance for this thesis.

2.2 THEORETICAL FRAMEWORK

2.2.1 Asymmetry Theory

> *Intra-BRICS differences, mistrust and challenges will form the basis of each BRICS country's balancing or bandwagoning strategy. (Notshulwana, 2012: 8).*

Moran (1990) in Devore (2013: 542) contends that, internationally, - "Defense-industrial globalization generates interdependencies between states, but these are asymmetric in nature […] states producing weapons components for which few substitutes exist possess an advantage in terms of relative power over states that provide easily replaceable components." Haas (2019: 38) describes

these asymmetric relationships between the West and East in the following terms – "The first is the growing ability of actors like China, Russia, and India to press for parity in some established areas of Western advantages, such as air and missile power."

Without attempting to unpack the entire philosophy behind asymmetry theory as conceptualised over an extended period of time by Womack – Sithole (2015) provides a very concise description of the theory as follows - "Asymmetry theory envisages that in a relationship between two unequal states, the relationship will hold larger significance for the smaller and/or weaker than the larger and/or stronger one. This should result in the smaller and/or weaker paying more attention to the relationship, planning, coordinating and generally strategizing to ensure that it is not overwhelmed by the larger and/or stronger and that it derives the benefits of the relationship." (Womack, 2004 & 2006 in Sithole, 2015: 26-27). This assumption can be contested in future research on the subject matter.

Asymmetry theory characterises the relativity between South Africa and at least China, Russia and India in the BRICS alliance. It positions South Africa at the 'smaller/weaker' end of the spectrum and thus suggests that South Africa take a stronger role in relationship building to ensure (as much as possible/if possible) an equal partner status. It results, in many ways, in the perception that - "South Africa also punches above its weight but in more subtle ways than the others (Draper, 2011; Davies, 2012; Alden & Schoeman, 2013; Naidu, 2013 & Hazelhurst, 2014)." (Sithole, 2015: 27). Sithole (2015: 28) proposes that - "The sovereign smaller state need not always defer to the bigger one in all instances. Asymmetry theory posits that these differences engender complementarity and cooperation". This thesis does not concern itself with this perception, but rather focus on which strategic business levers could assist with moderating the effect of asymmetry in bilateral relationships between South Africa and the BRIC States.

2.2.2 Realism vs. Idealism

> *States have sought self-sufficiency in armaments production throughout most of modern history. The drive to defense-industrial self-sufficiency was often associated with interrelated diplomatic, military [realist paradigm], and economic considerations [idealist paradigm]. (Devore, 2013: 535).*

At a glance, why is the DTIS important to States and thus also, why should it be developed and kept vitalised? Bitzinger (2003: 15) in Kurç and Neuman (2017: 221) assumes a typical approach that could be associated with a realist world view of defence technology and industrial capabilities. Caverley (2007: 600-601) states – "Realists claim that states are preoccupied with survival and that military power (or the potential to develop it) remains the principal guarantor of a state's continued existence. Reliance on foreign sources for essential weapons components places the supply of the very tools of survival into the hands of other actors. Any concession of self-sufficiency in weapons production by powerful states, therefore, threatens to deal realism a sharp empirical blow." These authors argue that independent defence industrial capabilities and national power are symbiotic and

critical to national security. A realist world view in the development stages of national DTIS policy is thus positioned as utilitarian but may have a growth ceiling. Economic growth during periods of autarkic industrial policy may be a spin-off that reinforces a shift in the future towards a more idealistic and liberal approach to DTIS policy. It should also be noted that realism, within the context of military capability development, is not mutually exclusive to autarky. Developing the national DTIS in order to support military autonomy could also be achieved with an idealistic world view of such policies. The time it takes to achieve autonomy might differ due to the differences in world views. Or, argued from another perspective, if the application of the world views had the same limitations on time available for the development, then the level of capability achievable could possibly differ.

Let us consider idealism within the context of DTIS development. A more idealistic world view decouples defence technology and industrial capabilities development from the singular objective of creating military power. Devore (2013) argues that national security ambitions of self-sufficient defence technology and industrial capabilities could also be used to fuel economic growth. Devore (2013) base this notion on the fact that the defence technology and industrial companies have for an extended period of time developed technologies and products that were later commercialised, fuelling economic growth. “Thus, widely accepted economic theories suggested that domestic arms production would accelerate rather than impede economic development.” (Devore, 2013: 535-6). A South African perspective on this idealism is expressed in the DDIS (2017) and captures the essence thereof – “A defence industry can even be a key factor in changing the profile of an economy: South Africa’s defence industry can be argued to have changed the profile of the economy from one focused and dependent on agriculture and mining, to one with precision engineering, and composite materials expertise, and the ability to develop high-end electronics and software, among other capabilities.”

Idealism will probably provide more linkages with economic growth objectives. Economic development and growth could/will probably result in more resources available in the future with which to create more military and DTIS capabilities. For the purpose of this research, the researcher assumes an idealist world view to the subject matter, discussion, analysis and findings.

2.2.3 Globalisation/Liberalism vs. Autarky vs Hybridisation

The national policy objective that seeks to transform States from being net armament importers into self-sufficient armament producers is loosely described as climbing the “Ladder of Production.” (Devore, 2013: 536). There are at least three schools of thought and practice exists on how to, conceptually, climb this ladder – liberalisation/globalisation, autarky and hybrid defence industrial policy. (Devore 2013; Squeff & De Assis, 2015; Kurç & Neuman, 2017; Frolov, 2017 and others).

The school supporting the globalisation or liberalisation of the defence technology and industrial market place dates back to at least 1983. It is based on the conceptualisation of liberal defence markets - in other words, defence markets (and by implication DTIS) that are not an integral part of public enterprises (i.e. SOEs). (Wulf 1983 in Kurç & Neuman, 2017).

The liberal school suggests the diversification of production and reduced dependence on specific products (Squeff & De Assis, 2015) such that market forces determine the supply and demand for R&D and production via market mechanisms that aim at optimising supply chains. This school argues for stepping away from traditional protectionism (or autarky) associated with the national production of armament towards embracing an integrated system of international supply and demand that is controlled by defence technology and industrial market-related networks instead of Governments. It is argued that the continuous change resulting from the phenomenon of globalisation will motivate States to become more integrated and export-orientated in terms of defence technology and industrial strategy. (Kurç & Neuman, 2017: 220). A fundamental DTIS policy decision, as a by-product of the liberal approach, for States is for example - what combination of Foreign Direct Investment (FDI) vs. armament imports would be best suited to reach defence autonomy or any other objective. (Devore, 2013). "By liberalizing regulations on foreign direct investment, as South Africa did, a state can position its defense firms to participate in the supply chains of European and American multinational corporations." (Devore, 2013: 534). Therefore, liberal defence technology and industrial policy should allow the SA DTIS broader scope for bilateral relationship building with the BRIC DTISs. This approach coupled to an idealist world view of the utility of the DTIS is mutually reinforcing.

A number of authors argue that defence technology and industrial interdependence is the product of a liberal approach to defence industrialisation rendering States incapable of self-sufficient armament production for national consumption. (Mabee, 2009 in Devore, 2013: 539). Self-sufficiency is not a sustainable DTIS strategy, even for the developed States. The developing or emerging States can also now develop DTIS capabilities that would underwrite their capacities for defence autonomy and their ability to penetrate new armaments markets. (Devore, 2013). "[A]ctivist governments consciously employed steering, regulation, and, in two-thirds of the cases, state ownership of defense corporations to achieve their ends." (Devore, 2013: 534). This self-sufficiency was and is mostly achieved with autarkic DTIS policy and strategy. This is realism in action, driving military capability with State-controlled DTIS capability development with defence autonomy and industrial self-sufficiency as the objective. In order to achieve some level of self-sufficiency, States weave some autarky into their liberal policies and objectives. Caverley (2007: 600-601) states – "A state may prefer autarky to mutual interdependence but will prefer favourably asymmetric interdependence over autarky due to the enhancement of its relative power and therefore its chances of survival." However, according to Devore (2013), there are several authors (listed in Devore, 2013: 540) that are of the opinion that – "… only the liberalization of procurement, export, and foreign direct investment policies will enable small and medium states to preserve some form of [the] defense-industrial base."

In contrast - autarky[4] or the quest for self-sufficiency as theory share a rich history. (Squeff & De Assis, 2015: 13). "Autarkic systems are the opposite of liberal economic systems, which encourage

[4] "… self-sufficiency in arms production". (Kurç & Neuman, 2017: 222), and "… an economic system of self-sufficiency and limited trade. A country is said to be in a complete state of autarky if it has a closed economy, which means that it does not engage in international trade with any other country. […] Autarkic systems are the

the free flow of goods and services." (Encyclopaedia Britannica, 2019). Autarky, the second school, favours state-controlled defence technology and industrial capabilities motivated by the call for national independence (or self-sufficiency) from foreign supply chains. A national independent DTIS bolster national prestige (foreign policy objective) and ensure decision-making autonomy about defence capabilities. (Squeff & De Assis, 2015; Avila, *et al*., 2017; Kurç & Neuman, 2017). Defence technology and industrial autarky is a pragmatic approach to establish and maintain national defence technology and industrial capabilities and thus supply security. (Kurç & Neuman, 2017; Frolov, 2017). According to Devore (2013: 535), a self-sufficient DTIS empower States to "… more "intelligently" consume and employ imported weaponry." Thus, from the researcher's perspective, autarky is not equal to self-sufficiency but autarkic policy (protectionist policy) is used and presumed to be an effective means with which to achieve self-sufficiency and even dominance. In this sense, autarky could possibly be compared to being securocratic in nature.

In a critique of autarky - the desirability of autarky is questioned in terms of its utility for small States which will best benefit from more competition that supports innovation and development juxtapose against establishing industry champions with limited resources and sheltered from competition by Government. (Squeff & De Assis, 2015: 13). Emerging States are prone to autarkic national DTIS policy. (Devore, 2013). Yet, they probably have more to gain from a more liberal DTIS policy from an idealist world view.

The product of a compromise between these two schools of thought is possibly the third school - hybridisation. Boutin (2017: 41) describes it as "hybrid structure", which is composed of SOE as well as market-related structures. Based on this thinking, States could adopt a hybrid defence technology and industrialisation policy approach. In such an approach States attempt to integrate national defence technology and industrial capabilities as much a possible with the international market and dynamics in order to reap scale, knowledge and supply security benefits. Practically, - "[s]trategic and economic incentives together can motivate states to position their defense firms as producers of niche products or critical subsystems, yet security concerns alone might prompt governments to preserve specific systems-integration capabilities." (Devore, 2013: 543). This refers to the Tier Structure for defence industrial development discussed later in this Chapter. States could thus ring-fence certain defence technology and/or industrial capabilities, product and knowledge portfolios as national strategic leverage for defence and foreign policy initiatives. This is not uncommon, nuclear and crypto technology and capabilities being a case in point. Russia is an example of this (Frolov, 2017: 10).

Internationally, the developed defence technology and industrial markets have and are continuously shifting away from the volume production of new systems - focussing on the maintenance of R&D-based technological superiority. (Squeff & De Assis, 2015). This is possibly much closer to a

opposite of liberal economic systems, which encourage the free flow of goods and services." (Encyclopaedia Britannica, 2019).

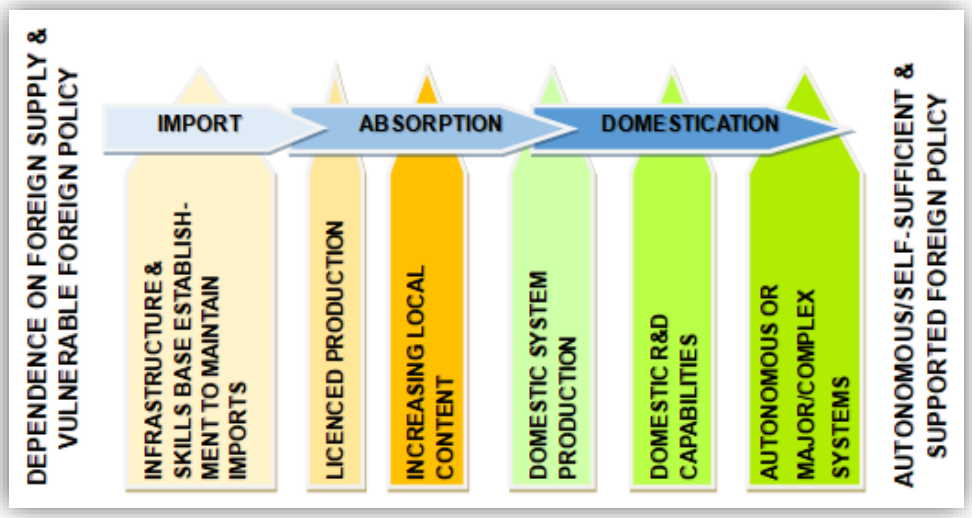
hybrid defence industrialisation approach in which States maintain sovereign defence technology and industrial capabilities but also allow for knowledge diversification by means of JVs and R&D collaboration. Emerging countries with well-developed defence technology and industrial capabilities could possibly consider a hybrid approach in order to get the best of both schools of thought.

A compromise between autarky and liberalism aims at maximising the potential of development drivers and minimise the impact of development barriers. Boutin (2017: 41) describes it as "hybrid structure", which is composed of SOE as well as market-related structures. Based on this thinking, countries could adopt a hybrid defence industrialisation policy approach. In such an approach States attempts to integrate national defence industrial capabilities as much a possible with the international defence industrial space and dynamics in order to reap scale and knowledge benefits. However, States could also ring-fence certain defence industrial capabilities, product and knowledge portfolios as national strategic leverage within defence and foreign policy[5] initiatives. This is not uncommon, nuclear and crypto technology and capabilities being a case in point. Russia is an example of this. (Frolov, 2017: 10).

2.2.4 The Stages and Phases of Defence Industrialisation ('Ladder of Production')

Devore (2013: 536) posits the notion that States progress through at least three stages of defence technology and industrial development, i.e. – "… importation, absorption and domestication of imported defence technologies". These stages provide the general framework for various phases of development. Figure 2.3 conceptualise the development of the DTIS from a state of dependence on foreign imported defence matériel through the various stages proposed by Devore (2013: 536) to self-sufficient in armament production.

Figure 2.3: Conceptual illustration of the "Ladder of Production" in the Quest for Autonomy



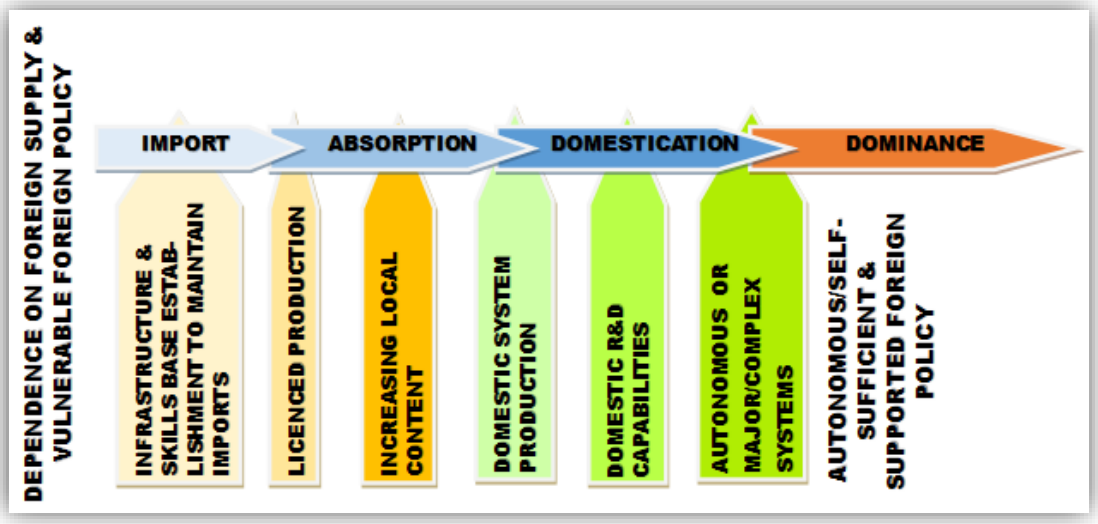
Source: Researcher's compilation of information based on a discussion about the conceptualisation of a "Ladder of Production" in Devore, (2013: 536) that takes the reader through some of the primary steps involved in the development of an autonomous DTIS.

[5] Kurç & Neuman (2017) identify the DTIS as an instrument of foreign policy.

The researcher superimposed the stages (import, absorption and domestication) onto the phases described by Devore (2013). According to Devore (2013), this provides the State with decision-making autonomy about its military order of battle and how to craft and exercise foreign policy, as was discussed earlier. A self-sufficient national DTIS provides a State with decision-making and action freedoms that better facilitate bi- or multilateral cooperation with other interested States. However, this does not mean that a particular State has a competitive or comparative advantage over any other State's DTIS. It also does not necessarily exclude the possibility. Self-sufficiency (even just a small number of technology/process/product niches) may contribute to the mitigation of the negative effects of asymmetry between States. This defence technology and industrial development transitional process from dependence to independence is conceptualised by Devore (2013: 535) as the "Ladder of Production" consisting of a number of distinct stages of development. The researcher is of the opinion that these stages will overlap with other stage based on the requirements of the particular State. For the purpose of this thesis, the stages are depicted as individual constructs to simplify discussion and understanding. Also, there is no attempt at quantifying any of these stages.

This developmental journey can be achieved within realist and idealist world views of the defence technology and industrial market place. The time-frame within which self-sufficiency could possibly be achieved will in all probability differ though. There would also have to be an acceptance of both the negative (barriers) and positive (drivers) consequences of each approach (autarky, liberal and hybrid) without real attempts to minimise barriers and maximise drivers. Devore (2013) stops at autonomous or self-sufficiency. In Figure 2.4 the researcher extends Figure 2.3 with the fourth stage for DTIS development, labelled - 'Dominance'.

Figure 2.4: The Next Phase: The Quest for Dominance



Source: Adapted from Figure 2.2.

Conceptually, 'domination' provides a final developmental stage in which States exploit their self-sufficiency to dictate foreign policy objectives internationally and be a coveted partner for bi- or multilateral DTIS cooperative arrangements. Domination has typically been achieved by superpowers

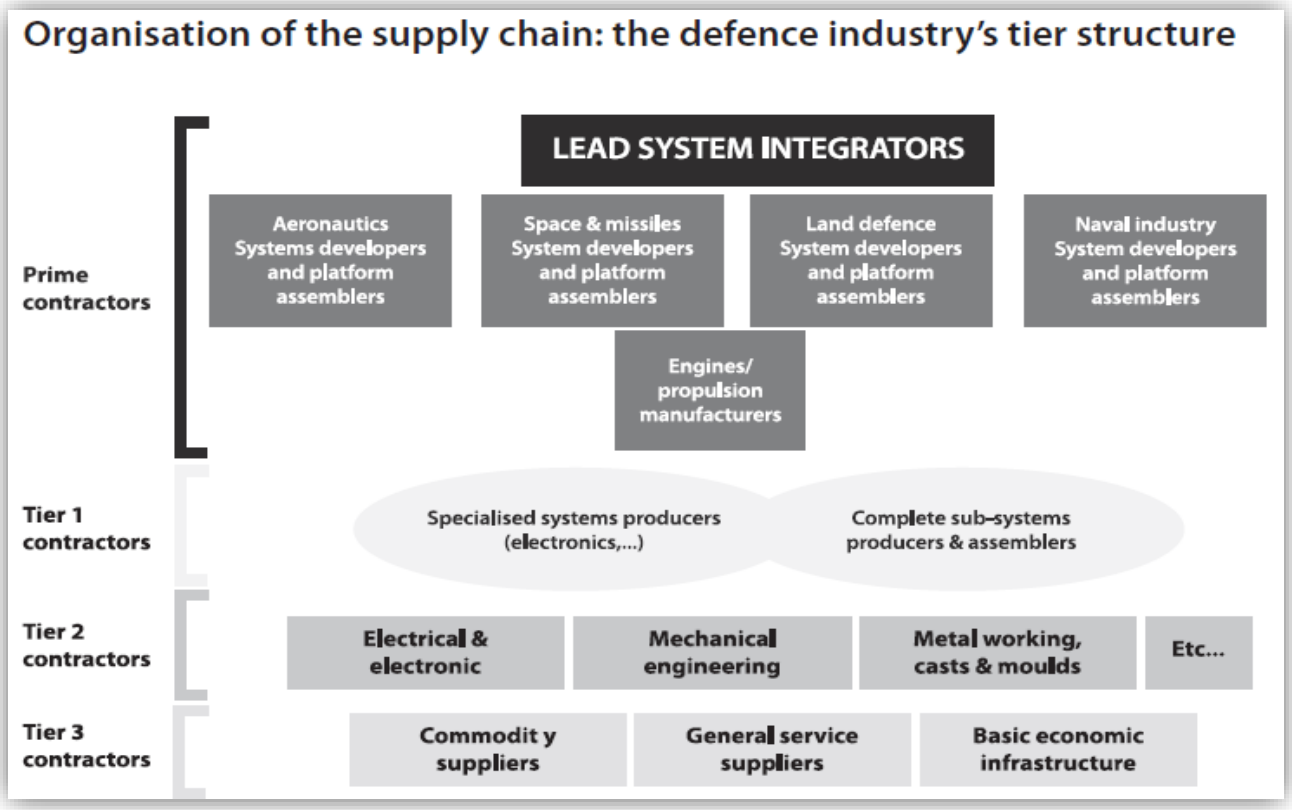
such as the USA. The utility of these theories in understanding the extent and nature of the BRICS DTISs become visible later in the thesis.

There is another dimension to the developmental levels of defence industrialisation. This dimension is called the Tier Structure of defence technology and industrial capability development. It provides more granularity with which to understand what is necessary for industries to compete.

2.2.5 The Tier Structure for Defence Industry Capability

Deloitte and Touche (2018a: 28) provides definitions for the defence technology and industry capability as follows: "[Original Equipment Manufacturer] (OEM) - Prime integrator; Tier one – System integrator; Tier two – Sub-system integrator and Tier three – Sub-component suppliers; Electronics – Communication and electronic systems and products used on commercial and military platforms; Aerostructures – Airframes including all or parts of the fuselage and wings; Propulsion – Aircraft (commercial and military) and rocket engines; and Services – Mission and program support, command and control (C2) solutions, cybersecurity, information." Verrue (2009: 13) conceptualise these segments as follows:

Figure 2.5a: Defence Industry Tier Structure



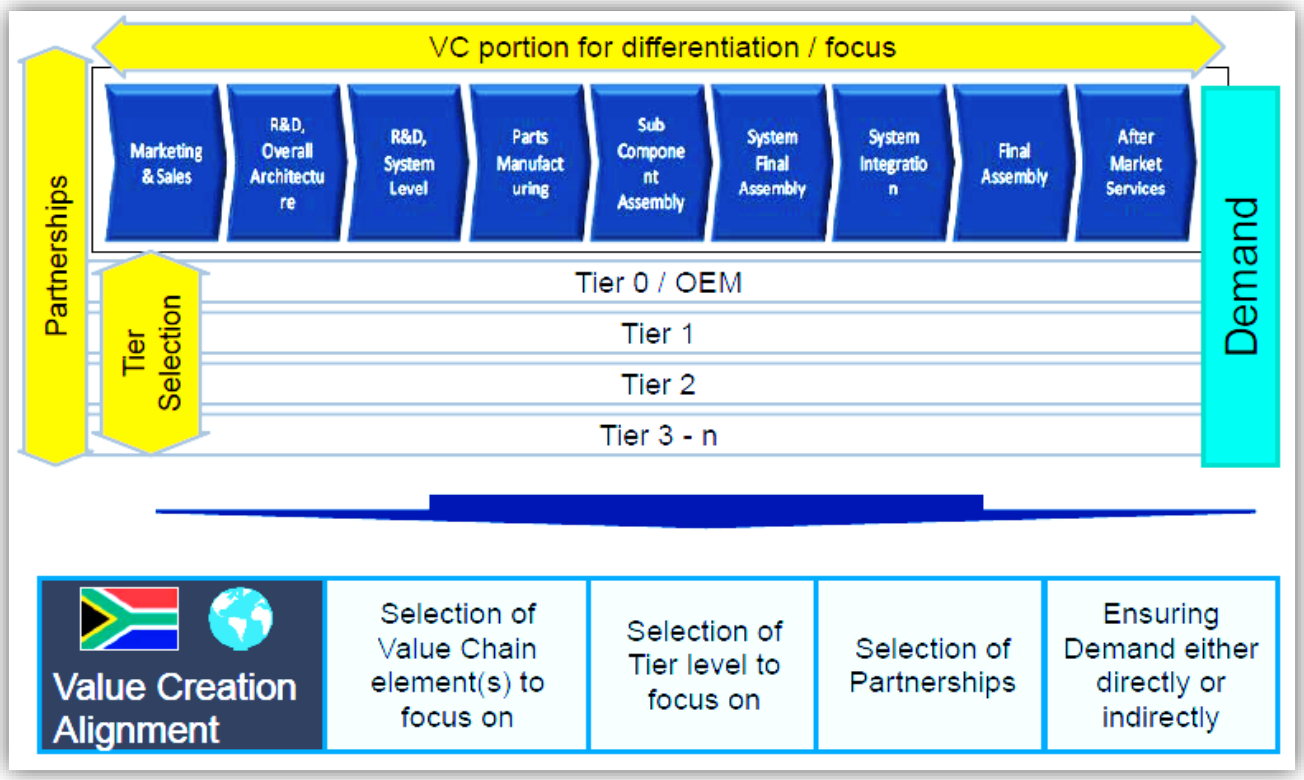
Source: Verrue (2009: 13).

Figure 2.5a does not provide a sense of the importance of international partnerships in the defence technology and industrial supply chains. Another view on this Tier Structure is provided by Kleynhans (2017: slide 15) Figure 2.5b introduce the importance of partnerships in the value chain

vis-à-vis the Tier Structure. The Tier achieved by defence technology and industries will have an effect on their relative attractiveness as a bilateral DTIS partner. Chapter 3 will focus on these issues.

"[B]ecause small and medium states' defense industries can best access international markets as subsidiaries or component suppliers to multinational corporations, their governments should also encourage foreign direct investment into their defense industries. Of necessity, this entails governments relinquishing their role as owners and managers of defense industries" (Devore, 2013: 541). This position emerging States to adopt a liberal defence industrialisation policy (or at least hybridisation) as Tier 3 defence industries, making them highly depended on the import of integrated systems/platforms, contrary to the objective of a self-sufficient DTIS. This is not an ideal position from foreign policy and military flexibility in decision-making. From a national security perspective, it reduces freedom of decision and action severely. Saxena (2016: 6) states it plainly - "In the crisis situation, dependence on other nations for weapons and equipment can put National Security in danger". Devore (2013: 543) states - "The incentives for promoting systems integration [Tier 1] are particularly acute in domains where large states refuse to export cutting-edge equipment". This situation could be remedied by a hybrid approach to defence industrialisation, which would provide more flexibility and control.

Figure 2.5b: Defence Industry Tier Structure



Source: Kleynhans (2017: slide 15).

In the conceptual framework following, the researcher combines elements of the various theories within a capability and capacity continuum, illustrating a possible time-to-client (or market) impact and

thus the ability to gain or increase competitive advantage. This will be in conjunction with the categorisation of development of defence technology and industry according to Tiers of Defence Industry Capability.

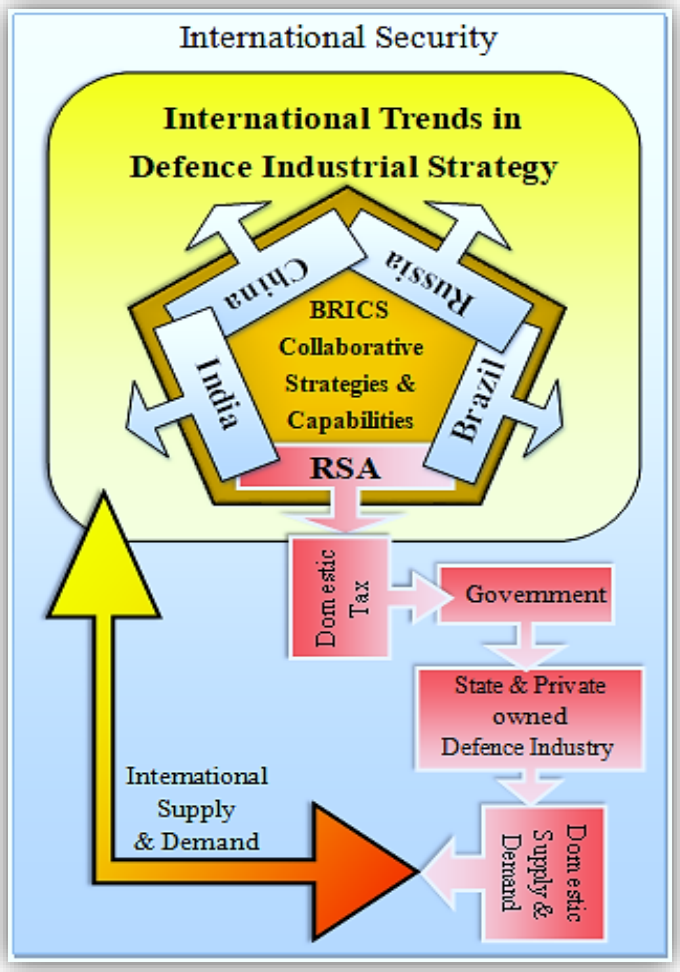
2.3 CONCEPTUAL FRAMEWORK

Conceptually, the DTIS functions the same way that most other manufacturing, R&D, and knowledge industries would function with the supply and demand market mechanisms. However, defence industries invariably combine R&D, knowledge development and manufacturing as well as other elements of the supply chain such as upgrades, maintenance and repair and disposal. This is not just done within a small localised space but invariably for the domestic market as well as for international customers with complex supply chains. These supply chains are subject to domestic legislation like all other domestic business. Defence industries are, however, also subject to specific arms control regimes that sets the rules for international trade. The internally agreed arms control regimes do not really impact demand for knowledge, technology and or goods and services. The impact is on the supply side. Not abiding by the rules set forth governing arms supply invariably have severe international relations fallout with commensurate negative economic repercussion. This will normally come full circle affecting the defence industries of the particular country that is in breach, negatively affecting exchange rates, commodities availability, export routes closing down and market share forfeited.

The DTIS, in conjunction with other government departments such as trade and industry and international relations, therefore, have to craft a particular mix of approaches to the defence knowledge, product and service market, following a realist or idealist world view. Countries with large DTISs (that are part of strong cooperative economic and/or defence alliances such as the North Atlantic Treaty Organisation – NATO) fare particularly well in maintaining the supply chain of their industries. As such, NATO-states control most of the DTIS supply chain.

South Africa is part of the BRICS economic alliance. BRICS is still an infant compared to the European Union, NATO and others. However, BRICS consists of states with enormous DTIS capability and capacity to service bilateral defence technology and industrial interests and supply chains at all three Tiers of DTIS development. How this can be achieved is a question for much debate and strategising. This thesis asks the question - Which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States? The conceptual framework for this thesis is captured in Figure 2.6. How can the domestic cycle (Figure 2.6) be enhanced with the use of strategic business levers in order to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States within international security and national security requirements? This is predicated on the fact that each BRIC State has similar (albeit very simplified) cycles of demand and supply – or supply chain.

Figure 2.6: Outline of the Conceptual Framework



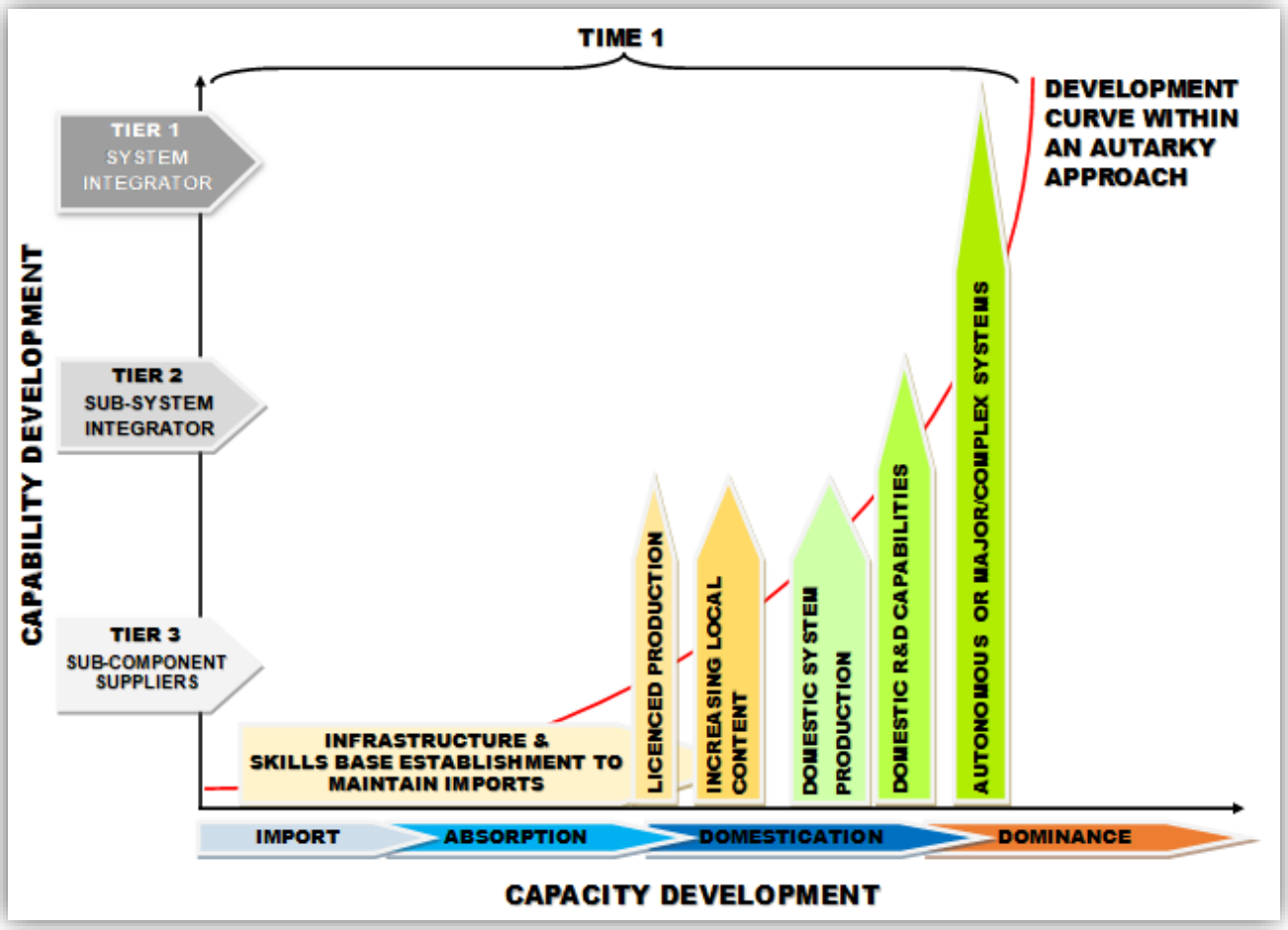
Source: Author's compilation of information.

To conceptualise the development of a DTIS within several aspects already discussed, the researcher compiled the following six illustrations (Figures 2.7 – 2.11). These assist with the conceptualisation of the difference between an autarkic and liberal defence technology and industrial policy, as was discussed previously. The discussion filters in concepts of time, capability, capacity and first-mover advantage.

The conceptualisation posits that first-mover advantage could be achieved quicker by using a liberal (or at least a hybrid) defence technology and industrial policy and possibly even quicker if elements of the particular DTIS are already at more advanced Tiers of development (i.e. Tier 1 to Tier 3). The final illustration (Figure 2.11) posits that by combining liberal (at best a hybrid approach) defence industrial development policy with a selection of strategic business levers the conceptual DTIS development picture can be shifted significantly in a positive direction (i.e. achieving quicker development and competitive advantage). This would be ideal for the SA DTIS in order to be attractive to the BRIC States for DTIS relationships and in the long-term SA economic development and possibly even foreign policy and military capability options.

Figure 2.7 combines the stages and phases of the 'Ladder of Production' (conceptualised by Devore, 2013 - in Figure 2.4 above) within a vertical axis depicting the defence industrial capability Tier Structure (as was proposed earlier by Deloitte & Touche, 2018a and Verrue, 2009) and a horizontal axis depicting the developmental stages prosed by Devore (2013). The phases proposed by Devore (2013) is used by the researcher (in a rudimentary manner and not aimed at quantification but purely illustrative) to show the possible progression of the development of a defence industry over a period of time. Figure 2.7 is an illustration of this for those defence industries managed with an autarkic defence technology and industrialisation policy. It will thus take this DTIS (on aggregate over the collective development cycles of each company within the DTIS) TIME 1 to progress from import dependence to autonomy and a Tier 1 system integrator.

Figure 2.7: Conceptual illustration of the "Ladder of Production" in the Quest for Autonomy and possibly Domination within an Autarky Approach

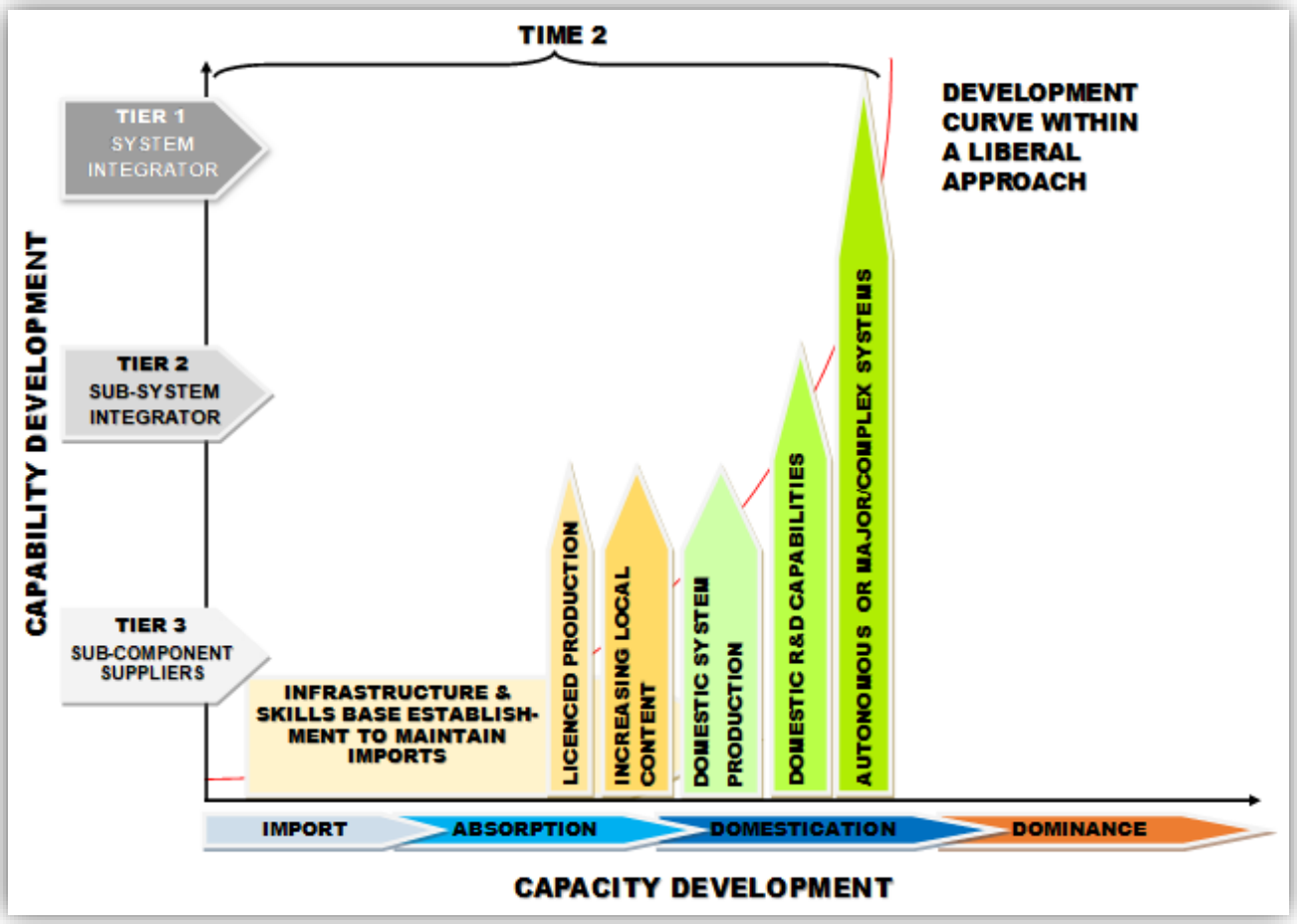


Source: Researcher's compilation of information based on a re-conceptualised "Ladder of Production" (Devore, (2013: 536) with the industry Tier System (Verrue, 2009: 13; Deloitte & Touche, 2018a: 28) to illustrate capability and capacity development over time with an autarkic defence technology and industrial policy.

The same is conceptualised in Figure 2.8 for a DTIS governed by a liberal defence industrialisation policy. Conceptually, it will take TIME 2 to progress from import dependence to

autonomy and a Tier 1 system integrator for this DTIS. The reduced time is based on the discussion above postulating that a liberal or at least a hybrid policy will result in quicker development because of access to more resources and possibly markets for export and collaboration.

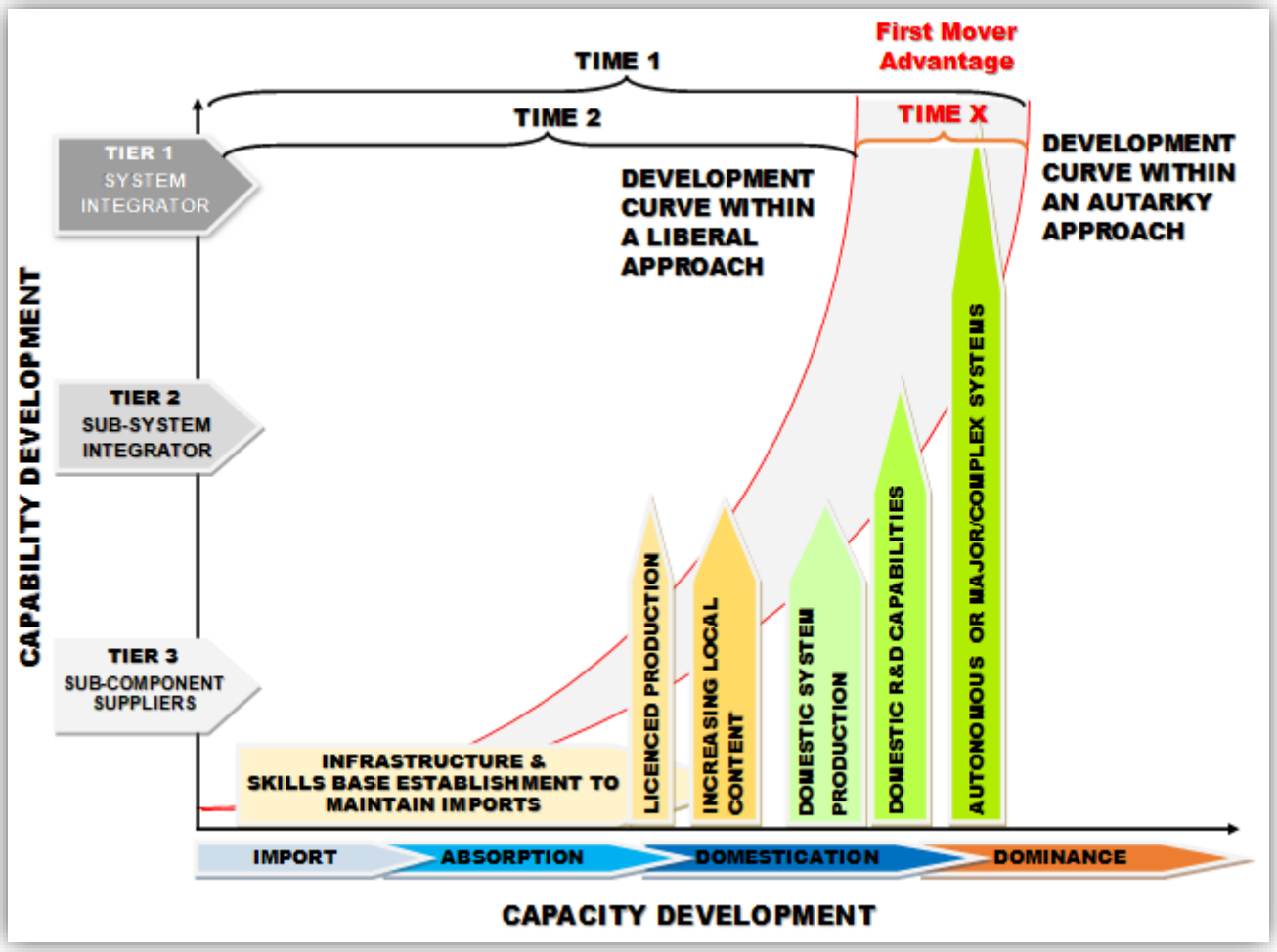
Figure 2.8: Conceptual illustration of the "Ladder of Production" in the Quest for Autonomy and possibly Domination within a Liberal/Globalised Approach



Source: Researcher's compilation of information based on a re-conceptualised "Ladder of Production" (Devore, (2013: 536) with the industry Tier System (Verrue, 2009: 13; Deloitte & Touche, 2018a: 28) to illustrate capability and capacity development over time with a liberal defence technology and industrial policy.

Figure 2.9 superimpose these two defence technology and industrial policy perspectives (Figure 2.7 and Figure 2.8) on to each other to produce a view of the difference in the time it will possibly take to progress from import dependence to autonomy. Conceptually, TIME X depicts the difference in time taken by the two approaches is to reach the same objective of autonomy and a Tier 1 system integrator. TIME X also represents the time differential (purely conceptual) facilitated by a liberal defence technology and industrial policy which is also an indication of the achievement of first-mover advantage in the market place and the positive movement towards competitive advantage and ultimately dominance.

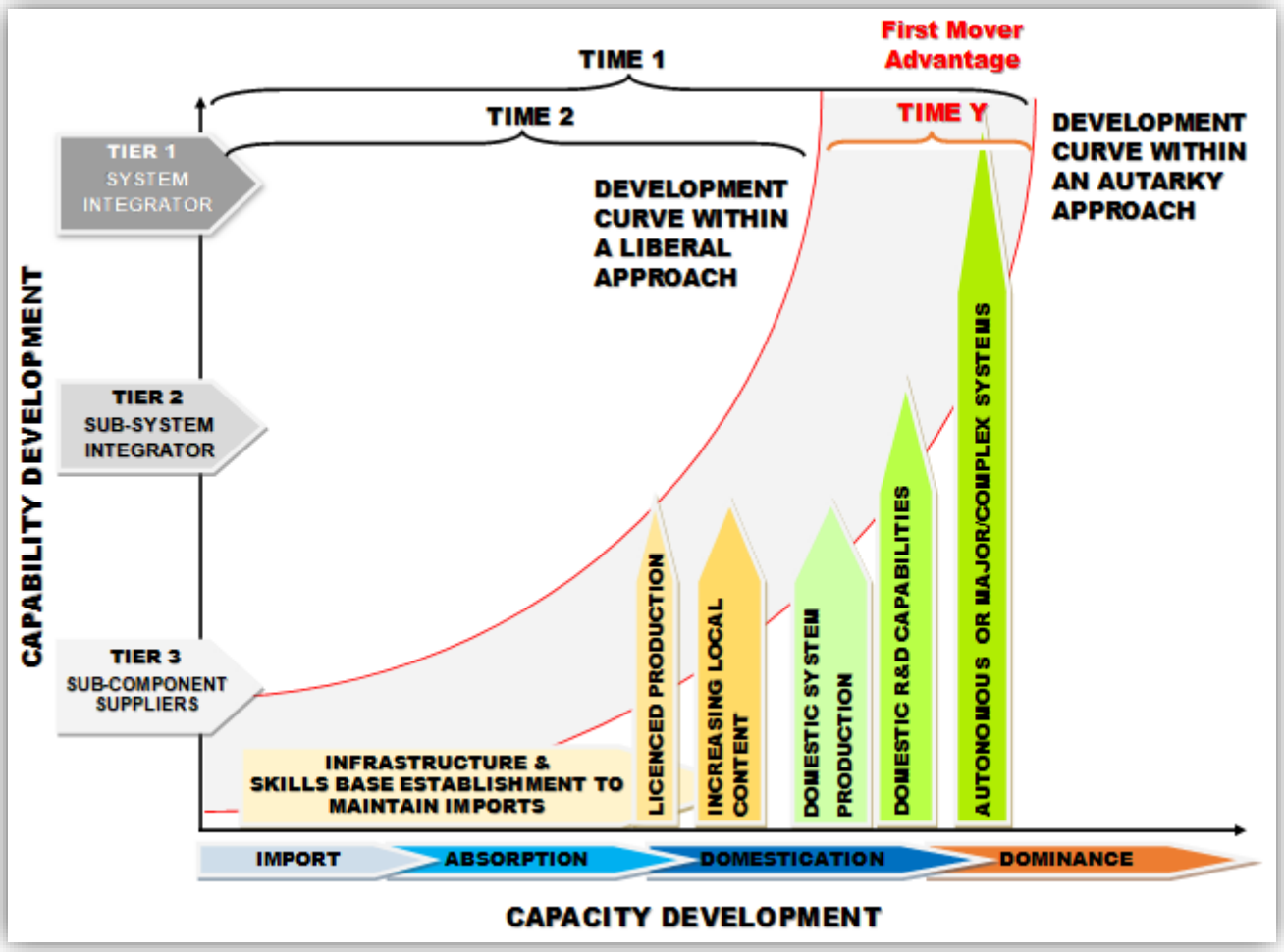
Figure 2.9: Conceptual illustration of the "Ladder of Production" in the Quest for Autonomy and possibly Domination – Contrasting the Autarky Approach and Liberal/Globalised Approach



Source: Researcher's compilation of information based on a re-conceptualised "Ladder of Production" (Devore, (2013: 536) with the industry Tier System (Verrue, 2009: 13; Deloitte & Touche, 2018a: 28) to illustrate capability and capacity development over time – contrasting the autarky approach and liberal defence technology and industrial policy.

Figure 2.10 illustrates that the achieved first-mover advantage (TIME X in Figure 2.9) could possibly be extended (TIME Y) when DTISs start the development process higher up the Tier Structure (illustrated in Figure 2.10). The DTIS started at Tier 3 as opposed to an entrepreneurial level). Even better results will be possible if the DTIS is at higher Tiers of development. Thus, for the SA DTIS to be an attractive partner within the BRIC DTIS context, the SA DTIS should strive to develop and sustain Tier 2 and 1 levels which would, and combined with a selected portfolio of strategic business levers, add considerable value to possible SA DTIS bilateral relationships with the BRIC States.

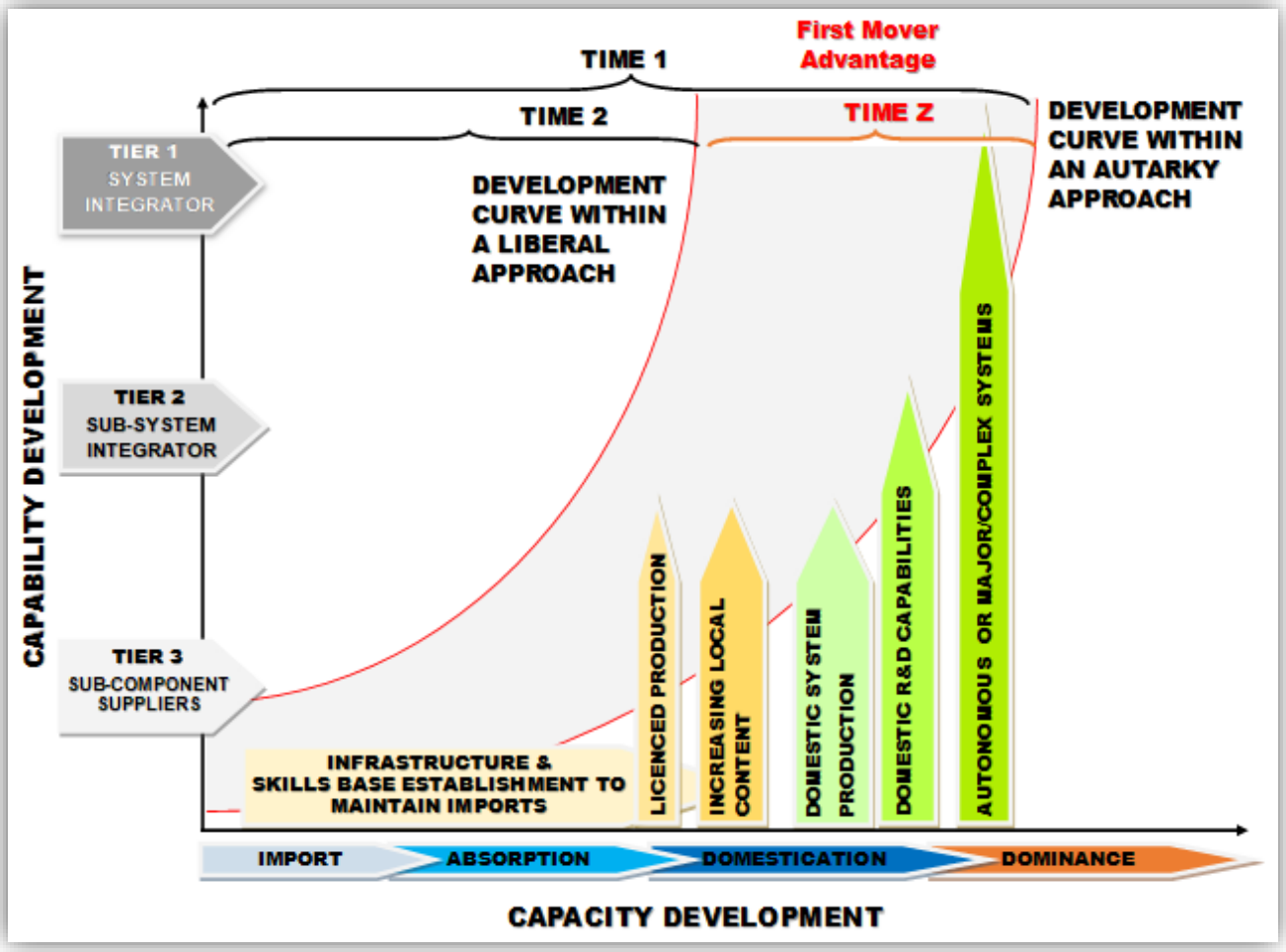
Figure 2.10: Conceptual illustration of the "Ladder of Production" in the Quest for Autonomy and possibly Domination – Contrasting the Autarky Approach and Liberal/Globalised Approach



Source: Researcher's compilation of information based on a re-conceptualised "Ladder of Production" (Devore, (2013: 536) with the industry Tier System (Verrue, 2009: 13; Deloitte & Touche, 2018a: 28) to illustrate capability and capacity development over time – contrasting the autarky approach and liberal defence technology and industrial policy.

Figure 2.11 extends the first-mover advantage even further by combining the effect achieved from starting higher up the Tier Structure (Figure 2.10) with selected strategic business levers (TIME Z). Taking in consideration that there is a possibility to follow a hybrid approach (a mixture of liberalisation and autarky defence industrial policy); a hybrid approach could possibly render a similar outcome than that of a liberal approach. This will obviously depend on how well the negative effects of autarky is mitigated and how well the positive effects of liberalisation are exploited. Defence technology and industrial strategies should provide tailored approaches to fit the country and industry-specific market conditions and mitigate the negative effects of bilateral asymmetry.

Figure 2.11: Conceptual illustration of the "Ladder of Production" in the Quest for Autonomy and possibly Domination – Contrasting the Autarky Approach and Liberal/Globalised Approach



Source: Researcher's compilation of information based on a re-conceptualised "Ladder of Production" (Devore, (2013: 535) with the industry Tier System (Verrue, 2009: 13; Deloitte & Touche, 2018a: 28) to illustrate capability and capacity development over time – contrasting the autarky approach and liberal defence technology and industrial policy.

In summary, there is no simple answer to the complexity of DTIS developmental policy and strategies. Many and varied options are available and are highly contextual. (Devore, 2009). The combinations of these options; superimposed onto domestic cycles of development, national security requirements, governmental and private funding/investment, interlaced with international market interaction and leveraged with strategic business levers; provide a highly condensed conceptual framework for this study. The researcher will now state the thesis that will govern the inductive reasoning process and research methodology throughout the remainder of the thesis.

2.4 THESIS

The thesis shape the construction of the literature studies (Chapter 2 and 3 of the thesis). It is in support of the process of inductive reasoning as proposed by the research methodology. That said, from the theoretical framework and clarified terms, the researcher posits that the SA DTIS will have to

adopt a liberal (or at the very least a hybrid) DTIS policy as an entry-level requirement to remain relevant within the defence technology and industrial ecosystem. Furthermore, the SA DTIS should be progressive and growing (ascended the 'Ladder of Production") in order to attract and sustain possible bilateral and/or multilateral DTIS relationships with the BRIC States. Such potential collaboration will require a portfolio of strategic business levers to facilitate mutually beneficial growth (or, conceptually, a shift in the development curve as per Figures 2.9 to 2.11). If there is a misalignment of DTIS policy approached and strategic business levers promoted it will be difficult for the partners (bi- or multilateral) to shift their DTIS development curves in order to gain a first-mover advantage (i.e. comparative and/or competitive advantage). The strategic business levers are highly dependent on access to and control of niche technology, products and services – without which, the application of any strategic business lever is rendered superfluous.

For the remainder of Chapter 2, the researcher will briefly explore published data about international defence technology and industrial contexts as a first glimpse of what can be construed as strategic business levers. In conjunction with the theoretical and conceptual frameworks, it will form a basis for the BRICS DTIS embedded case study in Chapter 3 of the thesis.

2.5 INTERNATIONAL FACETS SHAPING THE DEFENCE TECHNOLOGY AND INDUSTRIAL STRATEGIC BUSINESS LANDSCAPE

… the center of gravity for [DTIS] organizations continues to shift east. (Gates, et al., 2016: 17).

There is a symbiotic relationship between national defence forces and their associated national DTIS. Therefore, the first facet that contextualises understanding before delving into the DTIS is the relative ranking of militaries internationally. These rankings provide a glimpse of the relative strengths of a particular DTIS base on the ranking of the associated militaries. These relative positions of strength and levels of development are an indicator of who the global trendsetters are. The USA military is, perpetually, at the top of the ranking ("…1.28 million active military personnel, 13,398 aircraft, more than 6,200 tanks and a defence budget of $716 billion"). (BusinessTech, 2019). The Russian military is in the second place ("… 1 million active personnel, 4,000 aircraft, 21,932 tanks and a defence budget of $44 billion"). These two hegemons are followed by China, India and France. (BusinessTech, 2018 and 2019). This is a first-order indication of the asymmetry that needs mitigation between the DTIS s of South Africa, Russia, India and China if a role for the SA DTIS within BRICS is contemplated.

Instability across almost all spheres of global societies and dominant in certain regions resulted (since the Cold War) in strong (and strengthening) demand and supply of armament. Therefore, a second element for consideration, when delving into DTIS is the increasing demand for and supply of arms. International geopolitical tensions fuels this supply chain. (Allen (2017). Hays (2016: 3) states the following from a USA perspective to illustrate the point - "Feared aggression from Russia, China

and North Korea, combined with increased conflict in the Middle East and global terrorism, will drive defense spending, leading to global market opportunities for […] exporters."

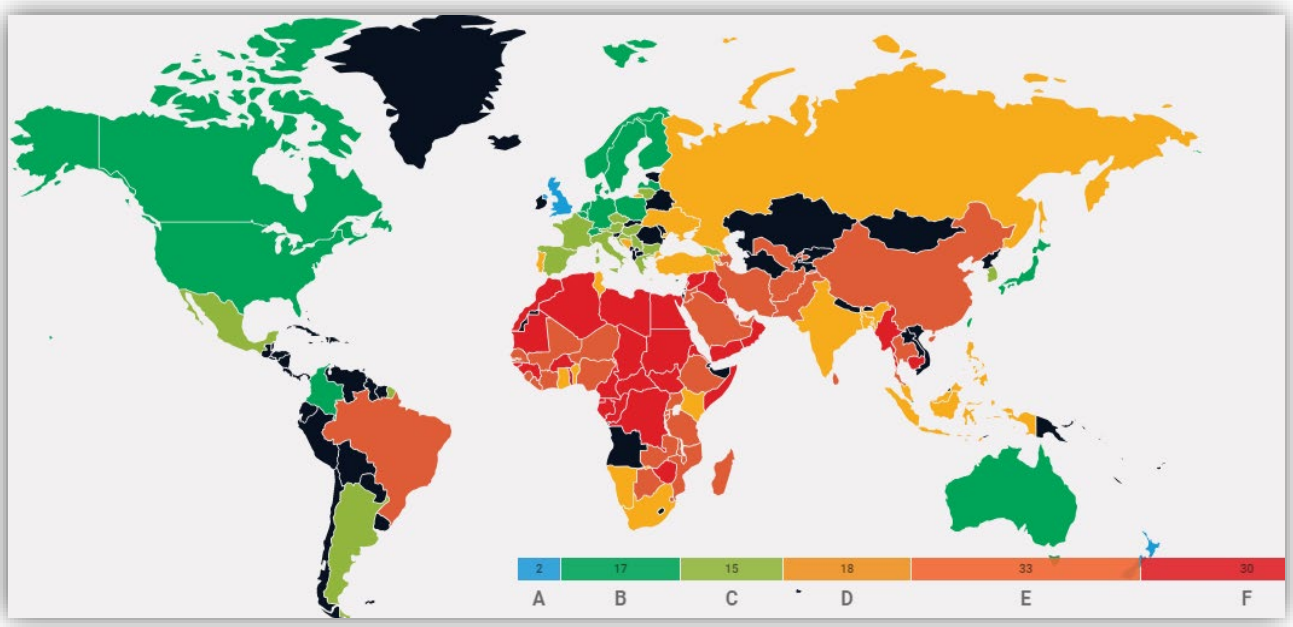
Some countries focussed on technology development since the Cold War arms race. Others nations focus on expanding their military capabilities, by implication also their DTIS. These developments and dynamics gave rise to rivals to the traditional arms supply duopoly of the USA and Russia - "… combined supplied 56 percent of the arms exports from 2012 to 2016." (Allen, 2017: 4). The challengers are India and China. (Allen, 2017), supporting the asymmetry argument and the shift towards the East of DTIS growth and opportunities.

There also seem to be a preference for bilateralism concerning technology and armament procurement programmes. The UK DOD favour bilateral collaboration for the purposes of technology and equipment development and support. This is based on the optimum balance perceived to be provided by bilateralism between advantages and disadvantages of DTIS relationships building. (United Kingdom, 2012).

Another perspective is the level of transparency about defence business of each country. The Government Defence Corruption Index, managed by Transparency International (Defence and Security), provides a comparative glimpse about national transparency profiles as well as comprehensive reports on each country. Thus, the data presented by several and varied authors and consulting firms may have inherent flaws based on the level of transparency available. The researcher takes note of this fact for this thesis. Unfortunately, the BRICS States is not the most exemplary in terms of transparency. Much data is, however, available and it will be used and triangulated where possible to provide useful context to the thesis.

With China, India and Russia being primary members of BRICS, and considering the data stated by BusinessTech (2019) above, then South Africa is in good company from a DTIS perspective. This statement by the researcher is supported by expressions on military expenditure growth amongst the top militaries internationally. SIPRI data indicates that the international military spends increased to US$1.7 trillion (reflecting only a 1.1% increase on 2016 data). This very slight increase is on the back of a plateau experienced during the period of 2012-2016. (BusinessTech, 2018). Internationally, military spending volumes are shifting away from the West. (BusinessTech, 2019). The significant growth in demand for armament in Asian (e.g. India and China), Middle East (e.g. Saudi Arabia) and Oceania States drives the shift and expanding international military spending. (BusinessTech, 2019). These positive trend indicators for the East are, however, brutally calibrated by the fact that all the BRICS States fall within the moderate to high corruption index status. Corruption erodes public trust in defence and its' associated DTIS (Abbas, Anderson, Dixon, Hurd & Raymond, 2016: 1), which undermines international collaboration. Figure 2.12 provides a cartographic representation of the relative transparency on defence business globally (that latest data is up to 2015) with blue representing the least corrupt –

Figure 2.12: Global Government Defence Corruption Index



Source: GI – Global, 2015[6].

China, the second-largest military spender globally (Yang, 2017; BusinessTech, 2018 and others), increased its military spending by 5.6% to $228 billion in 2017. This means that China's spending as a share of world military expenditure has risen from 5.8% in 2008 to 13% in 2017. In contrast - Russia's military spending in 2017 was 20% lower than in 2016 (at $66.3 billion), the first annual decrease since 1998 – a result of a restricted military budget due to economic issues in the country, the researchers said. Despite military expenditure increasing in sub-Saharan Africa, SIPRI found that South Africa has also seen a decrease in military expenditure." (BusinessTech, 2018). China would then seem to be an obvious, first-order candidate for DTIS bilateral collaboration – that is if asymmetry can be kept at bay to assure mutual beneficiation.

There is a number of countries outside the USA/Europe sphere of dominance; e.g. Russia, China, South Korea, Israel and Turkey; that are large and growing armament exporters. (SIPRI, 2019). This obviously pressurises the armament supply chain relationships with traditional armament exporters for better performance and pricing. The drive by the established and mature DTIS (typically Western companies) to lower costs associated with R&D and production resulted in a transformation of the international defence technology and industrial ecosystem. (Kurç & Neuman, 2017). "By the mid-1980s, inter-industry agreements were replacing inter-governmental agreements on arms production collaboration. The transfer of technology, technical data, and industrial know-how became the new form of exchange between States and defence companies, thus transforming arms production

[6] GI – Global colour and band legend representing level of corruption risk: Band A – Very low risk of corruption; Band B - Low risk of corruption; Band C - Moderate risk of corruption; Band D - High risk of corruption; Band E - Very high risk of corruption ; and Band F - Critical risk of corruption. (Abbas, *et al.*, 2016).

into a more transnational endeavour." (Kurç & Neuman, 2017: 219). This was a shift towards liberalism and resulted in less self-sufficiency for various countries as well as complex supply chains.

The consolidation resulted in large DTISs consisting of expansive multi-national conglomerates in the West and several emerging markets. Due to the limitations of domestic markets, the established defence technology and industrial multi-nationals began seeking opportunities in the emerging defence markets. The dynamics resulted in an integrated multi-national arms production and R&D system of varying complexity. The international defence technology and industrial market are littered with opportunity if symmetric relationships can be built and a prudent portfolio of strategic business levers is used. The market is, however, also fenced by foreign policy (amongst other things) to ensure bi- and multi-directional flow of goods, services, funding and knowledge.

"Since [Adam] Smith's era[7], succeeding generations of scholars and policymakers accepted the premise that DTIS self-sufficiency (and dominance) confers substantial foreign policy benefits." (Devore, 2013: 535). BRICS is but one of the multi-national economic alliances functioning within this integrated system, presenting opportunities for the DTIS both amongst the BRICS States and with the international DTIS as directed by individual foreign policy. Considering the history of linkages between defence technology and industrial policy and foreign policy objectives, Devore (2013) argues that defence technology and industrial self-sufficiency have a recognised history as an essential requirement for State foreign policy independence. Consequently, where States are dependent on armament imports, they are considered to be subservient to States that are capable of armament development, production and exports. This affords the armament production States greater relative national power from an international relations perspective and thus fuelling asymmetry. It also fuels the State's protectionist motive (autarky) of defence technology and industrial self-sufficiency vs. a non-interventionist (liberal) national policy - which might be prescribed for the rest of the national economy. "Besides the diplomatic benefits of arms production, the unwillingness of great powers either to export cutting-edge weaponry or build systems designed for unique geographic and climatic conditions convinced many governments that indigenous defense industries were essential to military effectiveness." (Devore, 2013: 535). Self-sufficiency is the obvious next frontier.

Then there is a continuous cycle of competitive build-up amongst West and Eastern DTISs that could generate opportunities for countries such as South Africa. For example, Russia set out, after the cessation of the Cold War, to modernise its military whilst the West, during this period, focused on expanding its expeditionary and asymmetric types of warfare. (Gressel, 2017). The modernised Russian military and associated industrial renewal is a powerful motivation for the Western Allies to reinvigorate their individual military modernisation programmes. (Gressel, 2017). Feeling the pressure from the Russian renewal and expansion, several European States have defence acquisition and

[7] "Autarkic systems are the opposite of liberal economic systems, which encourage the free flow of goods and services. Adam Smith, the 18th-century Scottish philosopher who is also considered to be the father of modern economics, was one of the first modern thinkers to question the benefits of autarkic policies." (Encyclopaedia Britannica, 2019).

development programmes that focus on the development of next-generation military platforms. For example, Germany and France (next-generation tank); the Sweden, Germany, UK and USA (next-generation stand-off munitions; Germany and the USA (next-generation air-defence platforms and systems). (Gressel, 2017). These developments motivate international DTISs to capture a competitive/comparative advantage in order to maintain market share, penetrate new markets and/or dominate specific markets. Russia, during this post-Cold War period, had to contend with its inability to build long-lasting partnerships with international companies/Governments; complex Sino-Russian- and India-Russian DTIS cooperation; continuous intellectual capital flight (brain-drain); and the cost of developing complex military systems and platforms in an attempt to keep up with industrial superpowers such as the USA and China. (Gressel, 2017). Russia will continuously feel market pressure from the USA and European DTIS innovation and modernisation programmes, thus inducing a kind of perpetual cycle much like that experienced during the Cold War in the DTIS.

It is within this complexity that the SA DTIS should continuously explore avenues to remain relevant as an attractive international defence technology and industrial bilateral partner. Careful consideration should be given to which worldview (realist or idealist) and defence technological and industrial policy school of thought (liberalisation, autarky or a hybridisation) should be ascribed to - and lastly, which strategic business levers are prudent for SA DTIS bilateral relationships with the BRIC States.

The following sections will explore some of the facets that drive or hamper DTIS development. The section also uncovers some strategic business levers used to shape the defence technology and industrial ecosystem. This explorative discussion aims at informing the discussion and analysis in Chapter 3 of the thesis that focuses on the DTISs of BRICS States.

2.5.1 A shift towards Liberalisation

Caverley (2007: 601 & 608) states – "… the United States strongly shifted away from its default autarkic approach in the mid-1970s because the gains of globalization in weapons production—reduced costs and, especially, enhanced quality - were dramatic. […] The United States, preferring the current transnational arrangement to defense autarky, makes economic and technological sacrifices to consolidate its commanding position.

With the global leader in defence and defence technology and industrialisation shifting away from autarchy, probably more towards a hybrid policy rather than total liberalisation, the rest of the world should take note. As such, - "In the article 'Defence Indigenisation: Made in India, by India, for India', […] Bikramdeep Singh has very aptly articulated that as India inches to achieve its rightful strategic autonomy, it needs to do much more in planting the seeds for a commercially viable and technologically robust indigenous defence industrial base." (Saxena, 2016: 14). In order to achieve this, India has significantly liberalised its DTIS policy to unlock the potential of various strategic business levers. This is discussed in more detail in Chapter 3 of the thesis.

2.5.2 Emergence and Expansion

Defence is undoubtedly a strategic sector and countries all over the world accord special treatment to nurture and develop this vital sector. (Behera, 2015).

The US and European DTISs are well known for their capabilities, capacities and global reach. (Nishith Desai Associates, 2018; Lineberger & Hussain, 2018b). However, what constitutes the emerging DTIS might not be that well known. Maiti (2018) provided a snapshot of emerging DTIS markets and their GDP growth rates (Figure 2.13) –

Figure 2.13: Major emerging markets in terms of defence expenditure and their expected GDP growth rates (2012-2020)

Source: Maiti (2018: 4).

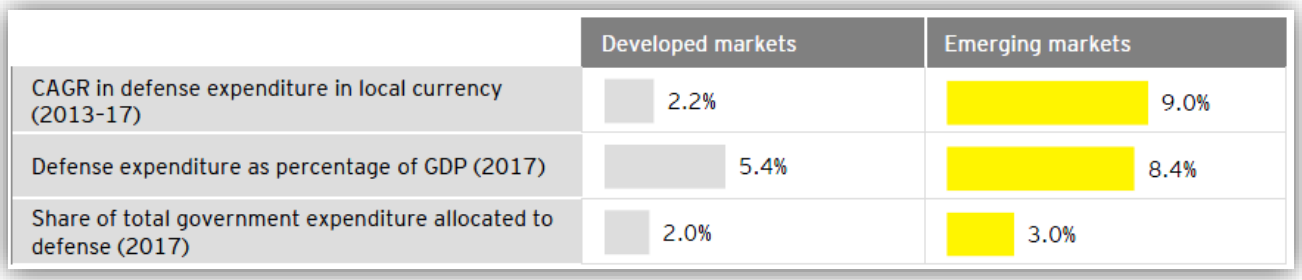
Interestingly the BRIC States are represented as emerging markets. South Africa as a BRICS partner state did not make the grade. It thus signals the opportunity for the SA DTIS within bi-and multilateral relationships. Such relationship-building would have been facilitated if these emerging defence markets embrace a liberal defence technology and industrial policy. However, according to Kurç and Neuman (2017), emerging DTIS markets are reluctant to adopt liberal defence technology and industrial policies. Kurç and Neuman (2017: 221) states that - “One size policy does not fit all. Different internal dynamics shape the defence industrialization policies of the emerging states.” It is

for this reason that the thesis explores what the BRIC DTISs in order to understand which strategic business levers would be prudent in bilateral DTIS relationship building.

Unfortunately, there is also a distinct overlap between this map and the Global Index for corruption map above when it comes to emerging DTIS markets that show a high to critical risk for corruption. Defence technology and industrial activity in such environments are precarious because of the political fallout when dubious practices are required to enter or do business in such (highly politicised) business environments. This should become clearer in Chapter 3 of the thesis when the researcher discusses specific strategic business levers used by BRICS states.

Linked to the discussion about developed and emerging DTISs are whether they are expanding or contracting. The traditional superiority of A&DTIS clusters situated in the US and Europe are challenged by expanding A&DTIS in other parts of the world (Maiti, 2018). This trend is set to continue pinned against Lineberger and Hussain's (2018) prediction of a 3% CAGR in defence spending in the medium-term.

Figure 2.14: Comparison between developed and emerging markets in terms of defence spending



Source: Maiti (2018: 2).

Maiti (2018) produced an Earnest and Young A&DTIS market analysis report analysing growth levers in the emerging markets. Using the Stockholm International Peace Research Institute (SIPRI) data for the period 2013-2017, Maiti (2018) states that the US defence expenditure contracted annually by 2.4% (with increases projected for 2019 – also in Lineberger & Hussain, 2018b: 7-8) and the European defence spending increased by 1.2% compound annual growth rate (CAGR). According to Maiti (2018), these figures indicate defence spending under pressure, an opinion supported by Lineberger and Hussain (2018). Emerging economies such as the Middle East and Asia are exhibiting growth trends. (Maiti, 2018; Lineberger & Hussain, 2018b).

Lineberger and Hussain (2018) projects increases in military expenditure for India (8%), Russia (5,9%) and China (5.4%); challenging the traditionally strong US defence industrial sector. "While the positive outlook for aircraft deliveries and defence expenditure [also Lineberger & Hussain (2018)] makes emerging and developing economies the key markets for the export of [DTIS] equipment and services, the positive outlook for GDP and foreign direct investment (FDI) suggests that they have a potential to emerge as manufacturing hubs provided that they get the right impetus from the local

governments." (Maiti, 2018: 3). This expanding market creates favourable conditions for South Africa as a BRICS alliance partner to seek bilateral, mutually beneficial, DTIS opportunities.

Thus, with defence requirements and the DTIS markets in continuous flux, leading DTIS are and will look eastward more-and-more in order to expand their market segments. A number of business strategies could be levered to accomplish this. One such business strategy is relationship building to exploit demand- and supply-side dynamics. Government plays a significant role in foreign relationship building.

At the very least, growth is projected for BRIC DTISs, which is very fortunate for the fifth economic partner State of BRICS – i.e. South Africa. This supports the thesis problem statement. The SA DTIS can be considered central to the South African foreign policy, defence and security complex, economic growth and new technology development. (South Africa, 2017a; NDIC, 2018). However, the SA DTIS is barely profitable, fuelling perceptions, from a BRICS multilateral perspective, that the SA DTIS has very little to offer economically as well as for defence and security.

Compounding the predicament and thus the possible exploitation of said opportunity abound is the limited awareness of the strategic business levers prudent for BRICS DTIS relationship building. Vitalising the SA DTIS capabilities require a clear understanding of the prevailing strategic defence technology and industrial business environment, policy approaches and the strategic business levers in use and preferred amongst the BRICS States to unlock relationship building. Thus the question - *which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States?* Another facet to briefly explore is how national interest?

There are several national policy objectives supporting the existence of a domestic DTIS. Some of these objectives are coupled to e.g. import-substitution initiatives to reduce the economic encumbrance of armament acquisition. Other national policy objectives drive the notion that a domestic DTIS support national skills development, innovation and a strengthened technology-base. Yet other more intangible policy objectives relate to national prestige in the international community and typically among emerging States. (Kurç & Neuman, 2017). Kurç and Neuman (2017: 221) states aptly that domestic DTIS is the - "symbolic key to attain international stature." This stature can be linked to the national interest. For example, Raska (2017) states that China perceives the Chinese DTIS as a national interest that requires strengthening in order to support Chinese geopolitical aspirations. These aspirations are obviously closely associated with the role of the Government.

2.5.3 Role of the Government

The roles of the government have been highlighted conceptually in the clarification of terms. These potential roles facilitate the symbiotic interaction between government and the DTIS by means of policy, departmental functions and funding. A UK DOD perspective on the role of government is – "The [UK] Government has a vital role in supporting UK-based industry to succeed in a competitive global marketplace". (United Kingdom, 2012: 8). That role is expanded on in Figure 2.2. Some of

these roles are supported by Dunning and Lundan (2008) and Shafaeddin (2005) in Devore (2013: 542) - "[G]overnments can promote firms' successful adaptation by facilitating capital accumulation, encouraging foreign direct investment, and protecting industries during times of transition." Berger (2005) and Dunning and Lundan, 2008 in Devore (2013: 542) also underline Governmental support role by means of R&D investments and business facilitation by means of international negotiation, "…shape the competitive advantages and terms of trade facing their firms."

More specifically, the role of the Presidency/Executive in the success of the DTIS of that country should not be underestimated. Russia is a case in point. The Russian Presidency is intimately involved in the leveraging and ongoing success of the Russian DTIS. As such Bret (2017) states that the role of the Russian Presidency is pivotal to the perceived strength of the Russian DTIS. It is based on an integrated structure (that allows for some internal competitive behaviour) that is constantly monitored by the Presidency. Centralisation of control over the Russian DTIS exports is legislated and continuously reviewed and updated since the start of the State Armaments Programme. "Notably, in 2016 President Putin amended the programme to grant integrated companies the right to sign foreign arms trade contracts" (Bret, 2017: 20), which indicate some liberalisation of the Russian DTIS policy emerging. These concessions assist with relaxing the centralised control over the prospects of armament export contracts since the Russian-Georgian war (*circa* 2008) and the establishment of the Military-Industrial Commission, chaired by the President – as a result of the 2014 sanction. The Military-Industrial Commission is perceived to be the most authoritative entity managing defence issues. (Bret, 2017).

The integrated nature of the role of Government in the DTIS is further illustrated by the Russian Ministry of Foreign Affairs and Ministry of Trade direct support to Russian DTIS market penetration and retention initiatives. Russia thus aims at using their DTIS to shore-up their brittle economy. For Brazil the linkages between foreign policy and defence industry are clear from the following statement – "Just as worrying, there are signs that Brazil's Ministry of Foreign Affairs is attempting to scale up the country's arms exports. The Ministry recently circulated a strategic commercial plan ("Planejamento Estratégico de Promoção Comercial", or PEPCOM 2017) to its embassies and consulates around the world. The Ministry advises Brazilian diplomats to ratchet up their efforts to sell military equipment, among other products. Such sales would include a range of Brazilian weaponry – from fighter planes to firearms and cluster munitions" (Muggah & Thompson, 2017; Da Silva, 2017). The ability of the DTIS to create employment is recognised as one element of economic development. Another element is industry modernisation. (Bret, 2017). This is an obvious idealist world view.

In a similar fashion as Russia; China also leverages its bulging DTIS and associated exports as a foreign policy lever for (soft) power projection. "… China is using arms exports as an instrument of its foreign policy to project power and influence to create strategic dependencies in areas that are vital to China's interests". (Raska, 2017: 59). This leverage is symbiotic to a strengthened Chinese DTIS in terms of national interest, stated above. Increasingly, China is marketing the product of its DTIS as alternative solutions to that traditionally provided by Russia. This is, currently, being done on the Latin

American -, African – and Central Asian continents. With continuous improvement in product quality and advances in technological sophistication, China will be able to compete in (probably most) markets with established North American and European nations. (Raska, 2017). With the assistance of the Chinese Government, the Chinese DTIS are able to compete in the armament market based on price and flexible financing arrangements (Raska, 2017), which is particularly welcome in cash-strapped developing world countries.

Squeff and De Assis (2015) writes that the DTIS related activity of Ministries of/for Defence (MOD) has a significant impact on the success of domestic DTIS both locally and internationally. This is based on the evidence that defence industries that those defence industries that does not supply its national defence force with products or services are rarely successful internationally.

The role and importance of the MOD and National Defence Force to the development of the DTIS are highlighted next. A DTIS is a *sine qua non* for national defence capability. (Frolov, 2017; Lin & Shen, 2018), and thus the important role of the National Defence Force in DTIS development. Lin and Shen (2018: 122) writes from a historical Chinese industrial perspective that - "[c]reating a system of national defence as strong as that in [Western countries] required defence industries capable of producing equally sophisticated military equipment." Thus the importance of MODs and other ministries to integrate departmental-level strategies to ensure market access, relationship building, funding, flexibility in approaches to contracts and supply chain optimisation for the DTIS. This is probably nowhere more evident as in Russia after the 2014 crisis that resulted in sanctions and an intensified national import substitution programme lead by the Deputy Prime Minister, based on Decree No. 785, for the Russian DTIS. (Frolov, 2017).

The MOD has a significant voice in the domestic defence sector structure due to the ability to choose whether to be a consumer only (buyer) and/or be an investor/owner of all or selected defence industrial capabilities. (United Kingdom, 2005; Squeff & De Assis, 2015). Thus, if a country pursues a revitalisation strategy that includes a foreign collaboration it would be advisable to first invest inwardly (R&D and self-consumption) and then establish relationships with the foreign MODs that have a close fit with the domestic DTIS capability portfolio. This is possible within the BRICS context due to established defence and DTIS relationships, managed by the SA MOD under the custodianship of the SA DOD and Armscor (supported by departments such as International Relations and Cooperation, Trade and Industry and Public Enterprises). This interaction is highlighted in the conceptual framework of the thesis (Figure 2.6). The role of Government is thus pivotal to the shifting of the development curve as conceptualised in Figures 2.10 and 2.11. The government also plays a significant role in relationships building, R&D, portfolio construction, supply chains, investment and funding and arms control (amongst others) –discussions on these following.

2.5.4 Relationship Building

Defence technology and industrial relationship building started as early as the 1980s in a quest to lower production costs and access new technology. (Kurç & Neuman, 2017). Humphries and

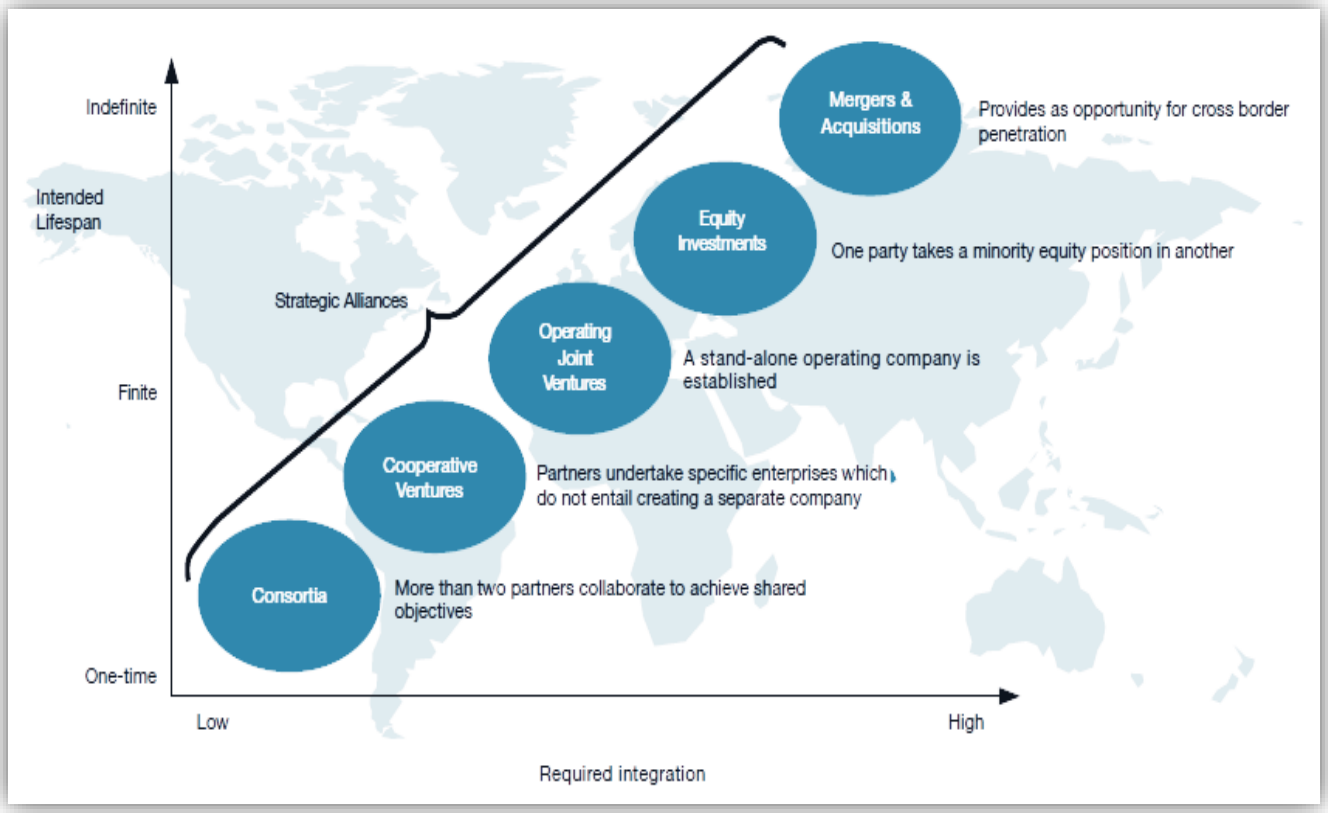
Wilding (2004) in Squeff and De Assis (2015) positions relationship building as a strategic competitive advantage within the DTIS market place. This relationship-building is calibrated by the uniqueness of the defence market (complex interaction between specific skills and asset development, arms control, structural elements, national interests, national security, sources of funding, foreign and trade policy, etc.). They are also of the opinion that relationship building has a long-term focus. This provides space for the incubation of trust that represents an intangible entry barrier for rivals and competitor suppliers. "[C]ontracts do not depend only on activities of the partnership or their transaction costs, but on the trust relationships that emerge over repeated ties." (Squeff and De Assis, 2015: 10). For example, Russia is failing to create lasting relationships internationally due to Russian foreign policy and Russian - "… reluctance to engage in deepened cooperation with other states. (Gressel, 2017: 35). Relationship building also has a downside - "If Moscow were to deepen its defence ties with China now, Russia would become a subcontractor of the Chinese military-industrial complex – something Moscow is keen to avoid. India, on the other hand, wants to diversify its armament suppliers and R&D cooperation away from Russia" (Gressel, 2017: 35), but Russia is obviously squeamish based on the Chinese predicament.

It is vital for the executive layer of large DTIS companies to adapt capital expenditure and R&D-related decision-making in order to access new technology and relationships. This approach will assist with the shift in the development curve. (Starr & Jones, 2018). Relationship building can thus be positively associated with development and future competitive advantage - "… collaborate with defense customers to tap into technology innovation outside the [DTIS] and adapt it to future platforms rather than developing bespoke solutions." (Starr & Jones, 2018: 6).

Hooke (2005) provides a synoptic comparative illustration depicting some of the relationship-building or strategic alliance crafting instruments that are available to the DTIS (Figure 2.15). Hooke (2005) states that direct exports of equipment normally requires those exports to be accompanied by local participation. This local participation requirement brought about several types of strategic alliances or strategic business levers.

"Clearly it is vital that companies select the right form of alliance structure to meet the circumstances and this in itself can be the focus of intense negotiation, given that it can indicate either a short- or long-term commitment to the partner and its host country." (Hooke, 2005: 27). This corresponds to the notion of Kurç and Neuman (2017: 221), stated earlier, that - "One size policy does not fit all." It also underlines the research problem of understanding the BRICS DTIS strategic business requirements.

Figure 2.15: Strategic Alliance Structure



Source: Hooke (2005: 28).

For example, China uses what is labelled "military-technical packages" to complement other economic and trade relationships with clients in various developing countries on the African, Asian continents and in the Middle East. (Raska, 2017). Internally, China also focuses on establishing dual-use technologies relationships between commercial and military industries as part of "…joint civil-military technology cooperation" (Raska, 2017: 57), or Joint Ventures (JV).

Relationship building in the DTIS has a history of consolidation and divestiture based on Mergers and Acquisitions (M&A) strategies that aim at reducing costs, optimising supply chains, accessing R&D opportunities and market penetration in general. A short term focus invariably focuses on contracting variables such as delivery time and unit costs. It would be interesting to understand the focus of BRICS countries – be it long-term relationship building or short-term satisfaction.

Before the 1980s, relationship building between various national DTIS was based on government-to-government agreements (realism paradigm and autarkic). Currently, these relationships are forged along the lines of industry-to-industry agreements. (Kurç & Neuman, 2017). This conforms more to liberal (or at least hybrid) defence technology and industrialisation policy. "Through these growing international inter-firm activities, defence companies were able to establish "intricate international networks of research, production and information". (Skons, 1993: 165 in Kurç & Neuman, 2017). These networks (or consolidation) in many cases eroded self-sufficiency but

allowed access to markets and new technology to be able to contribute to economic growth, foreign policy and military options.

Starr and Jones (2018) and Maiti (2018) concluded that it is paramount for DTISs to seek new market penetration and relationships building as a business strategy within emerging markets. Gate, *et al*. (2016: 18) states that a shift in business strategy from a "make in" business model to a "sell to" strategy in an emerging DTIS market requires a niche approach. Relationship building is particularly suitable for this shift.

Lineberger and Hussain (2018) states that M&A of defence industries has accelerated since 2017 and the trend is likely to continue and driven by OEMs with large cash reserves in their quest for increased profit/shareholder value. (Gates, *et al*., 2016; Lineberger & Hussain, 2018b). Gates, *et al*. (2016) state that M&A as a business strategy is on the increase enabling DTISs to shape/reshape their capability and product portfolios. On a global scale, it is projected that M&A, as a business strategy for capability consolidation and/or portfolio expansion/reshaping, will enable increased negotiating leverage during contracting for at least the medium-term. (Gates, *et al*., 2016; Lineberger & Hussain, 2018b). Mergers and Acquisition that positively impact both horizontal and vertical capability integration across the supply chain are regarded as advantageous.

Another form of relationship building is establishing business partnerships through JVs, a trend on the increase. (Hooke, 2005; Gates, *et al*., 2016; Maiti, 2018; Lineberger & Hussain, 2018b). "[S]hared risk and reward agreements and strategic alliances ranging from consortia to joint ventures were becoming [after the end of the Cold War] increasingly popular to reduce the risk associated with major procurement programmes." (Hooke, 2005: 3). JVs, according to Lineberger and Hussain (2018), could be a preferred strategy by companies seeking to enhance their market position (typically as an antidote to pressures from suppliers and rivals) and gain access to new technology or opportunities (Gates, *et al*., 2016), which is important in an industry that is based on continuous innovation). What makes JVs particularly effective in relationship building and product development is the characteristic that allows for client participation in the processes increases the probability of success. (Squeff and De Assis, 2015).

Joint Ventures is a preferred strategy with which to expand competitiveness due to its inherent risk-sharing structure as compared to M&A strategies. "Changes in regulations, access to new technologies, the need for local partners, and a fast-growing [DTIS] are likely to make India and the Middle East 'hot spots' for cross-border JVs in the near-term for both commercial aircraft and defence sectors." (Lineberger & Hussain, 2018b: 16). In order to develop the Indian DTIS, India seems to have developed an appetite for armament imports diversification, JVs and technology transfers. Russia-India JVs are based on a long-term Russia-India strategic client relationship. It involves the development of the next model multi-role helicopter in India (thus developing industrial capability in India) on the back of another lease agreement for a Russian multi-role nuclear submarine; technology development cooperation with the building of the Brahmos missile system. This Russia-India strategic DTIS relationship also has a geopolitical dimension. Russia is using, to a certain extent, its relationship

with India to balance the Chinese DTIS rivalry in Pakistan and Bangladesh and elsewhere (Algeria, South Korea and Indonesia). (Bret, 2017). As stated earlier, DTIS relationships between foreign States have a geopolitical impact.

Relationships building within national DTISs could take the form of traditional partnering between legacy industries or partnering between *avant-garde* industries in order to stimulate innovation (from a niche technology/product- as well as business process perspective). “Although large states’ multinational corporations dominate many forms of arms production, smaller firms in small and medium states can compete in niches where scale and scope economies are comparatively unimportant.” (Dowdall, Braddon & Hartley, 2004 in Devore, 2013: 542). This refers to the asymmetry predicament. “States can therefore enhance their leverage within the global defense market by positioning their corporations [possibly through JVs or M&As] as producers of scarce components or enabling them to perfect hard-to-master industrial processes” (Devore, 2013: 543), in order to mitigate some or all the negative effect of asymmetry theory.

Gates, *et al*. (2016) is of the opinion that it is JVs between non-traditional industries that hold innovative opportunities tailorable for new markets. Strategic partnering between US and European defence industries and interested parties in emerging economies could generate much value by establishing local supply chains, production capabilities and R&D facilities. (Maiti, 2018). This could typically take the form of a JV that would allow for knowledge and risk-sharing. Maiti (2018) also emphasise the importance of trade relations between these countries. These can be driven by military expansion and ambition, by typically countries such as the BRIC States, in combination with expanded defence industrial capacity and strategic partnering internationally.

A, sometimes contentious, form of relationship building, is armament donations. This constitutes the transfer of arms from one country to another without cost. For example, Brazil donated arms to several countries over an extended period of time. Countries included are Mozambique, Bolivia, Paraguay, Ecuador, Paraguay, Ecuador and Bolivia. The transfers were mostly aircraft. Reasons stated was linked to the fact that Brazil had more modern aircraft, the aircraft was not economical to maintain and repair anymore and to strengthen bilateral relations. (Asano & Nascimento, 2015). Thus, relationship building through donations could lock the receiving country into a supply chain of the donor countries defence industry without any technology transfer, merger, JV contractual complexities. It also fertilises the soil for future upgrades to newer versions of the particular platform(s) if the donor country leverages the donation as a market penetration opportunity rather than a disposal opportunity. This is a notorious strategy utilised by states such as the USA and German.

The obvious outcome of some of these strategic business levers is DTIS consolidation, or to a lesser extent, an increase in DTIS supply chain density between partner States. This density is achieved with what is termed industrial clustering. Multi-national industrial clustering is the direct result of relationship building (Kurç & Neuman, 2017), for example, the clustering of European defence requirements, typically under the banner of the European Union (EU), to enable block procurement and acquisition programmes. (Starr & Jones, 2018). This would certainly increase pressure on

suppliers in terms of issues such as unit cost, supply chain management, configuration management, security arrangements, and arms control regulation. Block procurement/acquisition programmes or strategies also aims at the standardisation of technologies and processes to simplify the supply chain and thus realising significant cost and time savings. These strategy levers are in turn driven by defence requirements (especially in largescale defence cooperation alliances such as NATO and the EU) for interoperability and redundancy. Technology transfer arrangements between partner States are more than often agreed to, in order to strengthen trust and cooperation and share risk. Clustering, technology transfer and knowledge sharing invariably fuel innovation and thus development which is required to shift the development curve favourably. Research and development is key to this process.

2.5.5 Research and Development Driven Innovation

Research and development are crucial for an innovation-based strategy. Yet, internationally, DTISs are comparatively low spenders on R&D. (Starr & Jones, 2018). For example, the US DOD has been relentless in reducing defence spending on R&D, thus shifting the burden of innovation to the DTIS. Research and development driven innovation in the DTIS have, however, increased since 2016, fuelling new product and service development in the interest of capturing new growth segments. (Gates, *et al*., 2016). The best strategy for DTISs, according to Starr and Jones (2018), are to compete based on niche technology/product portfolios and/or industrial capability. This still conforms to well recognised strategic management theory typically found in the technology industries. (Thompson, Strickland & Gamble, 2005). Gates, *et al*. (2016) uses data from a 2016 Forbes survey to explain that defence industries prefer to establish organic growth in capability through internal investment and R&D, above JV and M&A strategies. What is not said is that once technologies and product portfolios mature, these become more suitable for leveraging within a JV and M&A growth strategy. It is thus of paramount importance for the DTIS to invest in innovation via R&D programmes to remain competitive (Gates, *et al*., 2016; Starr & Jones, 2018; Lineberger & Hussain, 2018b).

Competitive advantage is often delivered by bespoke solutions that deliver niche solutions and/or disruptors. The international trend within the DTIS has always leaned towards bespoke products and technology solutions. A growing need exists for DTISs to form strategic partnerships[8] with technology companies and innovators in the larger commercial market (typically in the dual-use domain) in order to have access to the latest knowledge that can be adapted to the requirements of the defence client. (Starr & Jones, 2018). According to Sithole (2015), bilateral agreements have a better legal foundation within which to achieve technology development. Bilateral relationships, formalised in agreements, has obvious advantages in terms of R&D cost savings, optimising time-to-market (or operations), early market penetration, innovative solutions - to name but a few.

[8] "While the concept of a 'strategic partnership' remains unclear in international relations, it conveys a relationship of significance and stature that supplements ordinary bilateral relationships, although the latter are better defined and binding than the former." (Sithole, 2015: iv).

2.5.6 Portfolio Flexibility and Cost Structure Optimisation

Strategic flexibility remains a key competitive advantage. DTISs that can tailor the product and/or technology portfolios, as well as a factor in partnerships dynamics, will be the most agile competitors when it comes to new market penetration. (Gates, *et al*., 2016). Defence industries will truly excel when these are combined with flexible options in cost structures and supply chains.

Gates, *et al*. (2016) state that defence industries that seek to enhance their growth prospects in new markets must re-calibrate their cost structures in order to increase competitive pressure on rivals competing for the same segment. DTISs that do not have direct control over the composition of their cost structures will find it difficult to compete in a market that requires cost structure flexibility. Continuous cost reduction is required competitive behaviour to increase shareholder value. Continuously reducing costs also shore up the barriers to entry to traditionally controlled market segments. For the SA DTIS to be an attractive bilateral partner for the BRIC DTISs cost structures will have to be flexible and lean-to facilitate low-cost, market-related solutions. Tier 1 and DTIS capabilities are of utmost importance for portfolio flexibly due to the integration expertise. However, to excel at providing a competitively priced system and sub-system integration, supply chains must be optimised.

2.5.7 Supply Chain Optimisation

The complexity of supply chains makes them costly and inefficient, thus hampering DTISs to take advantage of emerging opportunities. Gates, *et al*. (2016) calls for improved visibility of the supply chains as a hedge against supply chain failures which will hamper the penetration of new markets. This provides companies with insight into goods and services flows, thus enabling supply chain managers to reduce complexity and possibly introduce flexibility and agility to portfolios and cost structures.

The various national DTISs are also responding to market requirements, both domestically and internationally, by optimising supply chain integration and increased flexibility/agility through the employment of new enterprise-level solutions. Supply chain flexibility and agility are positioned as major risk mitigations when dealing with new market growth opportunities. (Gates, *et al*., 2016).

End-to-end supply chain digitisation is a trend that, along with pressure on defence procurement/acquisition expenditure, remains a priority for (at least) the EU defence sectors. (Starr and Jones, 2018). This has and will continue adding new technology and product rivals to the defence market. Some of these will challenge the traditional dynamics within the market. Others will act as disruptors resulting in possible changes to both the supply- and demand-side.

Supply chain management plays a significant role in the development and management of collaborative defence platforms. There is a requirement for partner countries working on these platforms to expand their – "… supply bases to respond to localization requirements and political trade-offs. Identifying reliable, high-standard partners [bi- or multilateral] will require the cultivation of insight

and relationships in new markets. Deploying the products into customer markets may also create challenges as training, support and maintenance capabilities may vary from market to market." (Gates, *et al*., 2016: 6). Again, there is no one-fit solution. Multilateralism is more geared towards a one-fit solution. Bilateralism, on the other hand, provide more scope for tailored solutions. Bilateralism could also be more suitable where a high level of asymmetry prevail, such as between South Africa and the individual BRIC States. Portfolio, product and/or technology niches could be better leveraged in a bilateral relationship to mitigate asymmetry. Thus the focus of this thesis on bilateralism.

Defence industries can also benefit from increased and faster adoption of the Internet of Things (IoT) within their supply chain enabler toolbox. In other words, more automation, i.e., aspects of the 4th IR[9]. The DTISs that can overcome these challenges will be able to compete across markets rather than within markets, exploiting growth opportunities when they occur rather than selective focus on where opportunity occurs. This would be an important goal for the SA DTIS due to its limited capabilities, capacities and niches. With optimised supply chains the SA DTIS will be in a better position to compete for market share on the back of better cost structures, the security of supply and schedule flexibility. This would make the SA DTIS an attractive bilateral partner for DTIS relationship building. Another key enabler for the shifting of the DTIS development curve is access to funding and attracting investment.

2.5.8 Funding/Investment Strategies

A discussion about industry trends would not be complete without making mention of how the funding of future competitiveness is envisioned. "While some foreign investment is still clearly focussed on reducing the overall cost structure, [DTIS producers] are increasingly using their investments to open up new markets [opportunity exploitation] and move closer to their customers [optimising supply chains]. As a result, investment flows are changing" (Gates, *et al*., 2016: 17), shifting gradually towards emerging market opportunities. (Gates, *et al*., 2016). Thus, the SA DTIS can benefit greatly from this shift by focussing on some of the aspects discussed above, engaging in bilateral relationship building and having knowledge of strategic business levers prudent for specific bilateral partners in order to minimise investment risk and maximise mutual beneficiation.

A leading USA defence industry and innovator, Lockheed Martin (LM), use a venture capital strategy with a long-term investment horison to fund innovation through R&D. "LM's fund invests in early-stage technology companies that are involved in autonomous systems and robotics, cybersecurity, artificial intelligence, advanced electronics, and sensor technologies." (Starr & Jones, 2018: 7). This kind of focus was already stated in 2004 by Skons, Bauer and Surry (2004) in Dunne and Haines (2006: 3), with a deeper emphasis on dual-use technology - "The new military-technology environment emphasises the electronics, communications and IT industries and further blurs the boundaries between defence and civil production." Starr and Jones (2018: 9) add - "Boeing, Airbus,

[9] The 4th IR is perceived to be - "based on the use of cyber-physical systems". (South Africa, 2017b: 43).

LM, and Raytheon have all bought interests in high-tech firms, working in areas that include cybersecurity, integrated circuits, drones, small electric airplanes, and augmented reality." Thus, the investment will not only follow opportunities in emerging markets but also specific technologies. Another reason for the SA DTIS to invest in R&D.

Starr and Jones (2018) also elaborate on a number of decision levers for defence industry investment strategies in order to gain or retain a competitive advantage. The following are suggested elements for A&DTIS investment strategies -

- "A disciplined approach to managing capital investments as a portfolio of options, based on returns and on the levers of intrinsic value. This includes a dynamic valuation of strategic options and trade-offs…" (Starr & Jones, 2018: 7).
- Creating agile strategic processes and responses to market uncertainty without being hampered by annual financial-planning cycles. (Starr & Jones, 2018).
- A "fit-for-growth" approach to funding, through extreme expenditure reduction by concentrating on "assets, markets, business portfolio, technology, and core capabilities" that ensure competitive advantage. This is a more centralised approach to funding priorities. (Starr & Jones, 2018: 7). Reducing manufacturing cost structures still, remain paramount for manufacturers as a non-domestic investment. (Gate, *et al*., 2016).
- Defence industries are continuously rethinking their foreign capital leverage positions in order to secure emerging growth opportunities. (Gate, *et al*., 2016).
- "Incentive and compensation programs that reward executives for investment decisions that result in successful innovation and improved competitive advantage." (Starr & Jones, 2018: 7) This will probably result in more focus on R&D and innovation than performance objectives that are typically linked to the return of equity and the like.
- A dynamic corporate culture that welcomes innovative thinking and progressive strategies. (Starr & Jones, 2018).

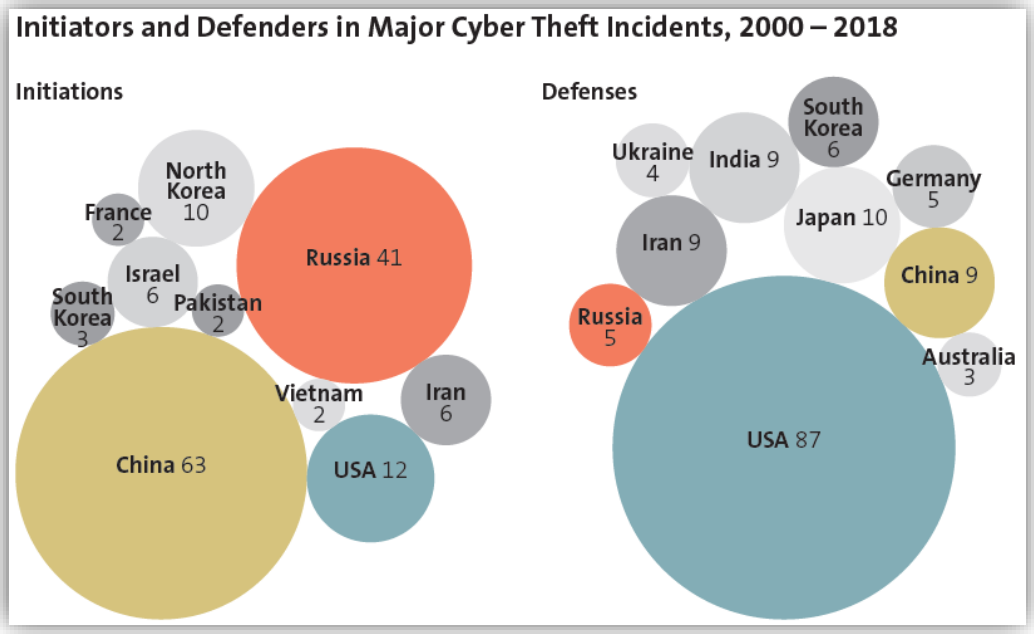
These strategies should be built into some of the facets discussed above to ensure funding reaches the incubators of innovation in order to stimulate investment interest. In order to know, DTIS will also have to invest in getting the right business intelligence.

2.5.9 Intelligence

DTISs need to be agile and persistent in their quest for knowledge and understanding of the competitive landscape. Intelligence is vital for the identification of emerging opportunities and trends, and the monitoring of monitor competitive behaviour (e.g. R&D and investment) (Gates, *et al*., 2016) in the quest for competitive advantage. This is almost common knowledge and practice. Yet, the use of intelligence capabilities (possibly in combination with those of the State) requires a concerted effort and strategic approach to ensure national defence industrial competitiveness. This Governmental role is, however, contentious and thus not elaborated on much in public literature.

Haas (2019: 41) provides a synoptic view (see Figure 2.16) of the current involvement of intelligence activity globally from the perspective of cyber-espionage. Russia and China (from a BRICS perspective) are significantly involved; South Africa, India and Brazil are not perpetrators. These activities affect the interaction between the DTISs internationally to maintain and protect their competitive advantage which is crucial to the ability of DTISs or individual companies to continuously augment their development curves.

Figure 2.16: Cyber-espionage Incidents



Source: Haas (2019: 41).

2.5.10 Barriers to the Shifting of the Development Curve

Whilst it is attractive for production companies, that is experiencing domestic market pressure, to expand into new markets abroad, they must take cognisance of the barriers that limit such expansion. The degree of ease with which these barriers can be lowered or be dismantled varies from an opportunity to opportunity. A discussion about some of these barriers in the defence industrial DTIS market space is used to close this section of the thesis.

2.5.10.1 Offsets

The objective of offsets is idealist in nature. Offset requirements can be seen as a specific barrier within the defence business environment that seeks to tailor the flow of goods, services, funding and knowledge. Offset programmes are increasingly visible in military business as well as increasing in size and scope. Several of the emerging defence markets (Maiti, 2018) are currently employing this technique to ensure favourable flows of development and FDI, which in turn endeavour to assure domestic defence technology and industrial capability development in the quest to shift the development curve or just simply move up the “Ladder of Production”. It requires defence contractors

to invest a percentage of the contract value into the domestic economy in specific industries (e.g. defence industries, technology institutes, etc.). This can be done through using various business levers such as technology transfer arrangements, procurement of local systems, products and/or components, co-production, production under licence agreements, as well as the construction of production or R&D facilities. However, text differentiates between offsets and technology transfer in several places. Offsets frequently translate into inflated cost structures, over and above the real contract value vis-à-vis contract deliverables. (Maiti, 2018; Squeff & De Assis, 2015). Hooke (2005: 31-32) states that the use of offsets has been banned in the USA and European Union from most industrial sectors except the DTIS. From a relationship-building perspective, countries will have to decide carefully how to administer these requirements in order not to damage existing relationships or block promising future relationships.

Thus, the SA DTIS and the Department of Trade and Industry should carefully consider the value proposition of offsets in defence acquisition initiatives from the perspective of the attractiveness of a particular value chain for market penetration or relationship building and all its complexities. Although the idealist nature of offsets masquerades nobility it could also result in unrealistic cost structures and complex supply chains which could raise the barrier to entry unnecessarily. Other barriers to market interaction concern IPR and technology transfer.

2.5.10.2 Technology Transfer and Intellectual Property Rights

Emerging DTIS markets prefer increasingly FDI accompanied by technology transfer. This is aligned with national ambition to establish domestic DTIS capabilities. However, established DTISs will be extremely reluctant to transfer technology if such transfer does not include adequate assurances that IPR will not be abused. (Maiti, 2018). Sino-Russian DTIS competition is a case in point. The Russian DTIS exhibit increasing paranoia to export defence technology and products to China due to China's record of IPR infringements. For example, the Chinese development of the Shenyang J-11 fighter that is a copy of the Russian SU27SK. (Bret, 2017). The Chinese disrespect for IPR is directly linked to the lack of (or poorly developed) organic national DTIS innovation capacities. Thus, China reverts to industrial espionage to circumvent the negative effects stemming from this predicament (Boutin, 2017) in support of the Chinese DTIS growth ambitions and as a strategy to remain relevant and keep up with the demands from the PLA and their client-base.

Industrial espionage provides the Chinese DTIS with a measure of control over access to innovation and mitigates some of the cost burden associated with innovation. "The extent and impact of industrial espionage is difficult to quantify due to its nature, but this is probably less important to China's defence modernisation efforts than legitimate commercial ties, which now are quite extensive and which will grow as industrial development in China sees high-technology state and non-state enterprises progress further up the value chain." (Boutin, 2017: 44).

Emerging markets that do not respect IPR will struggle to attract FDI for defence technology and industrial development. This process is made even more precarious by the fact that the international

business community does not regulate and respect IPR in a uniform manner and IP laws vary from country to country. (Maiti, 2018). The SA DTIS will thus have to be very cautious in their relationship building with e.g. China if the SA DTIS wants to lever niche technology and products within such an asymmetric relationship. It would, therefore, be prudent to choose the strategic business levers that would provide maximum assurances of IPR balanced with aspects that allow for market penetration or relationship building with similar motives.

2.5.10.3 Supply Chain Management

When emerging DTIS markets are still underdeveloped, it increases the costs associated with supply chain management (mostly on the logistics side) and thus has an impact on unit costs, the security of supply and the bottom line of the contractual arrangement (amongst others). (Maiti, 2018). Supply chain failures are thus regarded as a major risk to emerging market penetration. (Gates, *et al*., 2016). Thus, attractive, emerging DTIS markets are those that exhibit adequate to excellent infrastructure combined with optimised supply chain cost structure. Fortunately, all the BRICS partner states have adequate to excellent infrastructure to support optimised supply chains. This positive, however, could suffer severely from arms control over regulation stemming from governmental foreign policy and administrative roles.

2.5.10.4 International Arms Control

Arms control measures initially came about to restrict the proliferation of weapons of mass destruction. (Maiti, 2018). The control evolved into an extended list of dual-use technologies, materials and knowledge. This international arrangement is, in essence, based on national interest and security arrangements and is called the Wassenaar Arrangement. There are several other United Nations related arms control initiatives currently. (Guerra and Devoto, 2015: 1). Other arms control regimes are also in place that caters for the concerns of smaller groups of States, typically those associated with the control of missile and nuclear proliferation.

The impact of these control regimes could be quite severe on both the innovator and producer (supply-side) as well as the prospective client (demand-side). The control regime is aimed at denying supply, thus denying the producing country entry into specific markets under specific conditions. The prospective client (demand-side) are left without the products, services and knowledge required as well as in other cases the ability to grow a domestic DTIS. Although the specifics of the Wassenaar Arrangement dual-use control list are outside the scope of this thesis it is worth mentioning that most of the developed and well-established DTISs is a party to it as regulated by the specific States. From a BRICS perspective, Russia, India and South Africa are signatories to the Arrangement. (Wassenaar Arrangement, 2018). Arms control aimed at dual-use products, material and knowledge are is a very real hurdle for the Russian DTIS due to Russia's focus (for the past 20 years) on using commercial-off-the-shelf (COTS) components and systems to renew legacy Russian armaments systems and platforms. This is particularly relevant for advanced sensors and communication equipment. (Gressel,

2017). China also strategises around the integration of dual-use products, material and knowledge in order to modernise the PLA military capabilities. (Maiti, 2018). It is these technologies that fall within the Wassenaar Arrangement control regime. China faces similar barriers to access military and dual-use technology. (Reuben, 2014; Boutin, 2017). China is, however, not part of the Wassenaar Arrangement, making negotiation within the control regime impossible. "A number of states seek to restrict Chinese access to defence-related technologies, components, sub-components, and the firms that produce them. This involves both general national technology control regimes and investment review processes such as the Committee on Foreign Investment in the United States, and targeted measures instituted with the objective of prompting policy change in China". (Boutin, 2017: 43).

There is also the Arms Trade Treaty (ATT), which is a United Nations convention adopted by the UN General Assembly in 2013 to attempt the regulation of conventional arms trading. Guerra and Devoto (2015: 2) state that the ATT aims at the prevention of – "… illicit trade in conventional arms and prevent their diversion" through the "[establishment of] the highest possible common international standards for regulating or improving the regulation of the international trade in conventional arms." Its purpose is to - "… contribute to international and regional peace, security and stability; reduce human suffering; promote cooperation, transparency and responsible action by States Parties in the international trade in conventional arms, thereby building confidence among States Parties." Confidence, transparency and trust amongst countries trading in arms and those seeking to or having defence industrial relationships are thus critical for successful market interaction and developmental agendas. For an emerging economy and DTIS such as South Africa, it is critical to pay heed to the call for arms control prudence, especially as South Africa is a signatory to most arms control regimes.

"[T]he ATT covers the seven weapons categories identified in the United Nations Register of Conventional Arms (UNROCA) – tanks, armored combat vehicles, large-caliber artillery, combat aircraft, attack helicopters, warships, and missiles and missile launchers – as well as small arms." (Asano & Nascimento, 2015: 2). China and Russia have not signed the ATT. Brazil has signed the ATT (2013) but has not ratified it in Parliament. (Asano & Nascimento, 2015; Avila, *et al*., 2017; Muggah & Thompson, 2017). Reasons cited mostly relate to a negative impact on sovereignty.

In Brazil, the guidelines for controlling international transfers of conventional weapons are regulated by a policy known as PNEMEM (National Export Policy for Military Equipment) - promulgated during the military dictatorship. PNEMEM is a classified document, regularly update but not published for public scrutiny. (Asano & Nascimento, 2015; Muggah & Thompson, 2017). This makes arms trading with Brazil precarious from a foreign policy perspective, especially if your country has ratified the ATT and other agreements such as the Wassenaar Agreement.

Trading in armament is also regulated by instruments such as End User Certificates. These are described as – "… formal commitments not to re-sell the arms to any other country without the supplier's authorisation, use them to suppress internal opposition, or use them aggressively against other nations". (Avila, *et al*., 2017). This type of regulation is autarkic in nature. Non-compliance to the conditions set by the certificates may negatively impact the ability of States to trade in armament

and thus also to a certain extent exert pressure on national foreign policy and developmental agendas. The SA DTIS subscribe to this type of regulation and is thus restricted in terms of access to certain products and materials for the development of domestic capabilities but also restricted in terms of exporting SA DTIS products and materials to foreign markets that function outside of the armament control regimes. Failure to comply is usually associated with negative trade-related fallout.

Armament control is also idealist in nature, a paradigm labelled Guns vs. Butter, based on the following statement by Guerra and Devoto (2015) - "In the absence of adequate controls, arms transfers divert essential resources away from human development needs in arms receiving countries." (Guerra & Devoto, 2015: 1).

2.5.10.5 The Guns and Butter Nexus

The guns vs. butter nexus are described in Squeff and De Assis (2015: 12) as follows – " … [T]he end of the Cold War led governments to exert strong pressure for increased efficiency, in order to balance the unpopularity of defense spending with the pragmatic need to maintain defense forces." Current international economic conditions place severe pressure on defence spending in favour of economic development. On the flip side, there is an increasing demand for defence and security goods and services driven by international and national security concerns. (Lineberger & Hussain, 2018b). This summarises the guns and butter debate. This refers to the tension between DTIS developmental requirements and that of societal development needs. This tension is particularly acute in emerging States.

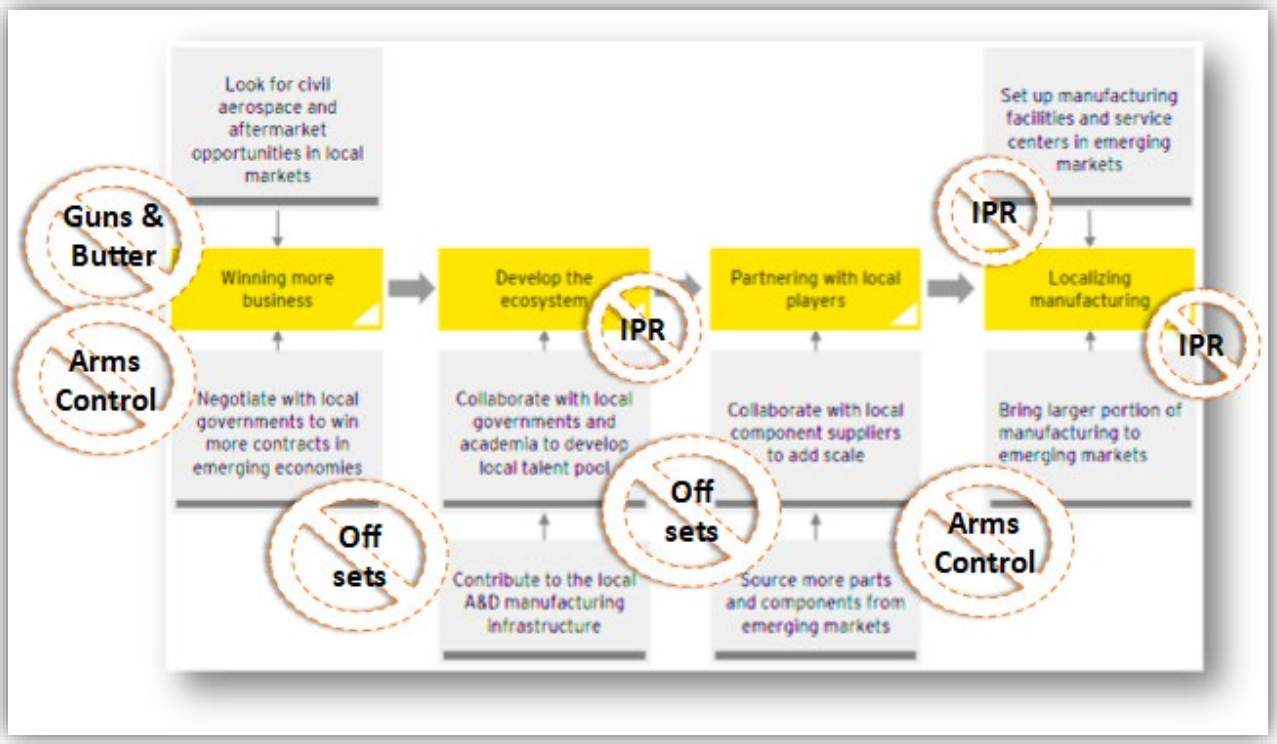
Cawthra (1998) calls for a balance between the requirements of human security and defence as a prerequisite for sustainable development – i.e. the development-security nexus. Although not explicitly stated, inherent in this balance is the question of the requirement for, and level of, defence industrialisation. The approach to defence industrialisation is in the "options" Cawthra (1998) proposes in the conclusion to his chapter in Philip (1998) with the following statement contextualised from the transition of South Africa through apartheid into democracy – "Given the absence of an external threat, South Africa's security will rest primarily on meeting the needs of the population. This should imply a continual move away from investment in defence. Nevertheless, most South Africans would argue that at least some defence capability should be retained, given domestic and regional requirements. [and thus the nexus and tension between developmental and defence requirements] Achieving the optimum balance between expenditure aimed at meeting the wider needs of human security [freedom from want], and expenditure on defence and policing to provide the stability needed for development [freedom from fear], will not be easy. Much will depend on an informed and transparent assessment of options and the consolidation of democratic processes." The 'guns vs. butter' nexus fuels requirements for offsets in DTIS contracts with foreign suppliers – which have its own implications as a barrier to development. Some of these options might be locked-up in unrealised bilateral DTIS relationships with the BRIC States. Such relationships could provide much-needed SA DTIS development that could fuel economic development in continuous cycles.

Due to the shifting security landscape, defence and security requirements continuously change, typically in emerging countries. (Maiti, 2018). This may lock DTISs, which cannot diversify their product/technology/service portfolios to match demand, out of the DTIS market. The 'guns vs. butter' nexus are gaining increasing relevance as countries grapple with the challenges to provide defence and security capabilities without eroding the fundamental requirements of sustainable development. Market entry is also key to sustainable development and DTIS success.

2.5.11 Market Entry and Market Share Maintenance Strategies

Maiti (2018) propose a number of strategies with which to accomplish entry into emerging markets. Market entry strategies are crafted for case-by-case application based on market analysis – in sync with previous statements on 'no one fit all' solutions. Maiti (2018: 11) is of the opinion that, in general, – "…most of the strategies involve not only selling to those markets but also working with the local governments to develop the [DTIS] manufacturing ecosystem of the local markets. On the other hand, local players in the emerging economies are looking at opportunities to collaborate with foreign players and gain the experience and capabilities to emerge as important links in the global [DTIS] ecosystem."

Figure 2.17: Roadmap for Increased Emerging Market Penetration by Global Defence Technology and Industrial Sectors



Source: Adapted from Maiti (2018: 12).

In Figure 2.16 Maiti (2018) propose a roadmap for consideration and adaptation to specific markets conditions when approaching emerging markets for defence industrial footprint establishment or expansion. The road map is overlaid with some of the barriers already discussed which possibly hamper successful market entry or expansion. Russia focuses strategic effort on their ability to deliver on export contracts (Bret, 2017), in an effort to assure supply chain reputational quality as a strategic asset. This should be the focus of any DTIS that seek to enter and/or maintain accessed market share. In the same manner, albeit nuanced, China is endeavouring to establish quality product lines and technologies in order to penetrate new markets as well as maintaining a foothold in its current markets. (Bitzinger & Raska, 2015; Raska, 2017). Both the strategies should be taken aboard by the SA DTIS in the quest for more market share. The SA DTIS should also, however, guard against losing possible market entry share due to bilateral relations with countries such as China once niche technologies and IP have been shared.

2.6 LIMITED CASE STUDY: RHEINMETALL DENEL MUNITIONS PTY (LTD)

Partnerships are the cornerstone of [RDM] business. (RDM, 2019c).

Rheinmetall Denel Munitions (RDM) is used to illustrate the utility and practicality of the DTIS facets discussed. The SA DTIS, with the assistance of various Departments of the SA Government (e.g. DOD, Department of Trade and Industry and Department of Public Enterprises) took a leap of faith into a liberal DTIS policy mid-2000s with the establishment of RDM. It was a response to an ever-deteriorating ability of the SA Government to fund, develop and manage some of the SA public enterprises. The domestic demand (SANDF) for the product range was also not providing sustainability and thus an equity partnership was understood to be a solution to the inability to penetrate new markets and to attract FDI in order to shift the development curve into a position of domination of the market segment.

RDM is the product of the acquisition of 51% of Denel Munitions equity by Rheinmetall Waffe Munition GmbH in 2008. Denel Munitions owns the remaining 49% equity. (RDM, 2019a, 2019b & 2019c). The company proudly maintain domestic (South African and SANDF) presence as well as global reach (USA, Brazil, Africa, Europe, Scandinavia, Middle East, Australia).

The Denel Munitions (pre-2008), consisted of a number of companies - Somchem (chemical factory, solid propulsion products and energetic material), Swartklip Products (pyrotechnics and chemicals), Naschem (ammunition and chemical) and Boksburg (forged shell bodies and metal components). (RDM, 2019a & 2019c). These were not adequately funded, optimally integrated and managed by 2008. The various roles of the SA Government in providing adequate funding, marketing abroad, domestic buying behaviour, etc. were gradually eroded by a SA DTIS in transition.

Since 2008, RDM has developed in a global, completely vertically integrated product systems and technology company. This was achieved with the assistance of the German Government support via Rheinmetall Defence Group in Germany. The RDM value chain, providing ammunition turnkey

solutions, currently consists of established technologies, system analysis, performance prediction and specification, simulation and modelling, design and system engineering. (RDM, 2019a, 2019b & 2019c). The RDM market spans various NATO countries, Asia, the Middle East, South America (Brazil), South Africa and other African countries. The RDM product portfolio includes product and technologies niches in the following portfolios: artillery ammunition (105mm and 155mm), mortar ammunition (60, 81 and 120mm), missile subsystems (propulsion units, warheads, etc.), minefield breaching systems, ammunition for naval applications, 40mm infantry ammunition and pyrotechnics, propellants and raw materials and ammunition and metal components. (RDM, 2019a).

This makes RDM a Tier 1 company with a significant ability to mitigate the negative effects of asymmetry in bilateral relationships with countries such as Russia, China and India. The extent of the integrated value chain and product portfolio provide RDM with considerable portfolio flexibility and the ability to penetrate new markets such as the United Arab Emirates and Saudi Arabia. Since the establishment of RDM the cost structures and supply chains have been optimised to transform the company into a profitable business within a year. (RDM, 2019b). The SANDF benefits from this RDM merger and also from what is termed by RDM as “teaming arrangements” with the Netherlands, Denmark and the UK, in the following manner –

- Reduced cost structures for the operation of SANDF ammunition and munition magazines and logistics.
- Life-cycle management by RDM.
- Demand and supply optimisation via RDM stock management systems. (RDM, 2019b).

Because RDM is fully compliant with various international, European, American and South African standards as well as arms control regulations it provides South Africa with a transparent industry that can be leveraged worldwide. This was not entirely possible pre-2008. Thus, the erstwhile Denel Munitions gained significant access to markets, funding, management expertise, supply chain optimisation and value chain integration. Hence the value of a more liberal approach to the use of strategic business levers such as JV and M&A to exploit the strengths of international ‘teaming arrangements’ or bilateral partnership and mitigate the downside risks of autarky in the quest for self-sufficiency and protectionism.

2.7 FINDINGS AND CONCLUSIONS

From the discussion above it emerged that DTISs are subject to at least three dominant DTIS policy choices – liberal, autarky and hybrid. Each of these has their own applications within domestic contexts. The application of these policies is subject to governmental ambitions of defence autonomy and a self-sufficient DTIS (or a degree thereof). The requirement for self-sufficiency could be linked to idealism (economic growth ambitions, economic alliance requirements and/or foreign policy) and/or realism (foreign policy objectives, military ambitions, military alliance requirements). A common element to all three policy approaches is the objective to gain comparative and/or competitive

advantage (as per the conceptual shift in DTIS development curves in Figures 2.9 to 11) as soon as possible and to possibly become a dominant player in the international defence technology and industrial market place. The application and impact of the theories have important consequences for the ability of the SA DTIS to be an attractive bilateral DTIS partner to the BRIC States. This is particularly relevant within the context of the asymmetry within the BRICS alliance.

The asymmetry between the possible bilateral partners places a large burden on the SA DTIS to develop and nurture DTIS products, technology and knowledge niches that could be leveraged against the negative asymmetry of such bilateral relations. Such niches, combined with a clear understanding of strategic business levers such as JVs and M&A could lower the barriers to entry for new markets. Also, with the continuous development of the SA DTIS and strategies to optimise supply chains, cost structures, IPR protection, transparency, adequate funding and good intelligence - the SA DTIS will grow increasingly attractive as a bilateral partner to the BRIC States – with due cognisance of the current DTIS growth in these markets. This is possible with the correct understanding of the strategic business levers available with which to manoeuvre in the market place. The question is - which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States – considering the likelihood that every BRIC State strives towards comparative or competitive strategic advantage (dominance) in the defence technology and industrial marketplace?

Within this context, South Africa should also be critically aware of the barriers that hamper market entry. This will require a thorough understanding of individual BRIC partner State geopolitical, defence/security, DTIS contexts and requirements and their impact on a possible role for the SA DTIS within BRICS.

2.8 EXPECTATION FOR THE NEXT CHAPTER

Chapter 3 analyse and describe the DTIS landscapes of the BRICS States from various perspectives. The discussion culminates with findings of the possible strategic business levers trending amongst the States and which could be useful for the SA DTIS within a bilateral setting with the individual BRIC States.

CHAPTER 3

SELECTIVE ANALYSIS OF THE DEFENCE TECHNOLOGY AND INDUSTRIAL SECTORS OF BRICS STATES

3.1 INTRODUCING BRICS

All signs indicate that growth opportunities are shifting from the mature markets to the emerging markets. (Gates, et al., 2016: 17).

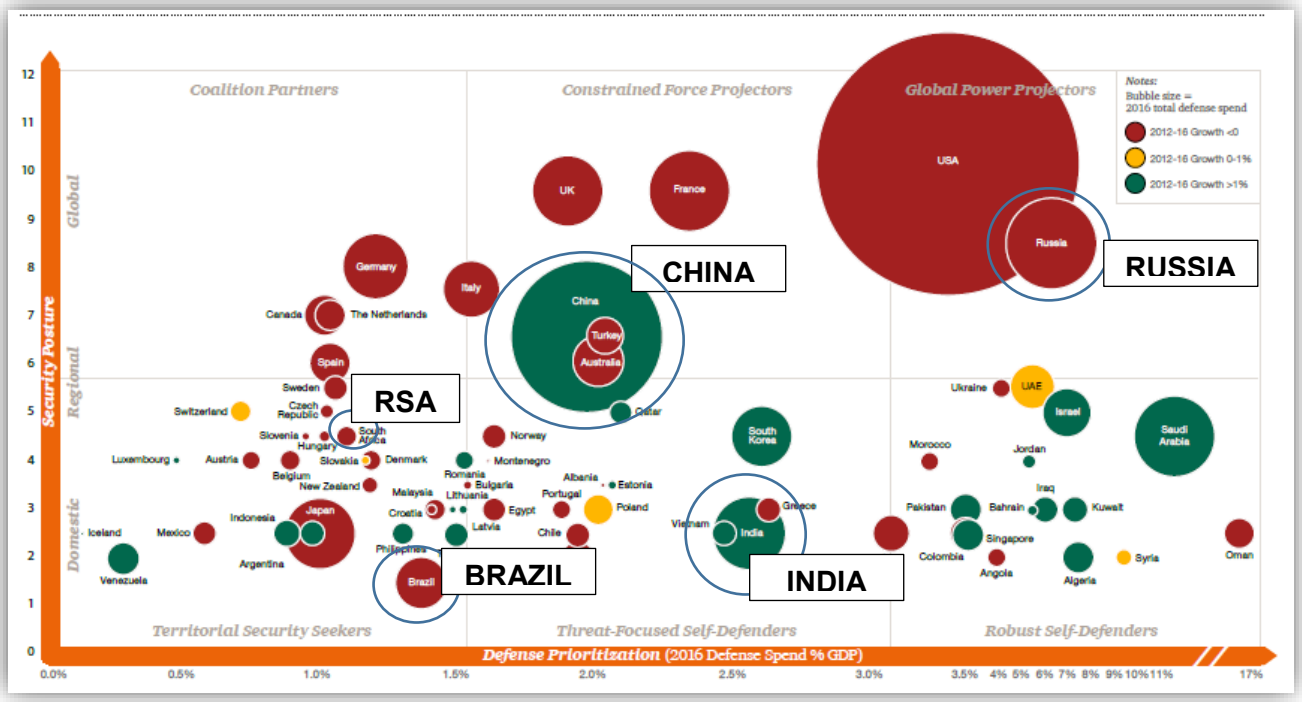
Brazil, Russia, India, China and South Africa form the economic alliance labelled BRICS. (South Africa, 2012: 257). South Africa was admitted to BRICS[10] in 2011[11]. (South Africa, 2012; PwC India Desk, 2018). The primary objectives of the BRICS alliance are the development of each partner State and financial assistance. The multinational agenda is managed by means of multinational summits and consensus is built by means of "industry-based cooperation agreements". (PwC India Desk, 2018: 7). BRICS could be the perfect idealistic multilateral development platform with which to attempt to overcome the difficult and costly defence technology and industrialisation challenges. "Not even major powers such as the United States, Russia or China are immune to this challenge, and are sourcing subsystems, sub-assemblies and components, and technologies, from other countries. This reality applies in equal measure to the [SA DTIS], particularly with respect to its ability to compete internationally." (NDIC, 2018: 32).

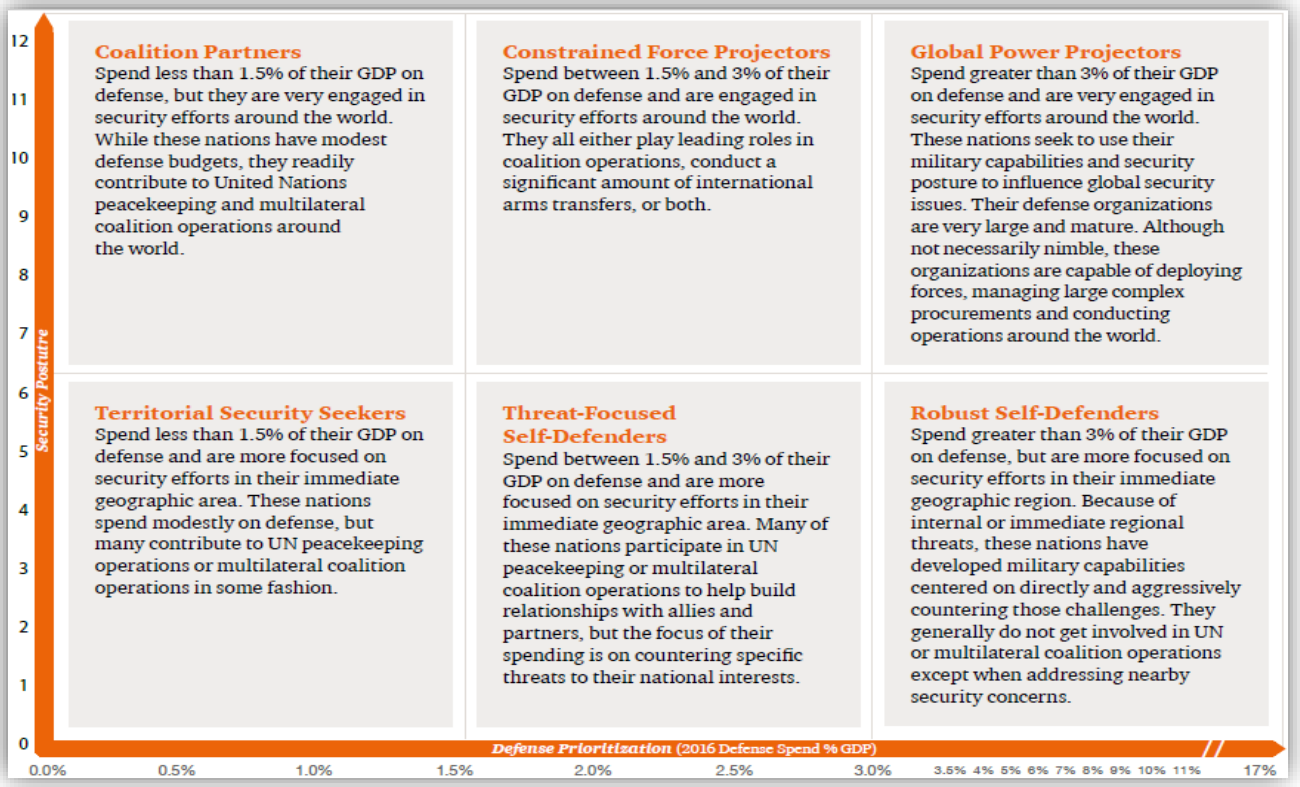
From a defence perspective, the BRICS States can be graphically positioned and sized according to individual defence and security postures. The following six-block matrix was conceptualised by a team of researchers from PriceWaterhouseCoopers (PwC), and periodically updated to achieve such comparison -

[10] "This began as an acronym for a group of countries investment bankers thought might do well over the medium term (BRIC). South Africa was invited to join to create an image of 'South-South' solidarity and to provide entree into Africa. As a political or strategic entity BRICS has little reality other than as a tool to counter the United States and Europe in the interests of, mainly, China and Russia. Economically the group has also ceased to interest, with Brazil, Russia in trouble and the Chinese economy slowing." (South Africa, 2017a: 64).

[11] 2010. (Zhang, 2012: 2).

Figure 3.1: Global Defence Map 2017 and Legend





Source: Allen (2017: 3 and 4) used data from SIPRI, Teal Group International Defense Briefing, The Military Balance, IHS Defense Budgets, PwC analysis to compile this graphic comparative analysis.

The fact that China, India and Russia are positioned in the higher-order defence posture and prioritisation blocks provide indications of possible DTIS opportunities for both South Africa and Brazil. This, however, can only be achieved if South Africa revitalise and continue to develop its DTIS

capabilities. Figure 3.2, however, also provide a very vexing graphic image of the asymmetry present in the relationships, which if not mitigated effectively will render attempts to establish mutually beneficial relations between the SA DTIS and those of Russia, China and India almost impossible. This asymmetry is further illustrated by the following comparative reflection of the relative capacities for innovation and associated factors amongst the BRICS States as well as the top performers internationally -

Figure 3.2: Innovation Indicator: Ranking of Select Countries

Country	*Capacity for innovation*	*Quality of scientific research institutions*	*Company spending on R&D*	*University-industry collaboration on R&D*	*Availability of scientists and engineers*	*PCT patents* granted per million population*
India	42	39	37	51	16	63
Brazil	34	46	33	44	113	48
Russia	56	70	79	85	90	44
China	23	44	24	35	46	38
S. Africa	41	34	39	30	122	37
US	7	6	7	3	5	12
UK	12	3	12	2	12	18
Japan	1	11	2	16	2	5

* PCT patent refers to patent granted under the Patent Cooperation Treaty (PCT).
Source: Klaus Schwab (ed.), *The Global Competitiveness Report 2012–2013*, World Economic Forum, Geneva, 2012.

Source: Behera (2016: 104).

Keeping the overall economic and military asymmetry between South Africa and BRIC in mind; there is also large disparity between South Africa, China and Russia (capacity for innovation), large disparate quality issues and percentage R&D spending within businesses between South Africa and Russia; large disparity between South Africa and Russia, India, Brazil in terms of collaboration between industry and universities. Of significant importance is the very significant asymmetries amongst all the BRICS States concerning the availability of scientists and engineers. This probably also inform the large disparity between South Africa and India in terms of patents filed. However, South Africa exhibits competitiveness when considering its capacity for innovation, which could inform the South African role in the BRIC DTISs. This can also be said of quality R&D and level of collaboration. Problematic for a possible role for the SA DTIS in BRIC is the comparative under capacity of scientists and engineers which will increasingly erode the innovation capacity of the SA DTIS.

At the 10th BRICS Summit, South Africa was commended for its driven approach to - "… development, inclusivity and mutual prosperity in the context of technology driven industrialisation and growth." (BRICS, 2018: 1). No reference is made to the capabilities of the DTISs of BRICS and their

possible/probable contribution to the developmental (idealistic) agenda. In the writer's opinion, it can be regarded as a lost opportunity for the various DTISs and for BRICS as a collective because of the defence technology and industrial policy void that could have been expressed on from a multilateral perspective.

The 10th BRICS Summit did, however, recommend the establishment of a BRICS Partnership on New Industrial Revolution (PartNIR). The Summit expressed on the – "… importance of BRICS scientific, technical, innovation and entrepreneurship cooperation for sustainable development and to enhance inclusive growth." (BRICS, 2018: 11). Projected to be aligned with the 4th Industrial Revolution (4th IR) and to be prioritised by each partner State, the mandate of the PartNIR is to strengthen – "… BRICS cooperation in digitalisation, industrialisation, innovation, inclusiveness and investment, to maximise the opportunities and address the challenges arising from the [4th IR]. It should enhance comparative advantages, boost economic growth, promote economic transformation of BRICS countries, strengthen sustainable industrial production capacity, create networks of science parks and technology business incubators, and support small and medium-sized enterprises in technology intensive areas." (BRICS, 2018: 10). Importance was also attached to collaboration between member States, affirming – "… the value of implementing coordinated BRICS scientific projects aimed at promoting BRICS science, technology and innovation potential as a contribution to our combined efforts in addressing the challenges of the [4th IR]." (BRICS, 2018: 11). Other elements of industrial cooperation that were supported by the Summit are Intellectual Property Rights (IPR) cooperation and technology transfer in the interest of the developmental agenda. (BRICS, 2018). Thus, although the Summit did not state these objectives specifically for the DTIS, the DTIS of each country was also not specifically excluded. The business levers named should thus form the backbone of the DTIS cooperation between the BRICS States, i.e. industrialisation, investment, IPR cooperation, technology transfer, science and technology networks, digitalisation, innovation, and inclusiveness. If these are strategic business levers for industrial development in general then they can be assumed to be also relevant to each national DTIS.

Following this brief introduction of the *raison d'étre* of BRICS as an economic alliance, is a discussion of each BRICS member State as part of an embedded case study on the DTISs of BRICS States. The aim of the case study is to provide context and understanding of the level of development, policy approaches, markets, technologies and strategic business levers that can be attributed to each BRICS State. Closing of the analysis of each State is some drivers of development and perceived barriers to development for each. The analysis has a short- to medium-term focus. The Chapter will conclude with findings relevant to the research questions. The case study commences with a discussion of the SA DTIS in order to link opportunities and/or barriers succinctly with following discussions on the BRIC DTISs.

3.2 SOUTH AFRICAN DTIS - AN INTRODUCTION

South Africa has the best basic industry, military and agricultural technology. Tremendous opportunity and common interests exist in this area. South Africa and China should build bilateral relations of mutual benefit. (Zhang, 2012: 173).

Devore (2013: 545) regard the SA DTIS as a relatively small internal market with – "…high pre-existing levels of defense industrial autonomy" and a highly autarkic DTIS. Much has changed since these statements by Zhang (2012) and Devore (2013). Currently, the Draft South African Defence Industry Strategy 2017 and NDIC Booklet 2018 state that the SANDF will never be a large enough market for the SA DTIS (South Africa, 2017a), thus the SANDF by itself will not make the SA DTIS a sustainable enterprise and instrument for economic growth, - "… except perhaps in some small, specialised sovereign niche areas". (South Africa, 2017a: 218). The order volume of the current SANDF and even a revitalised SANDF as per the DR 2015 is and will not ensure sustainability for the SA DTIS. (South Africa, 2017a: 218). It will certainly not provide the level of investment required to shift the development curve as conceptualised in Chapter 2 of the thesis. The Federation of American Scientists (*circa* 2001) state that the – "… South African government currently believes that the changes in global defense markets and industries preclude the future viability of a small broad-based defense industrial base. There will be a need to focus on niche areas of robust demand in which companies can maintain their strengths."

The DDIS 2017 proposes a number of options with which to revive and continuously develop the SA DTIS, in order to augment this negative position the SA DTIS finds itself in. One such option is through collaboration/cooperation with foreign States (Government-to-Government) and their DTISs (industry-to-industry). Bilateralism is supported by Notshulwana (2012) in a Development Bank Southern Africa policy brief. Bilateralism is thus perceived as the driver of the idealistic agenda of South Africa. This thesis focus, in particular, on possible bilateral cooperation opportunities between the SA DTIS and the BRIC States and which strategic business levers would be prudent.

Inspired by realism, motivated by autarky, the SA DTIS managed to develop a self-sufficient systems integration capability (Tier 1 capability) spliced with modest state-of-the-art conventional weapons systems and platform product lines. This clearly showcases the South African ability to move up and down the "Ladder of Production", described in Chapter 2 of the thesis. This pre-1994 SA DTIS was geared to service the domestic market requirements. (Devore, 2013). This is a prime example of the development of a DTIS; with the terms dictated by the international community which resulted in years of political and economic isolation due to flawed political aspirations. (Devore, 2013).

Post-1994, these conditions were replaced with conformance to international market requirements and conditions. ."Following the formation of the new government in 1994, the public mission of the apartheid era such as defence, energy and food self-sufficiency were largely abandoned […] to re-align priorities to address South Africa's overall social and economic development needs." (Zhang, 2012: 99). Post-1994 also gradually introduced a shift away from autarky towards a more

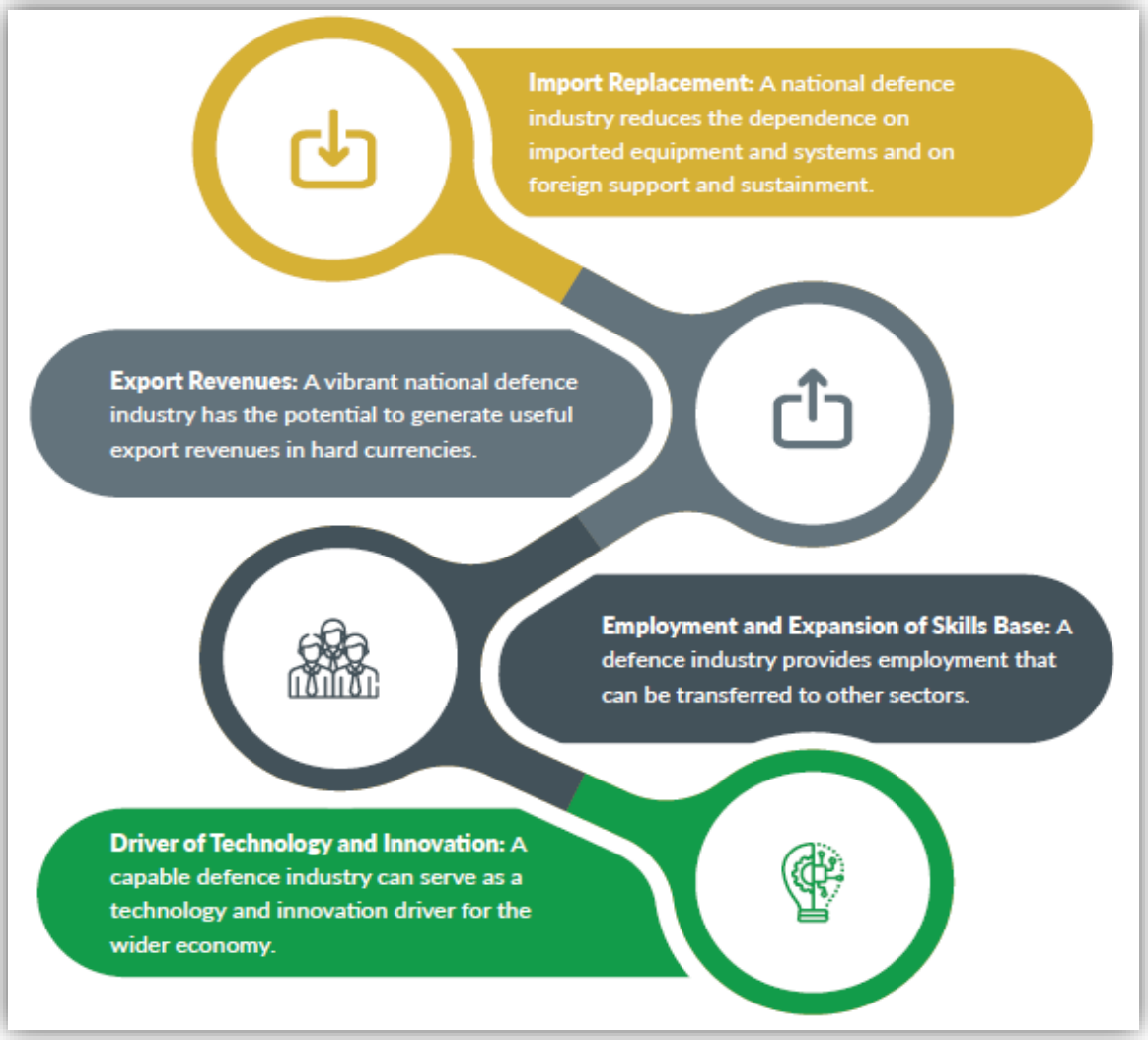
liberal approach which resulted in significant negative effects on the sustainability and further development of the SA DTIS. Survival of the SA DTIS is based on Tier 2 activities (supply chains and subsystems) and some niche technologies and products (Tier 1). The SA DTIS shifted towards a more idealist defence industrial perspective, i.e. a SA DTIS supporting economic development agenda and not just a military objective. However, strategic essential systems integration capabilities and other niche technologies were protected within certain SOEs (Devore, 2013), such as Denel[12], to ensure military autonomy – keeping the realism breathing.

In essence, though, the motive to continuously develop the SA DTIS is based on idealist motives (engineering skills and job preservation) rather than pure realists motives (a DTIS adjunct to the SANDF). This perspective is published in the NDIC Booklet, supporting both idealist (economic growth) and realist (military support) perspectives (FAS, *circa* 2001; South Africa, 2017a; NDIC, 2018). The South Africa Yearbook 2015/6 states that the – "… [SA DTIS] is one of the cornerstones of a stable and growing South African economy, the AMD is responsible for ensuring that a world-class, indigenous defence industry capability is maintained in a sustainable manner." (Tibane & Lentsoane (Eds.), 2016: 343).

What is also striking is the focus on self-sufficiency (i.e. divorcing the SA DTIS from import dependence). Because pure autarky is no longer a viable option, the SA DTIS will have to carefully consider options for bilateral cooperation and a suitable portfolio of strategic business levers to ensure market access to SA DTIS products and services. The idealism is also clearly visible in Figure 3.5. To illustrate the nexus between economic development motives and defence requirements (DTIS order book) the Rooivalk[13] attack helicopter development provides some interesting insights. From an economic perspective, the Rooivalk programme could be perceived to be an R6.25bn failure. It only delivered 12 helicopters (and 4 prototypes and pre-production aircraft) with no exports achieved as yet. However, what is not entirely visible is the revenue earner and engineering skills base that was maintained by the - "… export of subsystems and weapons developed as part of the Rooivalk programme earned the country R15-billion by the end of 2013. This figure was split across a number of local aerospace and defence companies, both public and private sector, including Aerosud, ATE (now Paramount Advanced Technologies), Denel Aero-structures, Denel Dynamics, and the optronics company […] Hensoldt Optronics." (Heitman in Campbell, 2017). This clear inward focus of the SA DTIS's economic role (idealism) is unequivocally, illustratively described in the NDIC Booklet 2018 in the following illustration -

[12] "Denel operates in a high tech and heavy engineering manufacturing sector with more than 3 300 engineers, Scientists and technicians." (Kleynhans, 2017: slide 8).
[13] "Winning the Turkish contract will ensure the survival of the Rooivalk, which has been sold only to the South African Air Force, which bought 12 helicopters in 1999. Since then Denel has not been successful in finding other buyers for the Rooivalk." (BusinessReport, 2007 and Ensor, 2007).

Figure 3.3: Economic Role of the South African Defence Technology and Industrial Sector



Source: South Africa (2018: 21).

Market access, though, remains a primary stumbling block for the SA DTIS (South Africa, 2017a; South Africa, 2017b; South Africa, 2018). Thus the focus of the IPAP 17/18-19/20 (South Africa, 2017b) on technology localisation and exports, keeping in mind the Plan also includes the SA DTIS. Yet, year-on-year, China, Russia and the Western nations such as the USA continue to grow their export volumes to the expanding African defence market. (Abbas, *et al.*, 2016: 24). The SA DTIS has not been very successful in penetrating new markets and certainly not the African defence market. Understanding the strategic business levers that could facilitate market access is thus critical to a SA DTIS that seeks to support economic growth and its domestic clients.

It must be noted, against the backdrop sketched thus far in Chapter 3 of the thesis, the SA DTIS is in good multilateral company for industrial relations, export opportunities and technology sharing with BRIC partner States. However, - "[m]ilitary spending in South Africa, the second largest [*sic*] spender in sub-Saharan Africa, has stabilised at around $3.6 billion per annum since 2012. Its military spending decreased marginally in 2017 by 1.9%." (BusinessTech, 2018). Funding shortfalls are a

recurring theme in the DDIS 2017 and highlighted as a critical barrier to SA DTIS success in the international market place and thus also as a potential instrument of economic growth. In contrast, the BRIC partner States are increasing their spending and are global DTIS leaders.

The National Development Plan 2030 (NDP 2030) was published in 2012 as a national and strategic policy position for the extended period up to 2030. In order to provide an overview of the position on collaboration within BRICS and the level of importance attached to this, the closing paragraphs of this introduction will specifically explore this South African national policy. The NDP 2030 positions South Africa as an important partner for BRICS in terms of the "…economically emerging African continent" (South Africa, 2012: 238) and then immediately recognise the asymmetry between South Africa and the rest of BRICS. Within this asymmetry, technology niches are positioned from the onset as a critical focal point for the role of South Africa in BRICS. However, whilst highlighting the advantages that can be leveraged by South Africa; the SA DTIS does not get any mention within this context (very similar to the void experienced within BRICS Summit agendas). The closest the NDP 2030 gets to address some element of the SA DTIS is in the policy expression on technology and research institutions (e.g. the CSIR). There is also recognition of the foreign relations functional support to leaders of companies and industries. These and other roles are positioned to mitigate the negative asymmetric effects, stating – "South Africa's foreign relations must reflect its role as an equal member and strategic African partner in the BRICS group and in world affairs, in general." (South Africa, 2012: 238).

The NDP 2030 classify relations with India and China as of particular importance - "Within BRICS, and in Africa, South Africa's relations with China and India are particularly important. China is fast becoming the most active and important foreign actor in Africa." (South Africa, 2012: 238). Note, it is also these two countries that are most asymmetric to South Africa. According to the NDP 2030 - "… South Africa can play an important role in facilitating exchange between Africa and Asia – especially since China and India's main interest is the continent's minerals [Note: not the SA DTIS capabilities]." (South Africa, 2012: 238). "The Department of International Relations and Cooperation, in collaboration with South Africa's research institutions and professional bodies, should lead a strategic drive to engage China on minerals, mining, research and development and infrastructure expansion on the continent." (South Africa, 2012: 239). Again, no calibration of the proposed R&D collaboration and no mention of the SA DTIS capabilities and niche technologies and the role of the SA DTIS in collaborative relations with China (and/or any of the other BRIC States). Interesting, Brazil and Russia is not mentioned at all within these contexts. It does seem that the SA DTIS does not attract national support in strategic level national policy. This will certainly negatively affect any possible role of the SA DTIS in BRICS. Let us take a look at how the SA DTIS progressed from import dependence to self-sufficiency and back a step or two after 1994 – in a possible quest for attractiveness as a potential bilateral partner to the BRIC States.

3.2.1 South African DTIS Synopsis

SA's current economic situation reinforces the NDP requirement for deeper levels of science, technology, and innovation, particularly as a catalyst for industrial and economic development. (South Africa, 2017b: 8).

The SA DTIS is a primary economic sector consisting of advanced R&D, technology production and services. The SA DTIS is also an incubator of engineering and technical skills that benefit the sector as well as the broader South African economy. (Campbell, 2017). "The sector has consistently provided meaningful skilled employment opportunities for about 15 000 highly skilled engineers, technicians and artisans – many of them contributing to key national projects in space, transportation, rail safety, mining, construction, power generation and telecommunications […] Conservatively, the sector is estimated to have a multiplier factor of 1:4 in terms of indirect additional job opportunities in the wider manufacturing and associated services sector, thus supporting at least 60 000 further skilled jobs in the economy.". (Mr Hamilton (AMD Executive Director) in Campbell, 2017).

A brief early history of the development trajectory taken by the SA DTIS reveals that it was import-dependent during the 1950s and 1960s. South Africa imported - "…dual-use equipment, technology, and manufacturing techniques and learned to incorporate those into armament systems via redesign, retrofit, and upgrade." (FAS, *circa* 2001). In support of the climb up the "Ladder of Production", South Africa established the Armaments Development and Production Corporation (Armscor) (earlier named Armaments Production Board) to manage the developing SOEs (e.g. Denel). By the mid-1960s Armscor was already manufacturing, under approximately 120 licences, several foreign-designed weapon systems. (Beri, 2000; FAS, *circa* 2001; Devore, 2013). Approximately 100 defence industries and associated industries were operational by the mid-1960s. (Van Dyk, *et al*., 2016). This was designed to establish defence industrial capabilities focussing on products that are not profitable for private industry – due to the prevailing conditions of arms embargoes. Armscor soon developed into the developing world's largest armament SOE at the prime contractor level (Tier 1).

The period 1968-1977 saw the SA DTIS progressing into licenced production and basic R&D as well as limited production of weapon systems. Other initiatives to become self-sufficient included investing in foreign-based industries, recruiting international specialist to assist with the design, develop and production of weapon systems. (FAS, *circa* 2001).

By the mid-1980s this figure more than doubled; by the end of 1980s, the figure reached in the order of 3000 industries. By then Armscor contracted an estimated 2700 private sector companies. The defence and related industrial capacity employed approximately 131750 people. In South Africa, it represented approximately 8,3% of the South African manufacturing sector workforce. (Van Dyk, *et al*., 2016). The defence and related industry developed the skills base to- "… design, reverse-engineer, manufacture, produce, maintain, refurbish, upgrade and modify a wide range of defence equipment." (Van Dyk, *et al*., 2016: 148). This was fuelled by an ever-increasing defence budget

during the 1970s and 1980s and the geopolitical instability in the region. During the 1980s the SA DTIS provided approximately 94% of the requirements for the SADF (Landgren, 1989 in Devore, 2013), virtual self-sufficiency. This figure is probably exaggerated, but even half that percentage is fairly impressive under the conditions it was achieved. "Despite their accomplishments, South Africa's autarkic defense industries were poorly positioned to survive exposure to the world's arms market following the country's gradual transition to majority rule (1989–94)."(Devore, 2013: 549).

By the late 1980s, on the back of a political survival motive, the SA DITS achieved self-sufficiency as a Tier 1 DTIS (at least in certain technologies) and was considered to be a world-class defence technology and industrial capability. (Beri, 2000; FAS, *circa* 2001; Devore, 2013). However, the SA DTIS was still not at Tier 1 production industry for integrated systems such as main battle tanks, combat aircraft and other complex defence electronics. (FAS, *circa* 2001).

The SA DTIS was subjected to severe budget cuts after the transition to a democratic State. The defence acquisition and procurement budget were reduced by an estimated 60% between 1989-1993. (Devore, 2013). This severely affected the economic sustainment of a (by then) 80 000 strong DTIS workforce and approximately 1100 companies of various sizes and at different Tiers. Significant gaps in the SA DTIS development soon reared their heads. One of the largest gaps was the ability to penetrate new markets. (Devore, 2013). Several of the traditional South African foreign clients were no longer fitting the assumed post-1994 political profile. South Africa moved away from exporting armament to States involved in – "… internal repression or external aggression." (Devore, 2013: 552). Thus, clients such as Chile, Iran, Mozambique, Angola, Peru, Morocco, Oman, Sri Lanka, Taiwan, South Korea, Israel, and Rwanda and Iraq in the 1970s -1980s were not sustainable (FAS, *circa* 2001; Devore, 2013) under the new foreign policy motives designed to be allowed back into the international community. This left the SA DTIS with substantially decreased domestic demand as well as a reduced foreign market footprint. It resulted in many dual-use and even defence manufacturers leaving the SA DTIS during the 1990s in order to survive. (Devore, 2013). This resulted in severe fragmentation of the South African defence technology and industrial supply chains. This was exacerbated by a socio-economic agenda that did not recognise the economic benefits inherent in the DTIS. The result – a SA DTIS spiralling towards an import dependence future was identified during the mid-1990s.

The situation leads to the promulgation of defence industrialisation policy geared towards breaching the gaps between the pre-1994 and post-1994 DTIS requirements and market realities. The South African Defence Review (1998) and the White Paper on the South African Defence Related Industries (1999) (WPDRI 1999) was the result. These national policy document recognised the requirement for a hybrid approach to defence industrialisation. They provided the first discussions on what should be regarded as - "… vital to national security". (Devore, 2013: 551). This view could be interpreted from both an idealist and realist perspective because the SA DTIS performed a critical function for foreign policy and military flexibility (stemming from an autonomous DTIS) as well as the economic dividends inherent in the vast DTIS Science, Engineering and Technology (SET) skills base. Currently, the South African Industrial Participation Action Plan (IPAP) 2017/18 Annual Report (South

Africa, 2018: 22) states this perspective as follows - “The [SA DTIS] is a globally competitive industry which supports national interests and is striving to be a preferred choice for aerospace and defence related solutions on the African continent. [This corresponds to the position stated in the IPAP 17/18-19/20 – “A much greater Africa effort by SA Inc. will be necessary if the continental trade and regional industrialisation push is to bear the dividend that is hoped for.” (South Africa, 2017b: 5)] The industry is successfully integrated into South Africa’s wider industrial landscape. It has helped to expand the national science, engineering and technology base and has supported the technical and technological skills base. In addition, it has successfully entered the global market through its exports to and global partnerships with many of the world’s leading aerospace and defence OEMs and Tier-1/Tier-2 companies.” (South Africa, 2018: 22).

Arguments are constructed that there are critical dependencies between the ability of a State to execute independent security policy and an independent system integrating capability in various technology domains – most importantly in command and control and EW domains linked to capabilities that ensure the security of supply from a logistics perspective. (Devore, 2013: 551). This manner of strategising was formalised in the following statement from the WPDRI 1999 - “Government recognises that defence related industries are an integral part of South Africa's defence capability. The government also recognises the strategic and defence value of having a local defence industrial capability. However, due to budgetary constraints, and within the framework of broader national industrial strategy, the government will be very selective of which technologies and capabilities are to be retained on the basis that they are strategic or that they constitute a national asset.” (South Africa, 1999: 2). This is still an authoritative national policy perspective because no other update to this White Paper has been produced since.

The WPDRI 1999 defines a list of what is regarded as sovereign capabilities, labelling them “Strategically essential defence technologies and capabilities” as follows (South Africa, 1999: 38-39; FAS, *circa* 2001) - “1) Logistic support, repair, and maintenance 2) Systems integration
3) Command, control, and communication systems 4) Sensors, signal processing, and data processing 5) Software and software support for combat systems 6) Simulation systems and wargaming”. At a more granular level, - “… logistic support and the design, development, systems, integration and testing capabilities of the military electronics, guided missiles, artillery, and armored vehicles sectors” were considered strategically important and critical to export markets. (FAS, *circa* 2001). Specific technological competency domains are posited to be – “… electronics, weapons systems and communications.” (Creamer Research, 2006: 9) –

Table 3.1: Technology Competency Domains

Technology Domain	Systems
Electronics	“design and manufacture of guidance systems for missiles, gun-control systems for vehicles and fire-control systems for artillery”

	"design and development of avionics subsystems for fighter aircraft and attack helicopters"
Weapons	"weapons for aircraft, helicopters, ships, vehicles, artillery and infantry"
Communications	"development of secure communications, electronic warfare, radar and information technology"

Source: Creamer Research (2006: 9)

Areas of technology design and manufacture leaderships are perceived to be (*circa* 2006) – UAVs, artillery systems (G5 and G6), ammunition, propulsion systems, turret and gun systems for ICV, mine-protected vehicles, surveillance sensors and systems for UAVs and helicopters, a variety of missile systems, submarine periscopes laser range-finders, "missile launch warning systems and low-cost radar warning receivers for aircraft; health and utilisation monitoring systems for avionics; and electronic fuses for a variety of artillery rounds and aircraft bombs". (Creamer Research, 2006: 9).

Devore (2013: 552) is of the opinion that complex integrated systems and platforms such as missiles, unmanned aerial vehicles and artillery could still provide some competitive advantage. A comparative advantage could possibly be maintained at a sub-system level for electronics and airframe sections and engineering capacities in the maintenance and repair domains. These technology domains do not always function well within and react well to market forces. They invariably require some autarky (or protectionism). South Africa thus requires updated national policy (considering the WPDRI 1999 is outdated) that provides policy expression and direction to secure self-sufficiency in armament and associated R&D that is difficult to sustain commercially. This must be supported by a SA DTIS that includes a self-sufficient R&D capability. (FAS, *circa* 2001). Ambitions expressed in the WPDRI 1999 positioned the SA DTIS well for bilateral DTIS cooperation with the BRIC States (amongst others) in 2019 and the future.

The hybrid defence industrial policy that was gradually adopted, after the promulgation of the WPDRI 1999, included a sustained manufacturing capability that allowed South African defence industries to be incorporated into international defence industrial supply chains. In order to provide a stable platform for foreign policy and military flexibility, the post-1999 SA DTIS also ring-fenced – "… systems-integration skills essential for national security would be embedded in a state-owned corporation, Denel[14], formed in 1992 from Armscor's laboratories and production facilities." (Devore, 2013: 552 and FAS, *circa* 2001). Denel SOC thus became the primary and remained such, South African defence technology and industrial capability in support of the SANDF, foreign policy and other economic objectives – i.e. national interests. Emphasis was attached to SA DTIS development and

[14] "By 1993 Denel exported armaments to 41 countries, with artillery pieces being the main export product. In 1992-93 Denel accounted for 72 percent of South African defense industrial revenues, of which about 25 percent was from export sales. Denel also started to increase its diversification to non-defense markets. By 1994 about 25 percent of Denel's output was for the non-defense sector, and included mining equipment, industrial security, health care and medicine, and commercial products." (FAS, *circa* 2001).

export potential based on its legacy strategic value, the requirement for self-sufficiency and employment creation as well as foreign currency revenue from exports. (FAS, *circa* 2001). Idealism is clearly visible and indicates that the SA DTIS has accepted international practice on these matters. It also reflects a divorce from a pure autarky approach towards a hybrid approach. A more liberal approach (at least hybrid) allows for the use of strategic business levers that could be associated with liberalism and hybridism such as JVs, M&A, equity partnerships and technology transfers. Critically, South Africa also signed subscription to arms control, creating the National Conventional Arms Control Committee (NCACC) in 1995. (Devore, 2013). This introduced several restrictions in terms of markets and what can be exported.

State recognition of the criticality of armament exports for the survival of the SA DTIS within the current defence market conditions. This export focus of the SA DTIS must be calibrated by arms control so as not to be perceived internationally as an "indiscriminate exporter". (FAS, *circa* 2001). The SA armament exports control policies focus critically on regional security balances, anti-terrorism and respect for human rights – all having an idealist agenda because these reinforce economic development. (FAS, *circa* 2001). Thus the recommendation of the White Paper on Defence-Related Industries 1999 to make the NCACC a statutory State body. (FAS, *circa* 2001). This focus was already introduced in 1996 with the White Paper on Defence 1996 stating that the SA DTIS will – "… conduct its foreign policy, arms trade and external defence activities in accordance with international law and norms." (South Africa, 1996). Note also from this quote the linking of foreign policy and arms control and thus by implication the DTIS. This is a recurring theme throughout the recent DDIS 2017.

A defence industrial offsets programme was initiated by Armscor in 1997, labelled Defence Industrial Participation (DIP)[15], to manage future FDI resulting from foreign acquisition programmes. (Devore, 2013). "[DIP] is a form of countertrade and falls in the sub-category of (defence) offsets. The South African DIP programme played a developmental role in the country's defence industrial base (DIB), arresting its steady decline since the 1980s." (Van Dyk, *et al*., 2016: 146). During a period of international defence market consolidation in the late-1990s and early 2000s, the adoption of arms control and a shrinking defence budget the SA DTIS was forced to take a subcontractor (Tier 2) role in the international defence technology and industry market place – or perish.

The SDPs (2002-2012) addressed (supposedly) geostrategic instability. More importantly, it addressed an ailing SA DTIS. The early-2000s SDPs was the frontrunner that tested the DIP programme and institutionalised it in the SA DTIS. Technology transfer as a strategic business lever was used extensively since the inception of the DIP policy throughout the SDPs. (Van Dyk, *et al*., 2016). Dunne and Lamb (2003) and Dunne and Haines (2006) questioned the success of the DIP derived from the Strategic Defence Packages (SDPs). Their critique was, however, delivered early in

[15] Van Dyk, *et al*. (2016: 147) states that – "DIP, managed exclusively by Armscor, South Africa's acquisition agency. DIP favours pursuing defence industry development objectives. The other is the National Industrial Participation Programme (NIPP), managed independently by the Department of Trade and Industry (dti) that focuses primarily on civil industry. Both programmes (DIP and NIPP) are often erroneously conflated and collectively referred to as 'offsets', which may create the impression that they are synonymous."

the SDPs (*circa* 2003) with the SDPs spanned the period 2002-2012. During this period there was increased strategic business lever usage, to diversify an ailing SA DTIS, manifesting in various transnational equity deals (M&A), transfer of technology (probably also technology sharing), JVs and production under licence. (Dunne & Haines, 2006).

This erosion of The SA defence technology and industrial capabilities (into Tier 1 and 2 positions) was the result of various factors, but most visibly, the continuous cuts to the defence budget as was reflected in Figure 1.3 of the thesis. Very view of these capabilities remained at Tier 1. The SDPs was positioned to, not only to acquire defence systems/platforms but also to enable the SA DTIS to design, develop, integrate, maintain and repair at a sub-system level – essentially to start climbing the "Ladder of Production" again. This capability must become available for the entire life-cycle of the systems/platforms. The SA DTIS must also be in position after the SDPs to start-up R&D as well as – "…enter alliances with global defense companies, and promote defense exports." (FAS, *circa* 2001).

The SA DTIS was thus re-discovered by the international defence technology and industry market place, and used for their own gains in the short term. It resulted in new flows of FDI through the DIP programme as well as the M&A of domestic industrial capacities by foreign-based defence industries. The result was a SA DTIS focussed on niche technologies and supply chains, focus on the delivery of the SDPs and technologies, systems and services required once the SDPs were delivered and operational. Foreign M&As were (probably) mostly fuelled by the recognition that the SA DTIS was littered with competence, work ethic, innovative spirit, essentially undervalued in the market place. Soon companies such as SAAB (Sweden) acquired Grintek (South Africa) – SAAB Grintek; Thales (France) acquired African Defence Systems (South African) and BAE Systems (UK) acquired OMC Land Systems and Paradigm Systems (South African). (Devore, 2013). Other equity partnerships were as follows –

Figure 3.4: Foreign Direct Investment into South African Defence Industries

Foreign Investor	South African Firm	Nature of Relationship
BAe Systems (UK)	Land Systems OMC	ownership
BAe Systems (UK)	Paradigm Systems	ownership
EADS (Franco-German)	Reutech Radar	minority partnership (33%)
Rheinmetall (Germany)	Denel Munitions	majority partnership
SAAB (Sweden)	Grintek	ownership
SAAB (Sweden)	SAAB/Denel Aerostructures	majority partnership (80%)
Thales (France)	African Defence Systems	ownership
Turbomecca (France)	Turbomecca Africa	majority partnership (51%) with Denel (49%)
Zeiss Optroniks (Germany)	Denel Optronics	ownership

Source: Devore (2013: 553) and Heitman, 2008).

Note, during this and previous periods there was no DTIS-related relations building with BRIC States (with possibly the exception of Brazil). The SA defence market was virtually monopolised by European defence industries. These, largely European, multinational defence technology and

industrial relationships based on equity partnership or ownership were the impetus that kept the SA DTIS out of the doldrums. Access to foreign markets was now possible and provided systematic growth to component and subsystem providers (Tier 2 industries). (Devore, 2013). SA DTIS autonomy is less-and-less attainable, under these conditions, due to the integration into the international market and supply chains. The SA DTIS ambition to be self-sufficient was slowly slipping away.

The hybridisation of the SA DTIS is influenced by – "… a highly competitive agglomeration economy, much of which is foreign owned [*sic*]". (Devore, 2013: 555). The hybridisation consists of foreign ownership mixed with SA government ownership of primary armament production capabilities such as RDM (Denel Munitions is a division of Denel SOC Ltd). Denel SOC Ltd is estimated to have 48% of the SA defence technology and industrial capability that includes systems-integration capabilities [Tier 1], which is considered essential for foreign policy and military decision-making flexibly. (Devore, 2013).

A hybrid SA DTIS policy was introduced by the SA Government with the intention to develop niches in the international armament ecosystem. This was to be accomplished by integrating such niches into internationally competitive supply chains of foreign multinational defence industries. The intention was to create a comparative/competitive advantage with which to penetrate or dominate markets or be an attractive bilateral partner. Allowing FDI and foreign M&A of strategic SA defence and technology capabilities (e.g. Denel) provided a short-term lifeline to some of the SA DTIS niches. It also resulted in some autarky to preserve some of the SA DTIS sovereign capabilities (e.g. the missiles production capabilities of Denel Dynamics). The FDI and other M&As eroded the SA DTIS decision-making autonomy and flexibility and also its control over IPR. (Devore, 2013: 555).

A very recent SA DTIS policy statement positions the NDIC as the inter-departmental forum with which to ensure that the SA DTIS is used to the fullest capacity in SANDF acquisition programmes in support of national imperatives to localise defence production and create strategic independence (self-sufficiency) in equipment maintenance and upgrading of systems/capabilities. (NDIC, 2018: 2). The objective of 'some form of strategic independence in maintenance and future upgrades of defence systems/platforms suggests that the SA DTIS are still highly dependent on imports and thus the initiative of localisation. From this policy statement, it does seem that the SA DTIS has moved down the "Ladder of Production" significantly and is strategising a recovery or mere survival within the prevailing defence market and economic contexts. Therefore, self-sufficiency (localisation) is still a prime SA DTIS objective. No intention is stated to dominate any market segment. This is important to understand when the SA DTIS want to use strategic business levers to access bilateral partnerships with the BRIC States in the post-SDP era. If there is a mismatch of proposed levers it will probably hamper access to partnerships, increased market footprint and new technologies. This will delay the development objective of self-sufficiency and thus also foreign policy and military decision-making autonomy.

As was stated earlier, the transition after 1994 opened up several markets due to firstly the liberalisation and then a more hybrid DTIS policy and the SDPs. Africa, the Middle East, South East

Asia (Malaysia) and Australia were positioned as important post-1994 SA DTIS markets. South African arms exports increased by 34 % in 1997. Sales expanded to India, Switzerland, Singapore, Colombia, and others. (FAS, *circa* 2001). More and more countries were systematically added to the SA DTIS market – i.e. Algeria, Thailand, Switzerland, Columbia, UAE, USA, Tanzania, Peru, Brazil, and Romania (FAS, *circa* 2001); Finland, Malaysia, Algeria (Martin, 2016b). In the past 19 years (at least) more markets were added - Germany (periscope technologies); UK (tail sections for trainer aircraft and vehicles); Italy (Maintenance, Repair and Overhaul (MRO) for Italian helicopters sold to the African and Far Eastern market); USA, Italy and Sweden (mine-resistant ambush-protected vehicles (MRAP). (Devore, 2013: 554-5).

India became a focal point for defence exports in the late-1990s. After the initial Indian-South African Joint Committee on Defense Cooperation meeting (August 1998), expression of interest in artillery, small arms, ammunition and maritime systems were stated. A year later (October 1999) this expression was broadened to interest in R&D and joint production. (FAS, *circa* 2001). This is confirmation bilateralism for defence technology and industrial cooperation. India soon afterwards became the largest customer and partner to the SA DTIS. (FAS, *circa* 2001). Almost two decades later the IPAP 2017/18 Annual Report makes mention (briefly) of the use of bilateral agreements within the context of the SA DTIS. (South Africa, 2018: 29). Yet, the IPAP 17/18-19/20 makes no mention of bilateralism or multilateralism – instead, the term “collaboration” is used more frequently with “joint venture” only used once. (South Africa, 2017b). From a national industrial development perspective, there is no SA DTIS focus on collaboration with BRICS stated in both the IPAP documents. (South Africa, 2017b; South Africa, 2018). Instead, Africa seems to be the preferred market. (South Africa, 2017b).

Other, quite significant bilateral SA DTIS initiatives are with Brazil, Malaysia and the UAE. “Malaysia is still a focus for marketing artillery, ammunition, helicopters, UAVs, combat turrets, communications equipment, and defense electronics.” (FAS, *circa* 2001). These are all current technology focus areas of the SA DTIS. Paramount has entered into the Nigerian and Australian markets recently with the acquisition of Nautic.[16] Note – Russia and China as markets or partners are conspicuous by there absence. Also noteworthy is the fact that the IPAP 17/18-19/20 does not make mention of Brazil, India or Russia. China is mentioned six times and Russia once - but not within the context of the SA DTIS. (South Africa, 2017b). So, there is a national policy void on the SA DTIS within the BRICS context. Thus, the DDIS 2017 and the NDIC Booklet becomes important documents with which to engage the SA DTIS.

With a synoptic view of the SA DTIS in the rearview mirror, let us consider other facets of the SA DTIS landscape that could influence bilateral partnerships between the SA DTIS and those of BRIC States.

[16] Paramount Group presentation to the Security and Defence Studies Programme 05/19 25 April 2019.

3.2.1.1 South African DTIS Growth Barriers and Drivers

This symbiotic relationship is of paramount importance for the drive to grow export sales, as the success of international sales is largely linked to the use of such equipment by our own forces. (Hamilton in Campbell, 2017).

Some of the challenges to SA DTIS ability to climb the "Ladder of Production" to attain self-sufficiency yet again are, according to Heitman in Campbell (2017), linked to the fact that the SANDF is a weak procurer of the SA DTIS products, systems and/or services which assists the perpetuation of deteriorating technology development capacities. This, in turn, perpetuates intellectual capital flight. Heitman and Hamilton (in Campbell, 2017) describes a number of primary barriers to growth and sustainability –

- Inadequate funding of the SA DTIS. Shortages (now) in the engineering and technical skills. Sharing the concern, Zhang (2012) states that the proverbial 'brain-drain' is a key problem facing the science and technology community of the South African National System of Innovation (and probably several other components of the South African society). This will obviously have a negative impact on the innovation ability of the SA DTIS and thus its attractiveness for bilateral cooperation.
- Continuously declining SA DOD budget/available spend on capital acquisition.
- An underfunded primary client of the SA DTIS – the SANDF.
- Due to the political nature of a DTIS, the SA Government is not supporting the SA DTIS to penetrate new foreign markets.
- The SA DTIS is also hampered by a less-than-effective arms control capability that negatively impacts the SA DTIS reputation in the international market place.
- The SA DTIS is continuously crowded out of international markets due to inadequate integration into the dominating international DTISs. The strong focus of the SA DTIS on electronic subsystems design, develop and manufacture is threatening to the established, international, OEM supply chains. It spawns tactics to crowd-out the SA DTIS from international supply chains. Heitman in Campbell (2017) is of the opinion that JVs with foreign OEMs will be of great value to ensure the SA DTIS survival within these markets.
- Encroaching traditional SA DTIS niches. Heitman in Campbell (2017) elaborate on the increased competitive behaviour of foreign industries (reaching for domination as per Figure 2.9 - 2.11 in Chapter 2 of the thesis) in the mine-protected Armoured Personnel Carrier market. Traditionally, the SA DTIS maintained a competitive advantage in these product systems. Worldwide production of these product systems, as well as surplus USA mine-resistant ambush, protected (MRAP) vehicles being offered for sale, are crowding-out the SA DTIS from this market.
- Poor focus on expanding market segments. Although there is an international focus on the design, development and manufacturing of UAVs – the SA DTIS is not concentrating on penetrating this

market. Again, such penetration is contingent on the SANDF procuring domestic systems as well as adequate domestic funding of such a high-growth potential market segment. (Campbell, 2017).

Barriers to effective international market access by the SA DTIS is also stated in national policy and strategy documents. The DDIS 2017 and the Department of Trade and Industry (the dti) Industrial Policy Action Plan (IPAP) states the following possible barriers which face the SA DTIS -

- Inadequate availability of large-scale technology capability development programmes/initiatives.
- Shortages in skills, skills retention strategies, knowledge transfer to domestic industries, and knowledge-generating institutes/industries. (South Africa, 2017a; South Africa, 2017b).
- Reduced R&D budgets.
- Lack of technology demonstrators.
- Absence of an encompassing SA DTIS sustainability programme which includes measures to develop and sustain export and a "South Africa First" philosophy, which would put a much stronger emphasis on localisation of technology".
- No export market diversification.
- Deficient diversification of product portfolios.
- Increasing foreign ownership in sovereign/strategic technology niches.
- Lack of coherence in industrial development policy.

(South Africa, 2017a; South Africa, 2017b; South Africa, 2018; Campbell, 2017).

Exacerbating the impact and long-term reach of these barriers to SA DTIS development and sustainment is a South African Joint Standing Committee on Defence (JSCD) mandated to provide oversight to the SA DTIS, typically with regards to inadequate funding, skills retention, and capital acquisition policies. However, Abbas, *et al.* (2016: 3) is of the opinion that the JSCD is a - "… dysfunctional rubber stamp, with questions raised about its members' independence." This undermines areas of good governance established for the purpose of attracting foreign investment and supporting South African initiatives to enter into bilateral cooperative arrangements with BRIC (and other) countries. This said, South Africa is regarded as transparent about their defence exports, discussed later as a positive influence on a developmental agenda.

The DDIS 2017 highlight some of the barriers that result from the asymmetry within BRICS. The strategy states that, other than possibly Brazil, the rest of the BRIC would not be interested in bilateral partnerships with South Africa for the purpose of the implementation of the proposals of the DR 2015 in order to reduce cost and timeframes. This is possibly due to their competitive agendas for the African defence equipment market share. This perspective was also stated earlier in the thesis. The SA DTIS will either become a client of Russia, India and/or China or will have to assume a subordinate role in the armament supply chains in Africa. This conforms exactly to the negative nature of the asymmetry between the SA DTIS and those of Russia, India and China – discussed earlier. "Also, all three are supplying equipment to some countries at what might be termed 'friendship prices' that

entirely undercut anything South Africa could offer, so such a 'partnership' would hold no benefit for the industry and could, instead, fatally undermine any chance of major defence sales into Sub-Saharan Africa." (South Africa, 2017a: 141-142).

On a more positive note, Zhang (2012: 173) states that - "… South Africa has the best basic industry, military and agricultural technology. Tremendous opportunity and common interests exist in this area. South Africa and China should build bilateral relations of mutual benefit." South Africa is strongly positioned in R&D in the following domains – "… bio-technology [*sic*], information technology, and technology for manufacturing, technology to leverage knowledge, technology from natural resources sectors and technology for poverty reduction." (Zhang, 2012: 99-100). The discussion about the barriers above dampens the optimism by Zhang considerably.

There is a glimmer of hope for developmental momentum stemming from the developing bilateral relationship with China. "South Africa's diplomatic relationship with [China] is very new, being only 15 years old, and one of the least tested amongst African countries. Yet, the PRC had within twelve years (1998 to 2010) elevated the bilateral relationship from ordinary diplomatic ties, to a —partnership and then to a —strategic partnership and, in August 2010, to a comprehensive strategic partnership." (Sithole, 2015: 5-6). However, as has already been discussed above, from a DTIS perspective, this developing bilateral relationship holds very little promise for the SA DTIS.

Campbell (2017) regard SA DTIS's idealist approach towards SA economic development as a driver for growth. This is based on the fact that the SA DTIS is a recognised economic sector in the IPAP. The aims of the IPAP for the SA DTIS is broadly to make the sector sustainable from an engineering and manufacturing perspective in support of defence needs self-sufficiency objectives; to unlock export opportunities; "… to effectively support the development of local technologies and advanced manufacturing capabilities […] especially broad-based black economic empowerment and small, medium-sized and microenterprise (SMME) participants"; and also to focus more acutely on the aerospace industries and the national space programme. (Campbell, 2017).

The non-aligned status of the South African foreign policy could positively reinforce other SA DTIS development drivers. Being non-aligned allows for trade relations with most States, within the boundaries set by international arms control. (Campbell, 2017). A strong emphasis is placed on the necessity for the inclusion of local content in all acquisitions by the SANDF. Partnerships with African countries are also seen as a growth driver by Hamilton in Campbell (2017). Africa as the focal point is also stated in the IPAP 2017/18 Annual Report (South Africa, 2018). Nothing is said about bilateral DTIS cooperation with BRIC states in Campbell (2017). Possibly because Russia and China are already crowding the SA DTIS out of the African market.

Hamilton in Campbell (2017) is of the opinion that AMD remains a critical vehicle within the SA DTIS, traditionally and in the future, with which export growth can be achieved and sustained. Both Heitman and Hamilton (in Campbell, 2017) underline the criticality of a functional and symbiotic relationship between the SA DOD/SANDF and the SA DTIS as a necessary component of a market

penetration strategy. The inverse of this situation currently was stated above as a primary barrier to development.

Anti-corruption measures can be considered a driver of (or at least a requirement for) sustainable growth. South Africa is one of the few African countries that publish (fairly) accurate defence spending estimates. This provides a good basis for transparency and trust-building with current and future alliances such as bilateral cooperative arrangements with BRIC countries. Also, "… South Africa […] limit, by statutory or constitutional means, their defence institutions ability to have controlling or financial interests in businesses associated with the country's natural resource exploitation." (Abbas, *et al.*, 2016: 16). However, this alone will not develop the SA DTIS. It has to be clustered with a significant number of other drivers of development which at least in the short- to medium term is not present (e.g. funding).

The obvious DTIS development drivers are the technology and product portfolios developed, produced and marketed by them. As such Salojee (2014: 19) states that the SA DTIS was an international leader in the field of - "… long-range artillery, mechanised infantry vehicles, mine-protected vehicles, small and medium calibre ammunition and, more recently, unmanned aerial vehicle systems and guided-missile technology." FAS (*circa* 2001) adds the export quality of the South African test ranges and facilities to the national portfolio. These are and will service both economic and military objectives. The SA Government will also provide support where there is potential to achieve or maintain comparative or competitive advantage based on niche technologies such as precision-guided weapons and precision engagement systems and fire-directing systems or technology/product that presents significant potential for international cooperative arrangements. (South Africa, 2017a: 38-40). More recently the DDIS 2017 alluded to what is considered primary technology domains supported for development in support of the Defence Strategic Trajectory explained in the DR 2015 are:

"a. Command and control.

b. Information warfare and cyber defence and operations, at all levels of war.
c. Secure communications.
d. Information technology, including data fusion.
e. Intelligence-gathering sensor, analysis and evaluation.
f. Target acquisition and identification.
g. Unmanned systems (aerial, ground, surface and under-water).
h. Missile and wider guided munitions.
i. Night and poor visibility observation and engagement.
j. Electronic warfare.
k. Rugged tactical vehicles optimised for operations in the African theatre.
l. Mine and IED detection and protection.
m. Long-range artillery, precision bombardment and point target engagement systems.

n. Chemical, biological and radiological defence, including the manufacture of military carbons and canisters.
o. Battlefield medical care optimised for the African theatre.
p. Modelling, simulation (for development, training and planning) and stimulation." (South Africa, 2017a: 38-39).

These technology focus areas could drive growth within the SA DTIS. They are positioned at various levels within the Tier Structures concept discussed in Chapter 2 of the thesis. Opportunities might not all be at a Tier 1 level ('prime mission equipment or systems" - South Africa (2017a: 161), unfortunately, but the opportunities could provide access to the international market. Those opportunities that fit a Tier 1 profile are linked to (traditionally) defence technology and industrial niches – e.g. "long-range artillery, wheeled combat vehicles and mine-detection vehicles, or where South Africa can provide a more cost-effective system (e.g. potentially Rooivalk)" (FAS, *circa* 2001 and South Africa, 2017a: 161). At Tier 2 and 3 levels, opportunities may exist EW and communications technologies and system domains. Companies such as Reutech, Saab-Grintek Defence and GEW Technologies excel in these domains, locally and internationally. Then there are opportunities in the market segment that deals with improvements/adaptations to foreign imported systems/platforms (e.g. the innovations of LMT on retractable weapons mountings). These types of innovation fit well with the international appetite for stealth. Then at Tier 3 is the supplier role of components and sub-components to major OEMs globally by for example Aerosud, Airbus Optronics and Denel Aviation. South Africa also possess (at least) at a comparative advantage that is well suited for JVs and export contracts in the design, development and production of a selection of guided munitions and conventional munitions (e.g. the 155 mm artillery munitions consider to be world-class), artillery systems, EW systems and software and communication systems. (South Africa, 2017a: 164). Another Tier 3 DTIS activity is the MRO service support for typically small to medium armed forces (South Africa, 2017a: 160-161), taking cognisance of the fact that in Africa this MRO will in all probability be undertaken by the OEM situated in Russia and/or China. It is probably only the European countries that might consider the SA DTIS as a viable MRO sub-contractor in Africa, also possibly due to the traditional linkages between the SA DTIS and those in Europe.

The named technologies, products and services indicate SA DTIS fragmentation; probably containing several smaller companies that are not sustainable. Many of these companies will have to consider JVs and/or M&A with foreign partners to be able to survive in the defence market. Paramount has been acquiring some smaller companies (i.e. Nautic, Aerosud, ATE), providing horizontal and vertical integration across a number of capabilities which allows Paramount to have entered new foreign markets whilst expanding its product and services portfolio.

From an R&D perspective, the SA DTIS invested a combined R1.7bn (2015) in R&D and technology development projects. "In broad terms, major areas of current local R&D are additive manufacturing (3D printing), titanium beneficiation and radar technologies (especially

synthetic aperture radar)." (Campbell, 2017). The AMD is a key coordinator of the various SA Government departments investing and participating in R&D. The departments involved, and conforming to the role of Governments as discussed in Chapter 2 of the thesis, - "to ensure industry and government R&D programmes are complementary", are (at least) -

- Department of Science and Technology (DST) and typically the Council of Scientific and Industrial Research (CSIR), "Technology Localisation and Implementation Unit (formed by the DST and hosted and supported by the CSIR) to develop better coordination between local R&D projects" (Campbell, 2017) and "…provision of sovereign [R&D] and [T&E} for the Defence Force". (South Africa, 2017a: 53).
- DOD and Armscor – "Close relations between the industry and the [DOD] and Armscor also facilitate applied research, resulting in an improvement in existing systems and services and helping the development of new ones." (Campbell, 2017). Some of the R&D and Test and Evaluation (T&E) capabilities managed by Armscor are Alkantpan (ballistic test range for medium/heavy calibre munitions); Ergotech (ergonomics research, design, specification, T&E); Flamengro (computational fluid dynamics and finite element analysis support for design, development, T&E); Gerotek (vehicle mobility, performance, endurance, reliability test and evaluation and design optimisation); Paardefontein (national antenna test range); Armour Development (platform and personal protection equipment); Hazmat (R&D and manufacture of chemical/biological protective masks and filters, and of activated carbon); Institute for Maritime Technology and Protechnik Laboratories (chemical/biological protection). (South Africa, 2017a: 51-52).
- DOD and DPE - The Overberg Test Range (OTR) (Denel-owned) specialising in missile and aerostructure T&E. (South Africa, 2017a: 49).

Most of the stated technologies and product systems listed and named above stem from the existing SA DTIS capabilities. There is very little focus on future technologies and requirements of possible future battlespaces and scenarios. This 'last war focus' will severely hamper market penetration and role definition of the SA DTIS within the BRIC. Africa, it would seem, is the preferred SA DTIS focal point. (South Africa, 2017b; Campbell, 2018; South Africa, 2018). Conversely, this focus might be problematic from a South African foreign policy perspective in terms of arms control. The technology focus for the 'African theatre' is obviously linked to the SANDF capabilities and theatre requirements. However, in order to penetrate international markets, this focus might not be appropriate. The SA DTIS product systems have not successfully penetrated the African defence market. To be considered for bilateral DTIS partnerships with the BRIC States the focus might have to be adapted, except where the SA DTIS is used as a partner to service African defence requirements

via the BRIC (possibly by India, Russia and China) market segments in Africa. This was the projected reason for the South African partnership with BRIC from the onset.

Another driver of paramount importance, according to Heitman and Hamilton, is the SA DTIS's propensity for affordable innovation. Some examples are quoted – "Denel Dynamics […] remains a world leader in certain categories of guided missiles and other guided weapons […] Reutech Radar Systems, whose RSR210N air/sea surveillance radar is fitted to the frigates of the Royal Norwegian Navy." (Campbell, 2017). "[L]ocal industry has underpinned high-end technology and skills development, job creation and retention of strategically relevant technologies and manufacturing capabilities. The size, ingenuity and interdependence of the South African defence industry allow it to respond swiftly and flexibly to new client requirements, with some developments reaching fruition in as little as six to nine months from inception." (Campbell, 2017).

The SA DTIS focus area as stated by IPAP 17/18-19/20 – "Technology enhancement for high value [*sic*] manufacturing in [the] aerospace industry". (South Africa, 2017b: 41). This focus is quite evident in the IPAP 17/18-19/20 document synopsis of successful market penetration that could be construed as growth drivers within the SA DTIS. (South Africa, 2017b: 25-26). However, other successes vehicular systems, satellite technology and small arms are also mentioned which could provide impetus to a role for the SA DTIS in the BRIC DTISs -

- The 8x8 Infantry Combat Vehicle by Paramount addressing a world-wide demand, in a cost-effective manner, for this type of vehicle system.
- Paramount is also producing the locally designed Advanced, High-Performance, Reconnaissance, Light Aircraft (Ahrlac) in the purpose-built production facility in Pretoria.
- Components and parts for the Pilatus PC-12 passenger aircraft are now being produced by AAT Composites. Then there is the Falcon 402 passenger and utility aircraft being produced in Pretoria by Falcon Air.
- The lightest general-purpose machine gun (7.62mm), the DMG-5, is now being produced by Denel Land Systems – enlisting international interest.
- "A nano-satellite designed and built in South Africa was launched from the International Space Station in the first quarter of 2017 as part of the European Commission's QB50 research project. The satellite is managed by SCS Aerospace Group, South Africa's biggest private satellite concern. The camera technology being tested on the Sight1 nano-satellite was developed with initial support from the dti's Aerospace Industry Support Initiative." (South Africa, 2017b: 26).

Having discussed the most important parts of the SA DTIS landscape, let us consider what strategic business levers the SA DTIS is favouring within possible DTIS cooperation between South Africa and the BRIC States.

3.2.2 South African DTIS Strategic Business Approaches and Levers

First consideration should be given to expressions on a preference for multilateral or bilateral partnerships within the context of defence technology and industrial cooperation. The current SA DTIS is/will be regulated by the NDIC and its DDIS 2017. (South Africa, 2017a). However, the DDIS 2017 has not yet been promulgated and even when promulgated it remains a SA DOD strategy – "… intended primarily to ensure effective support for the Defence Force." (South Africa, 2017a: 215). It does provide some insight into what the SA DTIS strategy holds towards the future.

One aspect, as a starting point and relevant to the research questions for this thesis, is the position taken about future bilateral collaboration with BRIC countries. The DDIS 2017 envisage that strategic independence (self-sufficiency) could be enhanced on a case-by-case basis with international collaboration in R&D. This is to ensure that the SA DOD/DTIS keep pace with technology developments and innovation. The strategy also foresees that the platform for collaboration could be bi- and/or multilateral. The Defence Committees (Def Coms) are seen as administrative instruments to service such collaborative agreements. (South Africa, 2017a: 26). The participation of the SA DTIS in Def Coms (as defence diplomacy) and other diplomatic efforts is promoted by the NDIC in both bi- and multilateral collaboration. (South Africa, 2018: 13 and 32). The level of inclusiveness will thus be determined on a case-by-case basis.

Based on the White Paper on Defence 1996 the DDIS 2017 confirms the focus on collaborative ventures with foreign companies in at least – "… training and education, defence planning, exchange visits, combined exercises and procurement of arms and equipment " (South African, 1996 and South Africa, 2017a). Again, no definitive position on preference for multilateral or bilateral partnerships. Multilateral is only mentioned once throughout the DDIS 2017, in concert with bilateral cooperation.

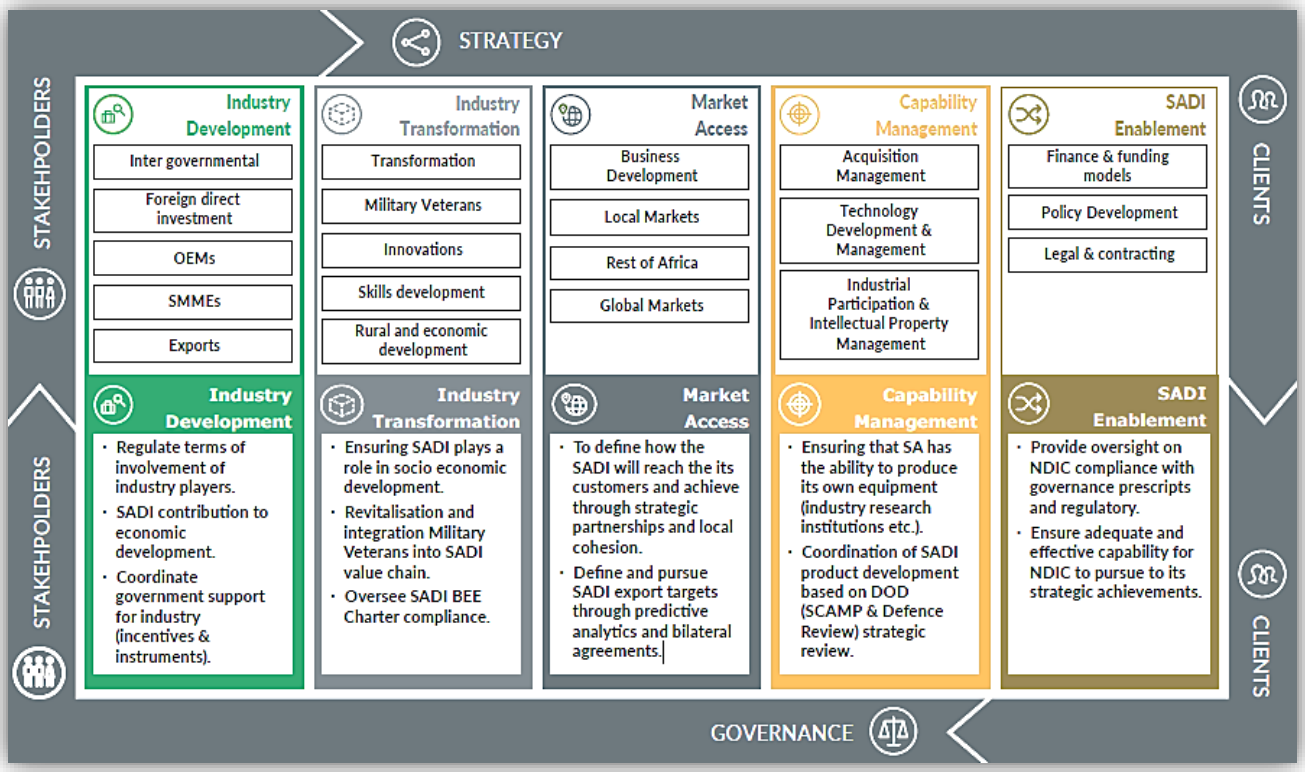
The White Paper on Defence 1996 was focussed on the SADC countries because the BRICS alliance did not exist at that point in time yet. The White Paper is also the original source for the focus on the African market. The White Paper on Defence 1996 goes on to state that bilateral agreements should be established with interested States to create partnerships that have industrial portfolios which could result in mutually beneficial (bilateral) industrial partnerships. (South Africa, 2017a: 182). Well, virtually none exists in the SADC. Thus the White Paper 1996 might have had a different intention. That intention is slightly clearer in the Draft Strategy on Defence Industry 2017, clearly favouring bilateral cooperation on defence and DTIS matters. (South Africa, 2017a: 182, 199).

The Draft Strategy on Defence Industry 2017 also projected that the SA DTIS will not be able to secure a sustainable segment of the defence technology and industry market without adequate levels of funding from SA DOD acquisition programmes. In order to augment this now very real predicament in the quest for sustainability with is through the establishment of "close partnerships" – which could be translated as bilateral partnerships based on the closeness aspect – with large multinational defence technology and industrial corporations in order to gain access to new markets, innovation and technology. (South Africa, 2017a: 211).

Import dependence on major or complex systems and platforms, such as those acquired by the SDPs, are currently the reality. It is a clear break from the self-sufficiency pre-1994. It also set the tone for the bilateral collaboration with (amongst others) the BRIC States in future. The motive for this is more self-centred and idealistic, though. It does not just focus on the attainment of military autonomy and DTIS self-sufficiency but also more idealistic on attracting foreign investment, export revenue and employment creation. (Campbell, 1999; FAS, *circa* 2001). Possible future bilateral partners might not share this agenda of development vs. pure military capability. They might also abuse this idealistic SA DTIS approach by focussing on the South African developmental agenda through investment and other bilateral agreements whilst plundering niche SA DTIS and other technologies in the process. States has no friends only interests. The NDIC propose to create or enhance market access by defining and pursuing SA DTIS export targets by means of bilateral agreements. (South Africa 2018: 12). No preference is given to the BRIC States. This underwrites the perspectives of the DDIS 2017. Having established that the SA DTIS does focus on bilateral partnerships for DTIS collaboration, the discussion can progress into which strategic business levers do the SA DTIS subscribe to in approaching possible bilateral partnerships?

Strategic business levers alluded to by the IPAP 17/18-19/20 as short-term responses to the various market demands are summarised in the following - “Aggressive technology acquisition, transfer and diffusion; Securing inward investment from global OEMs in key strategic value chains to build global competitive capabilities [e.g. …; aerospace and defence]”. (South Africa, 2017b: 41). Strategic business levers alluded to in the functions of the NDIC Secretariat (Figure 3.7) are FDI, inter-governmental cooperation/collaboration and DIP.

Figure 3.5: Strategic Business Levers Indicators in the Functions of the NDIC Secretariat



Source: South Africa (2018: 12).

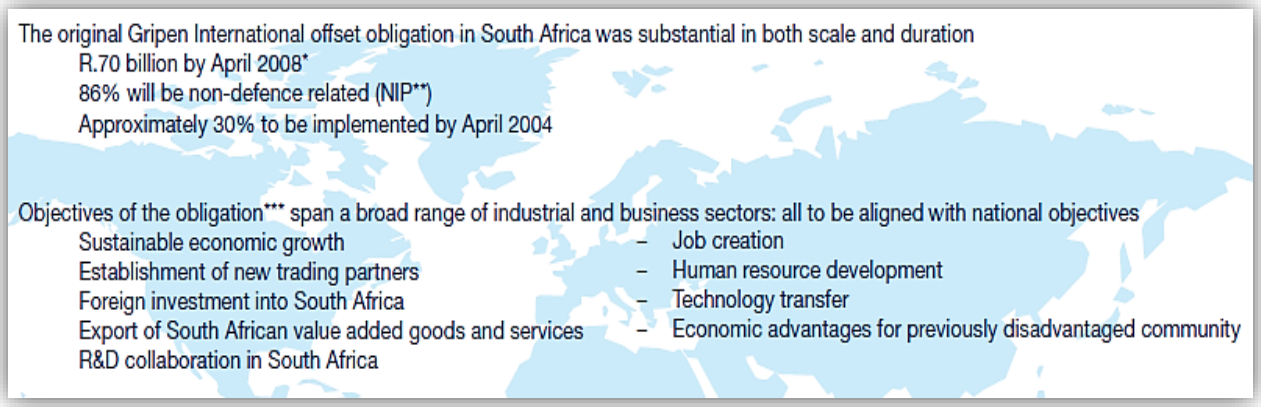
Figure 3.7 also provide a synoptic view of the Government's roles (adapted from United Kingdom (2005: 32) and discussed in Chapter 2) as an investor and customer (industry development, capability management, finance and funding models and industry transformation, as a planner (his planning activity of States is aimed at, amongst others, establishing and maintaining military capability and defence technology and industrial capabilities from various perspectives, as a supporter of industry (e.g. the Department of International Cooperation (DIRCO), Department of Trade and Industry (DTI), Department of Science and Technology (DST), National Treasury (NT) and the Department of Public Enterprises (DPE) (defenceWeb, 2018; South Africa, 2017a) are all examples that are encouraged to support and make use of the SA DTIS) and as a regulator of industry (SADI enablement, Industry Transformation and Industry development).

Directly linked to imports of defence matériel is offset programmes[17] - with distinct idealistic intentions. Bilateral partnerships with the SA DTIS will be subject to the SA DTIS offset policy requirements. The SA DTIS is a keen supporter of using offset programmes to drive economic growth both in the SA DTIS and the broader South African economy since it was introduced in 1996. (FAS, *circa* 2001; Hooke, 2005). Offset programmes are thus considered a strategic business lever focussing explicitly on domestic development.

[17] "South Africa's offset policy became law on September 1, 1996. It requires an offset of 50 percent of the imported value of the contract for any procurement over $10M in size." (FAS, *circa* 2001).

The SA DTIS offset policy requires foreign industries to create domestic employment as well as value chains with long-term viability in South Africa with a preference for - "… R&D collaboration, exports of value-added goods and services, economic improvements to disadvantaged communities, human resources development, and technology transfer." (FAS, *circa* 2001). A prime example of this was the offset programme attached to the SDP acquisition programme, signed in 1999. Figure 3.6 provides a synopsis of the Gripen fighter aircraft offset obligations. Hooke (2005: 32) provides a synopsis of the Gripen fighter aircraft offset obligations, estimated to be R70bn by 2008.

Figure 3.6: The Gripen South African Offset Obligation



Source: Hooke (2005: 32).

The offset agreement covered a range of military combat platforms and systems supplied by countries such as Germany, Sweden and Italy. The Financial Times placed the value of the SDP at around US$5.2bn and the offset value attached to the SDP to be realised by 2008 through supplier-introduced projects in South Africa with an estimated economic value of R70bn. (FAS, *circa* 2001; Hooke, 2005). Fourteen per cent of this value had to be a defence-related investment (FAS, *circa* 2001; Hooke, 2005), thus aiming at developing the SA DTIS. The very recent estimation of the offsets paid by Denel SOC Ltd on the turret JV with Malaysia/Turkey is summarised as follows – "The AV8 contract is the biggest export contract in Denel's history and the group's offset obligations total €342-million." Under the current economic conditions, this level of outward investment will probably not be sustainable.

The offset programmes are divided into defense industrial participation (DIP) and national industrial participation (NIP). DIP aims at SA DTIS development and NIP at broader economic industrial development. DIP is a useful strategic business (development) lever for the purpose of work-sharing, transfer of technology, and thus contributing to industrialisation and human capital development. (Van Dyk, *et al.*, 2016). For example, the SDP DIP included developmental work in components, sub-and systems, system integration, test and evaluation and manufacturing and assembling under license. NIP examples, aiming at broader economic development imperatives, from the SDPs is the stainless steel plant that had to be built by Germany in the Eastern Cape region in support of the commercial vehicle industry. (FAS, *circa* 2001). There is a call for better alignment

between the development strategies of the SA DTIS and that of the broader national industrial development imperatives. (Van Dyk, *et al*, 2016). Therefore, DIP and NIP initiatives will have to be synchronised in the national interest between typically Armscor (the defence materiel contracting agency) and the dti. (Van Dyk, *et al.*, 2016). This provides a clear indication that the SA DTIS is important for South African economic development, conforming to an idealist perspective. (Van Dyk, *et al*., 2016).

The DDIS 2017 does not make explicit mention of M&A as possible strategic business levers with which to promote bilateralism between the SA DTIS and those of BRIC State. It does, however, allude to equity partnerships which could be construed as a form of merger and/or acquisition. As such, a spin-off from the DIP programmes was a large number of mergers (M&A) between SA DTIS and well known European defence and technology industries. This entrenched the SA DTIS (at least some of the companies) in the transnational supply chains of OEMs which aimed at making the SA DTIS sustainable, at least in the short to medium term. Mergers do, however, have the down-side of the pulverisation of the South Africa technology-base with long-term negative consequences for the quest for self-sufficiency. (Van Dyk; *et al*., 2016: 156). There was and is today deliberate initiatives to continuously develop the SA DTIS using this approach. DIP could thus be positioned to do exactly the same for the SA DTIS in the BRIC States. Very similar to mergers as a strategic business lever, the DDIS 2017 also express on the attractiveness of equity partnerships (M&A); with a prerequisite of 51% domestic ownership, security and the protection of SA DTIS IPR. (NDIC, 2018; South Africa, 2017a).

The primary strategic business lever promoted in the NDIC and its associated DDIS 2017 is JVs between South African defence technology and industrial companies and foreign companies. (NDIC, 2018; South Africa, 2017a). Joint ventures with multinational defence technology and industrial companies are the favoured strategic lever with which to establish market penetration. (FAS, *circa* 2001; Tibane & Lentsoane (Eds.), 2016; South Africa, 2017a; NDIC, 2018; Campbell, 2018; Heitman in defenceWeb, 2018a). A good example of a longstanding JV between the SA DTIS and the Brazilian DTIS on a Government-to-Government (G-to-G) basis is the air-to-air missile development in Brazil. (BusinessReport, 2007). The JV consist of several South African and Brazilian companies such as Denel Dynamics, Avibras, Mectron and Opto Eletronica. (Martin, 2016).

Two recent examples of JVs are between the SA DTIS– UAE and SA DTIS-Malaysia-Turkey. The SA DTIS – UAE is based on guided bomb technology; resulting in the - "Tawazun Dynamics is a joint venture between the UAE's Tawazun Holdings (51%) and Denel (49%). Its mandate is to manufacture, integrate and support precision-guided weapons to the UAE and international clients." (Martin, 2016b). The SA DTIS and Malaysia are based on SA DTIS turret technology. The SA DTIS (Denel) – Deftek (Malaysia) JV is for 8x8 vehicle turret technology and system integration. (SA News, 2010; Campbell, 2019a).

Joint venturing has the proclivity to mitigate the negative effects of inadequate funding and support confidence in the quality of the products and/or services. The NDIC policy expression would thus like to see increased collaboration through JVs between the SA DTIS and foreign companies. (NDIC, 2018). It states the leverage objectives for the SA DTIS to - "... enter the supply chain of foreign defence companies; establish [JVs] with foreign defence companies; establish itself as a design and development house for foreign armed forces; take equity in defence companies in other countries; and enter into equity partnership arrangements with foreign defence companies." (NDIC, 2018: 32). Noteworthy, BRICS bilateral DTIS cooperation/partnerships are not prioritised or even mentioned. This is unfortunate given the strategic nature of the BRIC States and the growth of their DTISs.

Strategic focus is thus positioned on the establishment of JVs with defence technology and industries of emerging States in order to facilitate cost-sharing on R&D and innovation, production programmes and integration into transnational supply chain networks. (NDIC, 2018; South Africa, 2017a). Joint ventures can thus be understood as a strategic business lever of choice that seeks to establish more integration between parties in order to extract scale- and other benefits downstream. It has developed as a core objective. A caveat - such JVs must produce mutual beneficiation. (NDIC, 2018; South Africa, 2017a). At a more granular level, the JVs could be constructed around business practices such as the design, development and production of – "… components, sub-assemblies, sub-systems […] or even entire an equipment or system […] or provision of services", JVs for new product development, penetrating foreign product portfolios with South African products, allowing foreign equity partnerships and FDI in the form of industrial infrastructure. (South Africa, 2017a: 218-219). The DDIS 2017 also express the desire (if possible) for JVs with defence companies, defence multinational corporations and foreign Governments (R&D and state-owned production entities) that exhibit similar needs and has the same level of technology development. (South Africa, 2017a: 165). This confirms no predisposition to G-to-G of I-to-I bilaterals but a greater focus on symmetry and interests.

The DDIS 2017 provides a small (highly aggregated list) of possible regions around the globe for the application of a selected portfolio of strategic business levers. It fails to identify specific options for the BRIC States. Only regional indicators are provided, as follows -

"b. Central Asia (supply, support and sustainment, moving to local production).
d. South and South-East Asia (local production, partnerships and JVs).
e. South America (supply, local production, partnerships and JVs)." (South Africa, 2017a: 160-161).

The DDIS 2017 states that the South African government will provide support for defence exports by the assurance of a level of – "… prominence in 'bilaterals' with other countries", ensuring the effective management of Def Com related agreements, providing market analysis support, making contracting and access to export permits more effective. Other strategic business levers that could

be made available in the future, once the DDIS 2017 has been approved and promulgated, could consist of financial instruments with which to finance defence exports. Some of these are already published in the NDIC Booklet (2018) and positioned as governmental export support mechanisms. These are in the form of loans to facilitate the export of defence matériel in the national interest. A barter arrangement is also proposed for exports to States that would prefer to finance their defence materiel imports. (South Africa, 2017a; NDIC, 2018). Lastly, an Export Credit Guarantee System could be established with the aim of export guarantees for the SA DTIS - "… with government carrying the risk and the relevant fees therefore kept to a minimum. [...] Where the export to a particular country is deemed to be of national strategic importance, the guarantee will be provided free of any fees." (South Africa, 2017a: 202-203). Others relate to export support by diplomatic staff deployed around the world, collaborative delegations (State and industry) for foreign visits, a streamlined arms export control system, and the establishment of a government-to-government armament stales system. (NDIC, 2018: 32).

The remainder of Chapter 3 will continue to delve into the BRIC DTISs to build further context from which questionnaire questions can be constructed for the collection of primary data and analysis in Chapter 5 of the thesis. Let us now shift focus to Brazil. Brazil and South Africa share similar DTIS development-crash trajectory experiences.

3.3 BRAZILIAN DTIS – AN INTRODUCTION

> *Brazil maintains stable and amicable relationships with its neighboring countries, and has not engaged in any major armed conflict with another nation in over 50 years. Nevertheless, as a regional power Brazil is investing significantly in defense and security. (Defenceindex, 2013).*

Historically, the Brazillian DTIS emerged in the 1960s, bolstered by strategic intent to develop its DTIS into a national hub of security and development. Some successes were and are evident, even today (e.g. Embraer aircraft industry). These successes were supported by massive State funding and pockets of hungry defence markets (e.g. the Iraq-Iran war in the 1980s). By the 1980s the Brazilian DTIS had developed into the 6th largest armament exported and remained so for at least a decade. Entering the 1990s, with the Iraq-Iran war a distant memory and the Brazillian DTIS exploring new product portfolios with little expertise, the introduction of democracy, initiatives to demilitarise the State, an economic recession and commensurate reductions in the Brazilian defence budget, brought the Brazilian DTIS virtually to its knees. Reductions in armament exports soon followed. By the 2000s the Brazilian DTIS was virtually bankrupt. (Bitzinger, 2014).

Brazil has since (re)developed into a significant arms manufacturer and supplier internationally and is currently also navigating a revitalisation phase. (Bitzinger, 2014; Squeff & De Assis, 2015).

Brazil is restructuring its DTIS in the pursuit of self-sufficiency and autonomy for the Brazilian military. (Squeff & De Assis, 2015). This is fuelling increased Brazilian DTIS activity (Duddu, 2017), albeit much slower and more conservative under the new economic policy guidelines set by the Brazilian Constitutional Amendment (CA 95). CA 95 seeks to cut public spending and thus have a negative effect on military spending and the development curve of the Brazilian DTIS. (Da Silva, 2017). Brazil has had an increasing autarky approach to its DTIS capability development under Presidents Lula and President Dilma. This was fuelled by national autonomy as a national objective. (Squeff & De Assis, 2015; Da Silva, 2017).

Under the direction of President Lula, the Brazilian National Defence Strategy approved during 2008 (Squeff & De Assis, 2015) was adopted. This strategy assumed an idealistic approach to the *raison d'étre* for the Brazilian DTIS. The Brazilian National Defence Strategy 2008 state as an imperative to develop the Brazilian DTIS based on the requirement for the modernisation of the Brazilian military. Most importantly, the Brazilian DTIS were mandated to enter into - "… industrial partnerships with non-Brazilian entities" in order to become import independent (self-sufficient). The caveat is that Brazil must play a dominant role in any such partnerships. (GlobalSecurity.org, 2013). This indicates that the Brazilian DTIS policy entered into a phase of liberalisation (or at least hybridisation). The strategy positioned the Brazilian DTIS as a structural pillar of for Brazilian military. (Squeff & De Assis, 2015). The national - "… ambition for endogenous development of technologically competitive defence products" seems to be prevailing. (Squeff & De Assis, 2015: 44).

Recently, Brazilian military spending was projected to reach US$17.5 billion (2017) increasing to US$20.5 billion (2021) - "…registering a CAGR of 4.08% over the forecast period." (Research and Markets, 2016). Another estimate is for an estimated CAGR of 5.06% during 2018-2022. (Research and Markets, 2017). These estimates are primarily driven by significant military acquisition projects/contracts, the development and modernisation of military capabilities. (Research and Markets, 2016). This seems very promising. However, the report 'Future of the Brazil Defence Industry – Market Attractiveness, Competitive Landscape and Forecasts to 2022' is of the opinion that Brazil remains significantly dependent of imported equipment and technology from the US and Europe. (Duddu, 2017). Nonetheless, Brazil remains focussed on the creation of DTIS independence (self-sufficiency) by reducing dependence on international OEMs - a trend set to continue. This trend is, however, continually calibrated by several Brazilian policy initiatives - National Defence Industry Policy 2005, CA 95, the Greater Brazil Plan 2011 and the Planejamento Estratégico de Promoção Comercial (PEPCOM 2017). (Muggah & Thompson, 2017; Da Silva, 2017; Squeff & De Assis, 2015). The obvious (major) hurdles for this revitalisation process are funding and political will compounded by the fact that Brazil does not have a complete view of the total defence industrial sector in Brazil and its many complexities. (Squeff & De Assis, 2015). This might just be the case for the SA DTIS also.

3.3.1 Brazil DTIS Synopsis

Brazil is considered to be the Latin American defence equipment export nucleus. (Defenceindex, 2013; Avila, *et al*., 2017). The Brazilian defence industry is perceived as a primary driver for science and technological development in Brazil. (Eshel, 2015a). For at least the past 20 years Brazil has been a top international small armament and ammunition producer. (Muggah & Thompson, 2017). Brazil has effectively used - "… offset-enabled technology transfer" agreements to gradually build domestic defence industrial capability. (Defenceindex, 2013). After a period of economic decline during the 1990s and 2000s, the Brazilian DTIS contracted to three primary defence industries: Embraer, Avibras and Helibras. (Avila, *et al*., 2017).

During the LAAD 2017 defence exhibition in Brazil, the Brazilian Minister of Defence (MOD) highlighted some of Brazil's primary defence technology and industrial sub-sectors for naval, air and army programmes. (Export.gov., 2017). Some of these capabilities were established during the period of strong economic growth over the period 2000-2010, such as the KC-390 aircraft, SISFRON and Guarani armoured vehicle. (Da Silva, 2017). The Brazilian MOD stated the following defence acquisition/development programmes as strategic defence and defence industry priorities (Export.gov., 2017) -

- The Submarine Development Program (PROSUB). This program constitutes the production of four diesel-electric submarines. This programme is based on a contract with DCNS (France) for the Scorpene submarine variant. (Duddu, 2017).
- The Navy Nuclear Program (PNM). This program envisages one nuclear-powered submarine to be operational by 2029.
- The Tamandaré Class Corvette (2700 ton). This program project the construction of four 2700 ton vessels, construction to commence in 2019.

From a BRICS perspective, Russia, India and China have significant ship and submarine building expertise across the entire spectrum of systems. The SA DTIS have experience with naval combat systems integration, guns and missile systems.

- The Guarani (Army armoured wheeled vehicle programme). This programme aims at supplying the Brazilian army with 2044 new armoured wheel vehicles in troop-carrying (6x6 VBTP-MR) and reconnaissance (8x8 VBTP) variants. It is projected that the vehicles will be delivered to the Brazilian Army by 2035 (also mentioned in Asano & Nascimento, 2015). This is a JV with Iveco Defence Vehicles (CNH) and is being manufactured in Sete Lagoas, Brazil. (Eshel, 2015b). The VBTP will be armed with a 105mm cannon turret. This is an opportunity for the SA DTIS (Denel Land Systems) to enter the JV and supply its MT-105 turret to the programme. The SA DTIS compete directly with the Brazilian subsidiary ARES of Otomelara for this sub-system. (Eshel, 2015b).
- SISFRON (Integrated Border Monitoring System). The system is to be fully operational by 2035.

- Cyber Defence. This is a program directed by the Brazilian Army Command and commenced in 2010 already. It aims at providing both software and hardware solutions for defence against cyber-attacks. The programme should be concluded by 2020. The South African CSIR could have potentially been involved in this development.
- FX-2 (36 x fighter aircraft). This is the Gripen NG program. The contract includes twenty-eight Gripen E variants (single-seat configuration) and eight Gripen F variant (twin-seat configuration). (Eshel, 2015a; Eshel, 2016). This is a JV between Embraer (Brazil) and SAAB (Sweden) (also mentioned in Asano & Nascimento, 2015) to be concluded by 2025 (Eshel, 2015a). A joint programme could also possibly be negotiated between Sweden-Brazil-South Africa for the fitting of the missile technology, jointly developed by Brazil and South Africa, to the Gripen NG. This would provide enormous opportunity for the SA DTIS into the Gripen market segment.
- KC-390 (28 x cargo aircraft). Embraer is currently a world-class aviation technology company. This program is a JV between Embraer Defence and Security and several South American countries. (Bitzinger, 2014). The programme is envisioned to stretch over a 12 year period (also mentioned in Asano & Nascimento, 2015). Delivery of the first aircraft is scheduled for 2018. (Desk News, 2017).
- At least 10 countries have acquired the Super Tucano ground attack aircraft (including the US Air Force). (Bitzinger, 2014).
- Geostationary Satellite for Defence and Strategic Communications (SGDC). This platform is for K- and X-band communication and operated by Telebras. The integration of the system is done by means of a JV between Embraer and Telebras and is labelled Visiona. (Asano & Nascimento, 2015).
- Other programmes of interest. Technicae is the Brazilian subsidiary of Singapore Technologies (ST Kinetics) working jointly on the modernisation of the older Brazilian combat vehicle families. (Eshel, 2015b). This could also be a potential market entry point for the SA DTIS.
- Other systems developed by the Brazilian DTIS for export purposes include - "… a land-attack cruise missile, a GPS-guided artillery rocket, and antiship [*sic*] and anti-radiation missiles." (Bitzinger, 2014: 2).

"Brazil might take a cue from smaller arms-producing states – such as Singapore or Israel – and attempt to occupy a few high-technology niches where the competition is not great and where a smaller state can leverage its comparative advantage, i.e., cost, availability, etc." (Bitzinger, 2014: 2). This advice by Bitzinger (2014) should also be taken note of by the SA DTIS.

Over and above a number of South American countries and the USA investing in the KC-390 aircraft, Brazil is also supplying Astros II systems to Malaysia and Indonesia. (Bitzinger, 2014). From the acquisition programmes discussed above, other markets and collaboration are with Israel, Sweden, South Africa, Italy and Singapore. With this synoptic view of the Brazilian DTIS, let us consider other facets of the Brazilian DTIS landscape that could influence bilateral partnerships between the Brazilian DTIS and that of South Africa.

3.3.1.1 Brazil DTIS Growth Barriers and Drivers

The fact that the Brazilian Government does not know what the entire Brazilian DTIS consists of will certainly hamper the Government's roles in the developing process. "This fact is a clear obstacle to the formulation, implementation and monitoring of public policies for the sector." (Squeff & De Assis, 2015: 7). This could also hamper future cooperation with countries such as South Africa and possibly detract from the role Brazil can possibly play in the BRICS alliance from a DTIS perspective. It sends a clear message to the SA DTIS to do an audit on the entire SA DTIS and make the information publically available to build trust within BRICS and to ensure all capabilities are visible to the BRIC community for possible collaboration.

The Brazilian DTIS also finds itself precariously high on the GI ranking system (Band E), a very high risk for corruption in the DTIS. Brazil achieved the most negative ranking amongst the G20 States. (GI – Brazil, 2015: 1) (See Figure 2.12 for a comparative world-view) This is due to poor procurement policy execution, poorly resourced and ineffective legislative and other oversight (Tribunal de Contas da União (Federal Accounts Court) and the Controladoria-Geral da União (Comptroller General)), and non-competitive procurement contracting (single-source). (GI – Brazil, 2015) This negatively affects the development of the Brazilian DTIS which does not attract trust and confidence due to poor integrity and transparency. These matters will severely hamper the establishment of bilateral relationships with South Africa because of the potential for domestic and foreign policy fallout.

Another key requirement for successful contract negotiation is the negotiation of a favourable offset position, technology transfer to the Brazilian defence industry. (Squeff & De Assis, 2015). The competitive bidding policy applies to both domestic and international acquisition contracting. Low price coupled to technology transfer is a prerequisite for successful contracting. "Any defense deal worth more than US$5 million has an offset obligation equivalent to 100% of the contract value. The main entry strategy for foreign OEMs is through the direct offset route, which entails the transfer of technology to local companies and the manufacture and assembly of systems in Brazil." (Defenceindex, 2013). Although positioned to develop the Brazilian DTIS it could severely hamper collaboration with autarkic policies. The requirement for defence offsets, technology transfer as well as extended periods before contracting are key stumbling blocks. (Defenceindex, 2013; Duddu, 2017; Research and Markets, 2017) Brazil subscribes extensively to technology transfer agreements in order to protect and expand the national defence technology and industrial capability. (Avila, *et al*., 2017). e.g. the Sweden-Brazil joint development and production cooperation between SAAB and Embraer. (Avila, *et al*., 2017).

A key requirement for defence business in or with Brazil is patience during an almost certain protracted period of engagement. (Research and Markets, 2017). In order to navigate this gauntlet, companies are advised to have an established relationship with a local DTIS representative or even

locally-based offices to assure a greater level of success during the bidding and contracting phases. (Export.gov., 2017).

Primary drivers for Brazilian DTIS development is the continuous national imperative to modernise the Brazilian military, the well-established aircraft design and manufacturing sector (Maiti, 2018) as well as collaborative programmes in the maritime, vehicle and military IT sectors (Research and Markets, 2017). The continuously modernising is a perfect driver for tailored defence manufacturing and R&D expansion, focussing on those military capability gaps. (Defenceindex, 2013; Duddu, 2017; Research and Markets, 2017). These long-term development, production and acquisition plans include - "… weapons, escort ship platforms, transport ships, offshore patrol vessels, tugs and hydrographic/oceanographic ships, UAVs, long range [*sic*] radars, helicopters, tactical radio communication systems, [transport and fighter aircraft, diesel electric [*sic*] and nuclear powered submarines] and spare parts and components, among others." (Defenceindex, 2013; Export.gov., 2017).

Partnering with the Brazilian DTIS also facilitate market penetration of other South American States with offerings of more localised supply chains, service channels, understanding of local operating conditions and security needs. It also provides possible downstream collaboration with Western DTISs such as the US. For example, the partnering of the Sierra Nevada Corporation (US-based) with Embraer Defense & Security Brazil - "… to retrofit Embraer's battle hardened [*sic*] A-29 light attack aircraft for the U.S. Air Force and other air forces worldwide." (Starr & Jones, 2018: 7). Brazil also entered into joint research, development and industrial cooperation with foreign defence industries, for example, the Sweden-Brazil joint development and production cooperation between SAAB and Embraer. (Avila, *et al*., 2017). This migrates Brazil to a more hybrid approach to defence industrialisation. (Research and Markets, 2017; Maiti, 2018). Combine these with a – "… long-term partnership with the Brazilian aerospace and defense industry for the co-development and local production of components, parts, and assembly" in order to unlock business opportunities with Brazil. (Export.gov., 2017). However, it is the persistence of technology transfer in most of the arms contracts that are possibly the greatest barrier that international OEMs are not interested in crossing. (Duddu, 2017). Having discussed the most important parts of the Brazilian DTIS landscape, let us consider what strategic business levers the Brazilian DTIS are favouring for potential DTIS growth.

3.3.2 Brazil DTIS Strategic Business Approaches and Levers

"Joint ventures are common in Brazil, particularly as a method for foreign firms to compete for government contracts or in heavily regulated industries […]. Joint ventures are usually established through "*sociedades anônimas*," (which are like corporations), or "*limitadas*," (like limited partnerships)." (Export.gov., 2018). Other popular strategic business levers are licensing agreements, technical assistance agreements and trademark licensing." (Export.gov., 2018)..

As a means to develop the Brazilian DTIS Brazil extensively support technology transfer as part of import contracts. This limits the probability of collaboration and/or contracting because countries

might be reluctant to share their technology. Some countries also outright prevent technology transfer to protect their IPR. This leans toward autarky, which might have short term protection gains but will hamper further international collaboration in the medium- to long-term. This protectionism - "… has been a key deterrent for foreign OEMs entering the Brazilian industry." (Research and Markets, 2017).

Brazil has technology transfer and co-production agreements with Sweden (Avila, *et al*., 2017) and South Africa (missile technology). The Brazil-Sweden cooperation could - "… in the medium term, after having upgraded Brazil's own Air Force, Gripen NG jet fighters manufactured in Brazil could be sold to intermediary powers such as South Africa (which has already bought an older model)". (Avila, *et al*., 2017). The joint development and manufacturing of the Gripen NG in Brazil by a Sweden-Brazilian consortium has been declared a national priority by Brazil. (Avila, *et al*., 2017). Therein lies an opportunity for other BRICS states.

Then there is the longstanding (since *circa* 2006) JV between the SA DTIS and the Brazilian Air Force (G-to-G) for the development of air-to-air missiles. (BusinessReport, 2007). This JV resulted in a collaborative effort - "[d]rawing on experience with the Kentron V3A/B/C Kukri heat-seeking missiles and V4/R-Darter radar guided [*sic*] air-to-air missile, Denel Dynamics in 2006 began development of the fifth generation short range infrared guided [*sic*] A-Darter. Due to the complexity of the project, Brazil was taken on board as a partner. Some of the Brazilian companies participating in the A-Darter project include Avibras (rocket motors), Mectron (which makes missiles) and Opto Eletronica (seeker head)." (Martin, 2016a).

A very recent example of the use of JVs by the Brazilian DTIS is the KC-390 related JVs between Brazil (Embraer) and USA (Boeing). "This JV will be 80%-owned by Boeing, […] and 20% by Embraer. This JV is currently being referred to as NewCo. The second, proposed, JV covers Embraer's KC-390 multirole tanker-transport aircraft. This would be 51%-owned by Embraer and 49% by Boeing." The aim of these JVs is to penetrate markets such as the USA as well as the USA supply chains. Also, providing sustainability to the Brazilian DTIS. These JVs are directly coupled to Brazilian national sovereignty and interests. (Campbell, 2019b).

3.4 RUSSIAN DTIS – AN INTRODUCTION

> *The most important priority of Russia's state policy for the future will remain the issues of ensuring the dynamic development of the Armed Forces, the atomic and space industry, and the defence-industrial complex. (Frolov, 2017: 9).*

Russia is placing significant emphasis on the revival and development of its, once thriving, DTIS. (Frolov, 2017). Against the background of the 1991 Gulf War and demonstrated USA dominance reinforced the criticality of the early realisation of the importance of such Russian DTIS revival. However, Russia also realised that this revival is also severely hampered by resource shortages. (Cliff, Fei, Hagen, Hague, Heginbotham, & Stillion, 2011 in Haas, 2019: 29). Bitzinger and Popescu (2017: 4) states that the post–USSR Russia inherited much technology, know-how and industrial capability

and capacity as well as international brand acknowledgement which cemented the Russian status as primary global armament exporter for at least the next 30 years. This emphasis could be directly linked to the amplified Russian security posture, which in turn can be directly correlated with Russian involvement in the Ukraine, Syria and increasing distrust between NATO and Russia. (Allen, 2017).

Russia has a large and well established DTIS, ranking 4th in the world as a military spender and 3rd amongst defence industrial powers (Russian Defence Policy, 2017; Beliakova & Perlo-Freeman, 2018). Maiti (2018), Bitzinger (2017), Bitzinger and Popescu (2017), Bret (2017), Frolov (2017), Raska, (2017) and SIPRI (2019) rank Russia still the second-largest defence exporter. Bitzinger and Popescu (2017) qualify their opinion by stating that Russia is the 2nd largest defence industrial state based on arms exports (US$15bn in 2016 – Frolov, 2017: 16 and Bret, 2017: 19) and the diversity of their product portfolio.

However, the Russian armament exports have been on a plateau since approximately 2013 (Frolov, 2017), and the value of the new contracts portfolio is shrinking year-on-year (2015 – US$56bn to 2016 – US$50bn). "Arms exports by Russia decreased by 17 per cent between 2009–13 and 2014–18, in particular due to the reduction in arms imports by India and Venezuela." (SIPRI, 2019). The military reforms introduced by Serdyukov over the period 2007-2011 saw the Russian military ambition scaled down to be responsive to a more conservative task list. (Gressel, 2017). This most probably contributed to a flailing Russian DTIS. These and other geopolitical factors (Bret, 2017) is possibly compelling the Russian government to reconsider its traditional autarkic approach to the DTIS in order to re-introduce sustainable growth and the assurance of self-sufficiency.

Russia is focussing on the modernisation of the Russian military with a strong focus on technological innovation within the DTIS, based on the State Armaments Programme 2009, the National Security Strategy 2015 (Frolov, 2017; Bret, 2017; Maiti, 2018) and GPV-2025. (Gressel, 2017). The core of the Russian modernisation programme(s) over the past 20 years was to keep abreast of the computing revolution and the modernisation of legacy Russian systems with advanced electronic technology, sensors and communication technology. (Gressel, 2017: 34).

However, recent funding difficulties - resulting in part from the war in Syria - are a primary source of pressure on the Russian Defence budget and its ability to fund modernisation. (Frolov, 2017). In fact, Gressel (2017: 27) is of the opinion that the Russian military action in the Ukraine and Syria and the resulting international isolation – "…has fundamentally altered the premises underpinning Russia's armament and defence policy." This situation provides a glimpse of the impact of geopolitics on the Russian DTIS.

From a BRICS perspective, Russia remains a primary (Tier 1) supplier of helicopters, armoured vehicles, warships and aircraft engines to both India and China, based on long-standing, foreign policy-driven strategic relationships. India and China command approximately 49% of Russian arms exports. (Bret, 2017). Russia and India have had - "…one of the longest-running and most profitable relationships for sale of Russian military hardware." (Johnson, 2018 and Bret, 2017). The Russia-India JV was discussed earlier in the thesis as part of the relationship-building trends (globalisation

approach to the DTIS development). It exhibits an ever-present willingness of both India and Russia to engage in DTIS related JVs (development and leasing arrangements) in the national interest, despite both countries' quest for self-sufficiency with national policy programmes such as 'Russification' and 'Made in India'. (Frolov, 2017; Boulegue, 2018; Linerberger & Hussain, 2018; Nishith Desai Associates, 2018). This quest for self-sufficiency can also be equated to what is termed 'import substitution'.

Recently, a somewhat adversarial DTIS relationship has developed between Russia and China due to persistent efforts by the Chinese defence industry in penetrating Russian markets (e.g. Turkey and Indonesia) with cloned defence products. (Farley, 2017; Bret, 2017; Johnson, 2018). Notshulwana (2012: 7) states that - "Russia is the only member of BRICS that has raised some of the critical intra-BRICS challenges and mistrusts among its five member countries. Russia's foreign policy posture in BRICS is to balance China's rise and assertiveness." This will in all probability increase autarkic DTIS behaviour of the rest of BRICS.

3.4.1 Russian DTIS Synopsis

> *The [Russian DTIS] will have to contend with a new emphasis on diversification and 'conversion' towards the production of civil goods, as well as the 'leaner', scaled-back armament programme for 2018-2025. Moreover, some of the leading companies in Russia's [DTIS], such as Uralvagonzavod and Kurganmashzavod, are burdened with high levels of indebtedness, which may also threaten Russian military production in the years to come. (Frolov, 2017: 18).*

The Russian DTIS comprised an estimated 1339 companies/organisations with approximately 1.3 million workers in 2014. (Frolov, 2017). These figures are down from an estimated 9 million after the collapse of the USSR. Engineering and technical skill churn to Western-based companies, estimated at 800 000-1 million per year had a devastating effect on the Russian DTIS capabilities. This was compounded by wages that were not adjusted for inflation. (GlobalSecurity.org., 2018).

Refuting the view that the Russian DTIS is isolated internationally Russia claims to have defence industrial relations with at least 101 countries (Bret, 2017; Sisoev, 2018), with military-technical cooperation with an estimated 52 countries (Frolov, 2107) and Russian military systems in a 100 countries (Bret, 2017). Ecologically, the Russian DTIS consists of at least the following broad industrial capabilities: aviation and space/rocket industries, combat vehicles, shipbuilding, air defence, artillery, small arms, armaments, instrument manufacturing, radio electronics, and nuclear weapons. (Frolov, 2017: 10; Bret, 2017: 20). This encompasses the entire spectrum of military capability.

The Russian DTIS consists of a number of the world's largest arms manufacturers in order to deliver this vast portfolio of military capabilities. The Russian DTIS is essentially an oligopoly consisting of - "[T]he state-owned enterprise Rostec Corporation and its subsidiary Rosoboronexport [established by Putin in 2000] is responsible for 85-90% of Russian arms exports". The second part of the DTIS

consists of 22 companies – "MiG, NPO Mashinostryeniya, Almaz Antey, Russian Helicopters, KBP, KBM and the other 16 companies are permitted to directly export defence products without going through Rosoboronexport – particularly to implement contracts signed before Rostec was created in 2007." (Bret, 2017: 21). Amongst these are (based on Defence News Top 100 list of arms manufacturers in GlobalSecurity.org., 2018) seven Russian defence industries that rated amongst the 100 largest armament producers with revenues in excess of US$1bn: VKO Almaz-Antey, United Aircraft Corporation, Tactical Missile Armament Corporation, Helicopters of Russia, Uralvagonzavod (Russian tanks), Radioelectronic Technologies and RTI.

This all sounds very promising for future collaboration. However, the 2014 sanctions imposed by the European Union, USA and Ukraine on the Russian dual-use and military supply chain seriously affected the Russian DTIS. (Frolov, 2017: 15 and 17). The Russian DTIS is currently (again) sanctioned by the USA after the USA adopted the Countering America's Adversaries through Sanctions Act (CAASTA) during July 2017. (Frolov, 2017; Boulegue, 2018). These sanctions also included dual-use products. (Maiti, 2018). Amongst the Russian defence industries that are sanctioned are Rostec, United Aircraft Corporation, Almaz-Antey and Kalashnikov. The Russian DTIS strategy, to alleviate the pressure resulting from the sanctions (specifically from the impact on the Russian-Ukrainian cooperation), is to substitute import dependency with self-production for self-consumption (Frolov, 2017; Maiti, 2018; Boulegue, 2018), or "Russification/Russianising" (targeted at 85% by 2025) and imports from foreign suppliers such as China, India and Belarus (specifically the microelectronic technology) to keep pace with the western (NATO) technology frontier. Cooperating in JVs with foreign partners will also be promoted. (Frolov, 2017: 12; Boulegue, 2018). So, the quest for self-sufficiency by acceptance for the need for more liberal approaches to DTIS policy.

Some of the primary Russian armament client States during the period 2012-2016 was Vietnam (11%), India (38%) and China (11%) of the total Russian armament exports. (Ait, 2019). However, the reliance of China on Russian technology is dwindling fast (Ait, 2019), *even India is seeking independence from Russian supply (discussed in the next section)*. This predicament is the product of less than strategic business acumen on the part of Russia - when Russia commenced exporting its military capability crown jewels (Russian air defence systems, air-to-air missiles and air superiority fighters, etc.) to China since the 1990s. (Ait, 2019). The predicament is illustrated by the following quote about the precarious nature of Russian armament exports to China as a very important source of revenue - "… perhaps best epitomized by Russia's inability to market more than two dozen of its latest Su-35 fighter jets to the PLA in 2015, an offer which had to be accompanied by generous technology transfers to be accepted." (Ait, 2019). Since China has surpassed the Russian prowess in military aviation products and technologies in several primary aviation technology fields based on the specifications of the latest Russian fighter aircraft. It leads to the introduction of the Chinese 5th generation fighter aircraft (Chengdu J-20) in 2017. It also represents the first development of an extremely advanced fighter aircraft not by the USA. "China also preceded Russia in its deployment of

aircraft with active electronically scanned array radars, which are currently mounted on its J-20 and J-10C fighters, as well as its deployment of next generation [*sic*] air-to-air munitions with the entry into service of the PL-15". (Ait, 2019).

Thus, in the search for DTIS markets, domestic DTIS strategies should take care of the balance between revenue generation and long-term sustainable income from niche technologies, platforms and capabilities. This balance is more than often calibrated by economic pressure, geopolitical tensions and conflicts, typically present in the complex bilateral cooperation and relationships between Russia, China and the USA. With a synoptic view of the Russian DTIS in the rearview mirror, let us consider other facets of the Russian DTIS landscape that could influence bilateral partnerships between the Russian DTIS and that of South Africa.

3.4.1.1 Russian DTIS Growth Barriers and Drivers

A key barrier to Russia's DTIS marching back up the "Ladder of Production" is the poor Russian economic performance. This lack of economic growth reinforce the loss of Russian DTIS engineering and technical skills to other local industries and/or the international market. These rising barriers within the Russian DTIS problematise Russian efforts to keep pace with cost and complexity associated with next-generation armament and systems. It makes it improbable that Russia will be able to compete with countries such as the USA and China in the defence technology and industrial markets place. (Gressel, 2017: 35). Thus, complexity, expense, intellectual capital flight and shortages and economic downturn are pressuring the Russian DTIS modernisation and growth ambitions to accept more liberal DTIS policy approaches. This could unlock some opportunity for the SA DTIS.

The success of the import substitution programme (or Russification) which was set in motion by stringent sanctions, remains contingent on economic growth. Yet, the Russian military budgets are continuously reduced which is not favourable conditions for DTIS development. (Frolov, 2017). Russification also provides some drivers for the development of the Russian DTIS due to the requirement for the development of a large portfolio of products/systems in the quest for self-sufficiency. (Frolov, 2017). "Another drawback is the need to incur costs in advance in order to ensure timely delivery of the required products" (Frolov, 2017: 15), which, requires economic growth and increases in military and DTIS budgets. The catch-twenty-two situation is evident.

Defence industrial capability independence (or self-sufficiency) is a strategic focus for Russia currently and into the future. (Frolov, 2017; Gressel, 2017). Concurrently, a critical challenge with the Russification policy is the state of (dis)repair of the production capability and a critical requirement for modern production machinery. (Frolov, 2017). Sanctions have an obvious negative impact on this predicament. "This is emerging as one of the most important issues, especially under the current restrictions on obtaining new machine tools suitable for the production of military products and dual-use goods [controlled under arms control regimes]." (Frolov, 2017: 15).

Then there is Russian import dependence on Belarus manufactured components. It is in Russia's strategic interest to substitute these components with Russian manufactured components to

support the Russification. (Frolov, 2017). This will tailor any prospective market entry strategy of foreign defence industries, severely hampering defence sales into the Russian market but favouring industrial cooperation such as possibly JVs in manufacturing and/or R&D. The US and EU are major industrial partners and/or markets of the SA DTIS, thus, doing defence business in Russia might be problematic due to arms control (dual-use) restrictions. This restriction will severely hamper the establishment of defence industrial capabilities in Russia as a market growth strategy.

The Russian DTIS also suffers from a very negative corruption and transparency reputation, attracting a Band D (high risk) classification on the GI ranking. From a G20 perspective, this is one of the lowest-ranked States. (See Figure 2.12 for a comparative world-view) (GI – Russia, 2015: 1). Because of the excessive levels of secrecy surrounding defence expenditure in Russia transparency is negatively affected. This is the results of decades of autarkic and realist based defence and DTIS policy. Autarkic DTIS policy remains a safe haven for corruption as well as relationships that could negatively affect the 'good citizen' status of States internationally. These matters will severely hamper the establishment of bilateral relationships in the medium- to long-term with South Africa because of the potential for a foreign policy fallout.

Then there are manufacturing capabilities that date back to the Cold War and earlier. This predicament does not just affect production volumes but directly also the quality of products, processes and the entire supply chain (GlobalSecurity.org., 2018) and other issues regarding the safety conditions within factories (which negatively impacting recruiting).

Notwithstanding some benefit that could be extracted from Russification expressed on above, the Russian DTIS also benefit from strong Governmental support, - "… historically large market shares, an excellent international reputation, and its status as an alternative source of supply to the US, the structural strengths of Russia's DTIS remain intact." (Bret, 2017: 25). Russia, it seems, is still prioritising DTIS self-sufficiency as opposed to improved industrial efficiency gains (Gressel, 2017), supported by a Russian defence budget that reached 5.3% of the Russian GDP during 2017. (Lineberger & Hussain, 2018b: 10). Russia is a pragmatic DTIS competitor, traditionally focussed on the retention of its existing market share and client base. However, this has become fairly stagnant over the past couple of years. (Bret, 2017; Gressel, 2017).

Slight shifts in this competitive stance occurred in recent years towards penetrating markets in Asia, Africa and South America. This is reinforced by Russian concessions to its DTIS to cooperate with foreign DTISs in the quest to gain/retain market share and technological advantage in various defence and technology portfolios (Bret, 2017), thus adopting a more liberal DTIS policy (probably hybrid). With Russia's focus on Africa for market entry and expansion, a lowered barrier to cooperation between South Africa and Russia can be expected.

Maiti (2018) provides a snapshot of the Russian DTIS, for at least the medium-term, listing some key advantages and strategic levers. Russia is a notoriously big spender on defence capabilities, making Russia very attractive for consideration in a constellation of defence technology and industrial capabilities.

Russia wants to finance DTIS-related R&D for future military platforms and systems with revenue gained through exports. The Russian client-base consists of States (and possibly non-State actors) that are hard-pressed to afford Western military hard- and software. (Gressel, 2017). Russia, it would seem, can thus depend on a price advantage at least for the short- to medium-term. There is, however, a caveat that Middle Eastern, Asian and Indian companies are progressively demanding production and R&D shares to complement their own DTIS development programmes to establish self-sufficiency. (Gressel, 2017). This has an obviously eroding impact on the revenue resulting from exports (in at least the short-term). Technology transfer also allows China, India and countries such as Turkey to compete for the same market segment as Russia in the long-term - "… putting a question mark over the future of Russia's current strong position in arms exports." (Gressel, 2017: 35).

Russia also has a continuous focus on technology development. There has been a continuous focus on technologies for supersonic missile and hypersonic munitions, stealth and counter-stealth, cyber and anti-satellite capabilities. (Haas, 2019: 38-40). Cyber technology is a domain that could hold potential for collaboration, for example, the CSIR in South Africa. Having discussed the most important parts of the Russian DTIS landscape, let us consider what strategic business levers the Russian DTIS are favouring for potential DTIS growth.

3.4.2 Russian DTIS Strategic Business Approaches and Levers

Russification points to an intensified autarky DTIS policy being established after 2014, strengthened by the USA sanctions and a breakdown in cooperation between Russia and Ukraine. (Frolov, 2017). This is, however, balanced with foreign imports and technology collaboration (possible JVs), altering the overall approach to conceptionally a hybrid DTIS policy (at least for the near- to medium- term). The level of the flexibility of the hybrid approach will surely be determined on the level of sanctions levelled at Russia by the US and its Allies. The SA DTIS could position itself to become a reliable partner for collaboration with the Russian DTIS for technology development, components and/or products. However, heed the foreign policy fallout from the West.

For various reasons (amongst others the sanctions and the Syrian War mentioned above), the Russian military is currently (and probably for a while already) cash strapped and can thus not totally support the defence industrial order-book requirements. The scientific, engineering and technology initiatives within the Russian DTIS will, however, receive continued support by the Russian MOD. (Russian Defence Policy, 2017). The focus thus remains to stay abreast of the level of western (i.e. NATO) technological capabilities, innovation and development. That said, funding remains one of the largest hurdles for the Russian DTIS. This predicament could possibly keep the market doors open to JVs. This could possibly suit the SA DTIS revitalisation efforts.

Already mentioned in discussions above, Russia also faces intense rivalry from China in the form of what could possibly be labelled as industrial espionage, resulting in product cloning. (Bitzinger, 2017; Farley, 2017; Bret, 2017; Boutin, 2017; Johnson, 2018). Yet, collaboration between China and Russia continue to flourish because it is critical to the ambition of Chinese self-sufficiency and can

supply dual-use technology to Russia (Boutin, 2017) possibly because China is not a signatory to the Wassenaar Arrangement. However, this strategic collaboration is eroding the Russian competitive advantage in, at least, the fighter jet market segment (specifically the SU-35 model). (Johnson, 2018). Russia introduced the SU-35 export version to the international market in 2016. Algeria (amongst other nations) is projected to be one of the first clients to receive the SU-35. (Frolov, 2017). based on Algeria's strategic relationship with Russia. (Bret, 2017). Algeria also has defence industrial ties with South Africa. There are also a number of other military platforms that will be available for import from Russia, traditionally not available. These are for example – "… Il-76MD-90A military transport aircraft, Project 20382 corvettes, Project 21632 small missile ships". (Frolov, 2017: 17). The hybridisation of the Russian DTIS policy is a clear indication of the pressure the Russian DTIS is under to perform and remain sustainable. It also provides an opportunity for the South African DTIS to become involved in defence cooperation to possibly introduce some of these platforms to the Sub-Saharan African market.

Russia is not following the example set by China (albeit of the back of China's economic success) to optimise the Russian DTIS enabling innovation and efficiency gains and incorporating dual-use technology into the defence product supply chain. (Farley, 2017). This predicament or development introduces the importance of defence industrial intelligence and counter-intelligence and the possible role of defence industrial attaches.

Another critical challenge faced by the Russian DTIS is of a demographic nature. The highly skilled component of the defence industrial workforce are in or entering advanced age brackets. This situation is exacerbated by low wages, translating in a prohibitive recruitment environment for young Russian technicians and engineers. Topping this situation with negativity is the strict control of foreign travel passports for defence industry engineers. (GlobalSecurity.org., 2018). These circumstances are very favourable for international JVs. As such, Haas (2019: 38) provides an example of such collaboration – "Russian cooperation with India has resulted in the high-supersonic Brahmos anti-ship missile and similar collaborative armaments programs may enable the move towards hypersonic munitions in the coming decade."

3.5 INDIAN DTIS – AN INTRODUCTION

> *India has a diverse and rapidly expanding economic relationship with South Africa, and as India has progressed from a developing nation to an economic powerhouse, the market provides abundant and unexplored opportunities for* business. (PwC India Desk, 2018).

The Indian military and DTIS priorities are still largely determined by the ongoing Pakistani-Indian hostilities. Allen (2017: 17) conceptualise India as a "threat-focused self-defender". This focus on threat (whether it is real or perceived does not matter at this point) provide significant energy for the climb of the Indian "Ladder of Production". It is estimated that India will spend approximately $130bn on modernising the Indian military capabilities over the next 7 years (medium-term). This positions India as one of the largest defence technology and matériel markets, internationally.

Opportunity within such a dynamic market could be numerous for countries such a South Africa that still have some niche technologies to offer. The Indian DTIS modernisation programme will positively impact their quest for a 'self-reliant' DTIS. The development of the Indian DTIS is also projected to have an economic multiplier effect for India. (Behera, 2015). Such projected development might provide opportunities for the SA DTIS, as a BRICS partner.

Diplomatic relations normalised between South Africa and India in 1993. A significant import-export relationship exists between India and South Africa, with only China outpacing India in terms of import-export volumes to South Africa. Economically, there is significant trade between SA and India through bilateral trade agreements including defence, science and technology cooperation. Future strategic relations are ensured by multilateral alliances such as BRICS and IBSA[18] (India, Brazil, South Africa). (PwC India Desk, 2018).

3.5.1 Indian DTIS Synopsis

Behera (2016: 3) and Nishith Desai Associates (2018) provide a brief development history of the Indian DTIS, summarising the industrialisation into four stages -

- Indian Independence to mid-1960s – a quest for self-sufficiency as the primary economic principle for Indian industrial development.
- Mid-1960 to mid-1980s – the focus shifted to self-reliance in defence production.
- Mid-1980s to early-2000s – a shift in focus of self-reliance towards a more liberal DTIS policy that allows for co-production.
- Mid-2000s to late-2014 – establishing a more inclusive approach, allowing the Indian private sector broader participation in the Indian DTIS in a quest for self-reliance. This is the lead-in stage for the "Make in India" [19] policy. (Behera, 2016: 3). "The 'Make in India' (MII) drive of Prime Minister Narendra Modi offers a way of improving the country's self-reliance in defence production." (Behera, 2015).

India, as an emerging economy, has for an extended period of time (since independence in 1947) nurtured the ambition to have a self-sufficient DTIS. The climb up the production ladder was slow and based on an inherited DTIS base and little domestic technical know-how. Thus, India was entrenched, in the early decades of development, in a cycle of import dependence (Tier 3 and lower). In 1958 the Defence Research and Development Organisation (DRDO) came into being. (Behera, 2016; Nishith Desai Associates, 2018). This provided clear early indications of India's defence technology and industrial ambitions. The 1960s saw a shift from the requirement for self-sufficiency

[18] South Africa gained membership in 2005. (Notshulwana, 2012).

[19] "… the Defence Procurement Procedure 2016 (DPP 2016) was introduced with substantial amendment to DPP 2013, to provide for efficient and expedited procurement of defence technology and equipment, large incentives to the private sector - promising transparency and probity to the process. It aims to promote the 'Make in India' initiative by fostering growth of the domestic defence industry, and introduces the Buy (Indian-IDDM) and Buy and Make (Indian) categories of procurement. For government funded projects, government funding commitment has increased from 80% to 90% for prototype development, with 20% of the total developmental cost being payable in advance." (Nishith Desai Associates, 2018: 3).

to self-reliance (Behera, 2016), driven by geopolitical instability between India and China (since 1962) and India and Pakistan (since 1965) (ongoing till today), as well as USA, embargoes against India. It resulted in defence budget increases as well as motives for DTIS policy changes. (Behera, 2016: 7). These dynamics fuelled the shift of the conceptual development curve for the early Indian DTIS towards self-reliance and liberal DTIS policy. These developments unlocked Indian-Russian DTIS bilateral relations which made India largely a net importer of Russian defence technology and equipment till at least mid-1970s. (Nishith Desai Associates, 2018). This dependence expanded significantly until the end of the Cold War. (Behera, 2016: 8).

This was followed by the gradual establishment of rudimentary Indian DTIS production capacity and to a limited extent, licenced production instead of indigenous production. "Apart from MiG-21 [produced by Hindostan Aeronautics Ltd based in Bangalore, India], a number of other programmes were taken up for licence production, including tanks, destroyers, etc." (Behera, 2016: 7). The progression of the Indian DTIS development followed the conceptual "Ladder of Production" systematically, however, climbing was stymied by licensed production, resulting in a – "…stagnation in India's domestic capabilities in terms of research, development and production ". (Nishith Desai Associates, 2018: 1).

The missile and combat aircraft development programmes of the 1980s provided the next momentum required for the development of the Indian DTIS. Much of this momentum unlocked a JV between Russia and India for the production of the Brahmos supersonic cruise missile system. (Nishith Desai Associates, 2018: 1). The end of the Cold War, *circa* 1990, saw an Indian DTIS that was imported dependent on Russia. Estimated percentages relevant were ground-based air defence (100%), fighter aircraft (75%), ground-attack aircraft (60%), tracked armoured vehicles (100%), tanks (80%), naval destroyers (100%), frigates (70%), and conventional powered submarines (95%). (Behera, 2016: 8). Hence the ambition to become self-sufficient.

Up to 2014, the development of the Indian DTIS was hampered by inadequate funding (similar to South Africa, Brazil and Russia) and a lack of focus on R&D and innovation in the public sector (similar to at least to South Africa and Brazil). A compounding factor was the lack of an "enabling eco-system" that encouraged FDI and the development of the private sector. These factors slowed down the development of the Indian DTIS. Since 2014 the Indian DTIS is developing due to a policy shift towards liberalisation to lower the barriers to entry by foreign-based industry and funding. (Nishith Desai Associates, 2018: 3).

Currently, the Indian DTIS follows an idealist "Make in India" industrialisation policy. (Behera, 2015; Nishith Desai Associates, 2018). Conforming to liberal DTIS policy, the 'Make in India' policy drives the systematic privatisation of state-owned enterprises. "The Ministry of Defence should take the initiative to become the facilitator for DRDO, public and private sectors to join hands and leverage foreign collaborators to transfer the technologies that can help make the joint venture an export hub for the region in line with 'Make in India' campaign." (Saxena, 2016: 11). Thus, the Indian Government

plays a support and client role in the DTIS. Technology transfer is regarded by Chaudhry and Sidhu, (2016: 132) as critical to this quest for self-reliance (i.e. Make in India). It is also illustrated by the "Make in India" policy in the Defence Procurement Policy 2006 that allows the Indian DTIS scope to develop and produce advanced defence technology and products. The Indian Government committed to provide 80% towards developments costs. (Nishith Desai Associates, 2018: 1). This liberalisation of the Indian DTIS also permits up to 26% FDI, which points to more a hybrid policy than total liberalisation. (Nishith Desai Associates, 2018).

India currently imports approximately 60% of the national defence and associated requirements. (India, 2019). However, import dependence on advanced capabilities such as the Russian Sukhoi fighter aircraft, nuclear submarines and other naval platforms are still present. This was discussed in the previous section. To turn this predicament around the Defence Procurement Policy of 2013 was promulgated to support the "Make in India" policy with 'Buy from India' policy. This aims at establishing the Indian DTIS as the preferred choice for the design, development and production of indigenous military capabilities. (Nishith Desai Associates, 2018: 1). The Indian DTIS is slowly progressing towards attaining the status of being self-reliant. India is one of the few emerging markets that possess advanced military capabilities e.g. inter-continental ballistic missiles, aircraft carriers and nuclear-powered submarines. This supported by DTIS policy that allows international collaboration with developed nations to get access to advanced and next-generation technology for the Indian military. (Nishith Desai Associates, 2018: 1).

India's liberalised DTIS policy allows defence exports to at least the following countries as importers of Indian products – US, France, Kenya, Bhutan, Ethiopia, Israel, Taiwan, UK, Nepal, Belgium, Vietnam, Philippines, US, Netherlands, Switzerland, Canada, France, Mauritius, Myanmar and the UAE. Some of the products exported by India are, e.g. multi-function handheld thermal imagers, lightweight torpedoes, anti-submarine warfare upgrade suit and the Akash air defence system. (Saxena, 2016; Nishith Desai Associates, 2018 and India, 2019).

South Africa is mentioned only once in the comprehensive analysis of the Indian DTIS by Behera (2016), mentioning the import of South African armoured vehicles by India. Of particular interest to the SA DTIS might be the export of artillery gun components to the UAE in 2017 by the Ordnance Factory Board, Kolkata. (Nishith Desai Associates, 2018: 1). South Africa is a market leader in specific calibres of artillery systems and also active in the UAE market. A bilateral arrangement between the Indian and SA DTISs could provide scope for expanded market penetration in the UAE and possibly gains in economies of scale if technologies are transferred and use is made of probably more favourable labour conditions in India.

With a synoptic view of the Indian DTIS in the rearview mirror, let us consider other facets of the Indian DTIS landscape that could influence bilateral partnerships between the Indian DTIS and that of South Africa.

3.5.1.1 Indian DTIS Growth Barriers and Drivers

> *… divergent cultures and business landscapes combined with unique legal and political environments can make [JVs with India] particularly challenging. (PwC India Desk, 2018).*

India is still embroiled in the continuing geopolitical struggle with Pakistan. (Maiti, 2018: 6). This might be perceived as a driver for Indian DTIS growth, however, it also has a negative impact on investor confidence and possibly also hinder companies to establish a capital asset base in India.

Cooperation between Indian and South African DTIS is strained for a number of reasons. PwC India Desk (2018) found that mobility between the countries due to visa regulations; conducting business and ownership are some of the hurdles to cross. When you add security regulations to the basket, as required for the DTIS, cooperation becomes slow to static. One way around the cumbersome South African visa regulations is to get a BRICS visa (10 years valid for visits up to 30 days). Mobility is further complicated by no direct flights to South Africa from India. (PwC India Desk, 2018). Broad-Based Black Economic Empowerment (B-BBEE) is also stated as a hindrance from a business ownership perspective especially for small companies that cannot surrender a share of their company to a South African counterpart. However, PwC India Desk (2018) is of the opinion that there are opportunities for partnership with South African companies to unlock the potential of the South African business environment. Like in India, there is also bureaucracy and 'red tape' are major challenges to overcome when doing business in South Africa. (PwC India Desk, 2018). The compound effect of the bureaucracy in both countries will slow the growth potential down significantly. "The establishment of the Invest SA One Stop Shop is a major move that demonstrates the government's commitment to smoothing the way for investments coming into South Africa." (PwC India Desk, 2018: 18).

India, as the largest importer of armament, is plagued by corruption which is a major stumbling block to developing public trust in India concerning the Indian DTIS. (See Figure 2.12 for a comparative world-view) This is compounded by inefficacies in the procurement system, thus hampering the attainment of being self-reliant and more practically, defence matériel shortages. There is, however, the promise of improvement by the Indian MOD. (GI – India, 2015: 1). If this is not realised, partnering with the Indian DTIS could prove problematic to countries sensitive to corruption and those endowed with only limited resources.

Important notice in terms of time-scaled opportunity comes from Behera (2016). Behera (2016) states that by 2027 the Indian DTIS must be 70% self-reliant. "Incidentally, the target year coincides with the term of the current Long Term Integrated Perspective Plan (LTIPP) 2012-27 of the armed forces." (Behera, 2016: 162). This presents the SA DTIS with a limited window of opportunity to play/establish a role in the development of the Indian DTIS. Once the Indian DTIS has achieved this projected 70% self-reliance status the role for the SA DTIS in India would have significantly shrunk to insignificance.

Behera (2015) summarises a number of barriers to the successful implementation of the 'Make in India'" DTIS policy. Some of these barriers relate to some structural reforms required (e.g. the establishment of a MOD Council on Production); strategy and planning initiatives (e.g. a long-term strategy for defence industry and integrated planning between the Indian Defence Force and the Indian DTIS); promote a more liberal DTIS policy to allow for increased R&D that is independent of the DRDO[20] as well as a more equal dispensation for private defence technology and industrial partners within the ethos of 'Make in India'; establish a Defence Technology University; create financial incentive frameworks to encourage defence R&D and production domestically. (Behera, 2015). Outsourcing some R&D initiatives may provide opportunities for the South African defence R&D fraternity (primarily situated at the CSIR, Armscor and Institute for Maritime Technology) to establish bilateral relations in the form of JVs. Note should also be taken off the distinct requirement for integration between military and DTIS strategy and planning to ensure synergy and maximisation of beneficiation in the domestic economy from an idealistic perspective.

Financial incentives, duties and tax regimes also have a distinct effect on the Indian DTIS – ". "… [that] operates in a hostile financial framework that tends to render it less competitive vis-à-vis foreign manufactures. It operates in a double-digit interest regime compared to the nearly zero interest rate system prevalent in Europe, US and many other countries." (Behera, 2015). This may be a critical barrier to the SA DTIS establishing JVs in India, compounded by duties and levies in India for defence production – "Indian industry also suffers from prevailing taxes and duties, which offer virtually no incentive for any local company to undertake defence production." (Behera, 2015). However, opportunity may be hidden in JVs between the SA DTIS and India allowing joint production in South Africa, exporting to India – thus circumventing some of the negative effects of these duties and levies – "In fact, India follows an 'inverted structure' by which direct import is allowed free of duties whereas manufacturing the same product at home attracts several taxes and duties." (Behera, 2015: 8).

More positively, India has developed into a defence technology and industrial giant over the past decades. This is fuelled by the expanding Indian defence spending. India reached the third-largest defence budget during the 2017-18, reaching US$57.4 billion (2.5% of Indian GDP), largely driven by regional insecurity and upgrades to existing Order of Battle (ORBATs). (Lineberger & Hussain, 2018b: 10). India's increased defence spending is going to positively impact international defence sector growth from 2018 for at least the medium term. (Lineberger & Hussain, 2018b).

Although India imported most of its defence matérial from foreign suppliers; India has now commenced a strategic journey towards DTIS capability self-reliance, particularly from Russia.

[20] "[T]he Defence Advanced Research Projects Agency (DARPA) of the US, which has been at the heart of the several radical innovations including in the areas of stealth, internet, Global Positioning System (GPS) and Unmanned Aerial Vehicle (UAV), does not do R&D on its own. In fact, DARPA does not own a single lab of its own! Rather, it identifies talent and ideas from industry, academia, government laboratories and individuals, and awards R&D contracts to be executed in typical time scales of three-to-five years. DARPA's role is limited to shortlisting of projects and managing the programmes, which it does through 140-odd programme managers." (Behera, 2015).

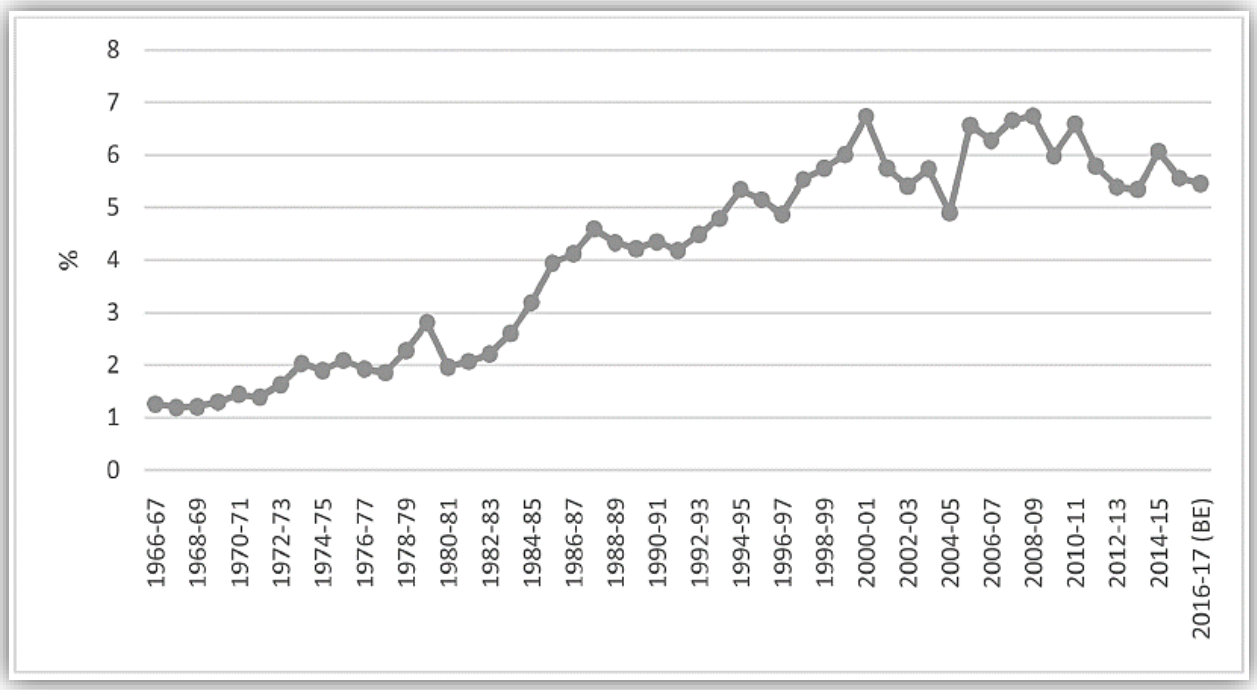
(Gressel, 2017). The future Indian DTIS will see considerable interest in access to Western defence technology and industrial assets. The Indian DTIS also have ambitions to - "…acquire and integrate the production systems, quality systems, processes and capabilities required to build to western standards." (Gates, *et al*., 2016: 18). In India, this quest is labelled "Make (and Buy) in India" and are welcoming foreign defence manufacturers to invest in the Indian defence sector using cooperative arrangements such as JVs. This liberal DTIS policy extends as far as 100% foreign ownership of defence companies as part of the "Make in India" policy. The caveats are that these JVs/M&As should provide employment to Indian citizens, sub-contract local Indian companies (as part of offsets) and bring FDI to India. This is aligned with an idealistic approach to DTIS policy in India. (NDIC, 2018: 33). Thus, India is now formally and vigorously climbing the 'Ladder of Production'.

Recently, India has entered into JVs in the past two years with global DTIS leaders (e.g. Airbus, Boeing, Lockheed Martin and Safran). (Nishith Desai Associates, 2018). India is set to be the third-biggest aviation market segment by 2025. (Lineberger & Hussain, 2018b). The fact that India is continuously modernising its military capability is a perfect driver for tailored defence manufacturing and R&D expansion. Behera (2016: 9) provides a summary of the increase of Indian defence R&D expenditure (budget) in Figure 3.7.

However, India levies a 30% or more offset requirement on contracts with values exceeding US$300m. (Maiti, 2018). This is typically aligned with the "Make in India" policy. The fact that India strives to be an international defence technology and industrial hub creates opportunities for defence industries to establish a footprint on the Asian sub-continent sharing in a global supply chain and defence industrial cluster benefits. Maiti (2018: 6) provide a snapshot of the Indian DTIS for at least the medium term listing some key advantages and strategic levers for the DTIS –

- India was the 4th largest defence spender internationally in 2017.
- India was the 2nd largest defence matériel importer internationally in 2017.
- India requires foreign suppliers to invest in the domestic Indian DTIS as an offset requirement.
- The number of JVs between Indian and foreign defence companies are increasing.
- The longstanding geopolitical struggle between India and Pakistan provide fertile ground for DTIS growth in terms of supply and demand for war material as well as R&D and innovation directed at maintaining an advantage. It also provides the impetus to the modernisation of the Indian Defence Force.
- There is also a focus on indigenisation of the Indian DTIS by means of the 'Make in India' policy. The initiative seems to be autarkic, but as discussed earlier. However, with the eagerness to establish JVs and cooperative agreements, the Indian approach to DTIS business is probably closer to being a hybrid model. This is visible in the Indian ambition to evolve into a defence manufacturing hub to the international community and a primary exporter of defence matériel.

Figure 3.7: Share of Research and Development in Indian Defence Expenditure (%)



Source: Behera (2016: 9).

Primary strategic business levers set in motion by India in the past two years are based on a combination of industrial policies/strategies to attract foreign investment. These are – "… increased international engagement, a revamped [FDI] policy, and a new defence procurement procedure with amendments on offset regulations, and the announcement of the strategic partnership model." (Lineberger & Hussain, 2018b: 10). There is thus a strong focus on relationship building in order to attract investment. India also realised that barriers need to be lowered for FDI attractiveness. Thus, India relaxed certain investment regulations making 100% ownership of businesses possible for foreign investors. (Lineberger & Hussain, 2018b).

With regards to the formation of strategic partnerships as part of the Indian "Strategic Partnership Model"; India lowered the fence to make strategic partnerships with selected foreign OEMs possible to facilitate enhanced prospects for India to become more independent in the future. These partnership includes technology transfers as a vehicle to ensure positive knowledge flows into the Indian defence sector. (Linerberger & Hussain, 2018; India, 2019).

Then there is the drive to establish a defence manufacturing hub within India and to become a major defence equipment exporter. (Maiti, 2018; India, 2019). India is seeking to grow its industrial capabilities in the fighter aircraft, submarines, helicopters and armoured fighting vehicle sub-sectors of the defence market. (Lineberger & Hussain, 2018: 10).

"To be sustainable, Indian companies operating in South Africa realise the necessity of equipping South Africans with the skills necessary to deliver locally, instead of employing a large expatriate population from India." (PwC India Desk, 2018: 12). This is applicable to the industrial

activity of Indian companies in South Africa. It is not specific to the Indian DTIS. However, this is a requirement by defence contracting in South Africa.

Significant opportunities exist within the context of the 4th IR. This technological revolution is poised to – "combines elements of the internet, robotics, machines, biotechnology, nanotechnology and artificial intelligence to bring about smart factories that can manufacture goods with little to no human intervention." (PwC India Desk, 2018: 18). The SA and Indian DTIS, as high technology sectors, will certainly benefit from the exploitation of such opportunities. However, there are some concerns about the transition into the 4th IR and its impact on unskilled labour. "Indian [information technology (IT)] companies well placed to provide the skills and services brought about by the [4th IR] will stand to benefit immensely by providing and transferring those skills to South Africa." (PwC India Desk, 2018: 18). It is thus critical for the South African DTIS to engage with India to prevent the sector from lagging behind the fast-moving IT skills and innovation curve.

The obvious growth drivers are technology and productions. The DRDO, as the primary Indian DTIS R&D Institute (Saxena, 2016) has developed into a multi-dimensional defence technology innovation capability. The DRDO execute R&D within the technology portfolios of aeronautics, armaments, aeronautics, naval systems, electronics, life science, combat engineering, materials, and missiles. Many of the technologies that have been developed by the DRDO have been inducted into the Indian military, which include a broad missile system portfolio, electronics systems (e.g. radars and EW systems), vehicle systems (e.g. combat vehicles), aerostructures (i.e. UAVs), advanced technologies (e.g. robotics), and naval technologies (e.g. submarine escape suits), among others. (Behera, 2016: 84). Behera (2016: 191-193) provide a comprehensive list of ongoing defence technology/production projects active since 2015. These include technology development and production of a broad portfolio of missiles and associated technology, combat aircraft, Active Electronically Scanned Array Radar, 155 mm/52 Caliber Advanced Towed Artillery Gun System, propellant, ammunition, Hypersonic Wind Tunnel, EW systems for Capital Ships, Aircrafts & Helicopters, submarine periscopes, UAVs, NBC Defence Technologies, and Augmentation of Environmental Test Facility for Warheads and Electronic System (amongst several others – see Behera (2016: 191-193) for a comprehensive list. The areas for collaboration with the SA DTIS is quite visible.

Behera (2016: 88) also provides a comprehensive list of defence technologies that are destined for acquisition by the DRDO. This indicates certain gaps in Indian DTIS capacities for innovation and R&D. It also provides a glimpse of opportunities for the SA DTIS. The technology gap areas include "… nano technology [*sic*] based sensors and displays, technology for hypersonic flights, low observable (stealth) technologies, focal plane arrays, gun barrel technologies, and fibre lasers technology". (Behera, 2016: 87-88). Other areas that might be of interest to the SA DTIS for collaboration with the Indian DTIS are in MEMs based [*sic*] sensors, actuators radio frequency devices that are MEMs-based, laser technologies, advanced materials, ammunition and propellant technologies, precision-guided munitions, shock- hardened sensors, helicopter technology. (Behera,

2016; Saxena, 2016). Technology transfers in these areas of interest could be established with strategic alliances, R&D-related JVs and collaboration. (Saxena, 2016). The SA DTIS should take note of this statement because of the lurking potential for the Rooivalk Attack Helicopter. Having discussed the most important parts of the Indian DTIS landscape, let us consider what strategic business levers the Indian DTIS are favouring for potential DTIS growth.

3.5.2 Indian DTIS Strategic Business Approaches and Levers

India has developed a significant DTIS. The "Make in India" DTIS policy is fundamental to the current disposition of the Indian DTIS. India is well aware of the requirement to have a well-established and quality DTIS to be perceived as a regional power. In order to reinforce the momentum of the development, India is promoting the import US, French and UK defence products as a possible hedge against the total collapse of the Russian DTIS (or the Russian DTIS not being able to keep pace with Western technological advances) thus negatively affecting the strategic defence matériel supply chain relationship between Russia and India. (Saxena, 2016; Behera, 2016; Farley, 2017; Bret, 2017; Gressel, 2017).

In the early 2000s, the Indian DTIS shifted further away from autarky towards liberalisation by allowing the Indian private sector 100% participation in defence technology development and production. This shift is conceptualised by Behera (2016: 10) as "Self-Reliance through Private Sector Participation" and was preceded by a phase in the development trajectory – self-reliance through co-production. (Behera, 2016). These shifts resulted in the introduction of offsets and a "make and make and buy" categories of the "Make in India" DTIS policy to allow for participation in various forms. This permits foreign contractors total freedom in their choices of Indian defence technology and industrial partner. The 'Make' category is aimed at facilitating the indigenisation of the defence technology and products by both public and private Indian companies. (Behera, 2016: 10). This category is complemented with a "Buy" category that aims at directing Indian military contracts to the Indian DTIS in the quest for self-reliance. This is thus a move away from licenced production towards establishing Tier 1 technology and industrial capabilities. (Behera, 2016: 11). These DTIS policies illustrate clearly that India is now open for business – with due regard for the indication provided earlier that the indigenisation should be 70% by 2027 – which makes the window for business and role establishment short- to medium-term. The South African DTIS will also face significant crowding out strategies from the large and developed DTISs of the USA, UK, Russia, Israel, etc.

Significant to understand in Indian DTIS policy is the sequence of preference among the categories described in the DPP-2013. In order of preference – "(1) Buy (Indian); (2) Buy & Make (Indian); (3) Make (Indian); (4) Buy & Make; and (5) Buy (Global)." (Behera, 2016: 11) Motivation is required for the Indian military to use for example the "Buy (Global)" category. This creates a positive nexus between the Indian DTIS and the Indian military in terms of self-reliance (Behera, 2016; Nishith Desai Associates, 2018) and thus budget allocations. The "Make in India" DTIS policy primarily aims

at providing investment protection for defence R&D and technology development initiatives locally, thus acts as an incentive programme for local R&D. (Behera, 2016).

It is envisioned that self-reliance can be achieved through the - "… building indigenous capabilities for manufacture and maintenance of defence equipment in a cost-effective manner." (Nishith Desai Associates, 2018: 52). The "Make in India" DTIS policy provides much greater latitude to "political and bureaucratic will" to achieve self-reliance with. (Behera, 2016: 13). The policy invites licenced production, an increase in the allowed FDI to 49%, and defence exports. (Behera, 2016). It indicates a clear drive to keep on climbing the "Ladder of Production" and the continuous active involvement of the Indian Government to achieve the goal. In doing so it also opens up opportunities for DTIS collaboration with other emerging economies such as South Africa and better international supply-chain integration. The SA DTIS could benefit from this integration if it can carve out a strategic role in these supply chains.

Indian DTIS policy allows for the use of various strategic business levers to unlock collaboration channels with Indian OEMs in their domestic market. First, the Indian Government uses G-to-G DTIS collaboration for large scale development and productions programmes. For example, a G-to-G agreement was signed between India and Russia for the "… co-development and co-production" of transport and fighter aircraft. (Behera, 2016: 9). As discussed earlier, this also illustrates the ongoing dependence of India on Russian DTIS expertise, probably also to the dismay of the Western nations. Thus, although the motive for using strategic business levers within the context of a liberal DTIS policy strive to achieve higher and accelerated levels of development (discussed in Chapter 2 of the thesis), its use also lock collaborators into an interdependent relationship that diminish the level of self-sufficiency if not combined with levers such a technology transfer and/or FDI. Therefore, Nishith Desai Associates (2018) is of the opinion that the Indian DTIS could attempt to bridge the chasm between technology and product development by means of technology transfer. (Nishith Desai Associates, 2018: 52). Examples of such technology transfer and co-production agreements are with (at least) Sweden (Avila, *et al*., 2017) and Russia (Bret, 2017).

Considering the array of strategic business levers depicted in Figure 2.15., India subscribes to at least JV and M&A. India has shown an enormous preference for the establishment of JVs in order to increase technology transfer with which India is rapidly building its DTIS into a world-class competitor (Saxena, 2016; Jaini, 2016; Bret, 2017; Gressel, 2017; Nishith Desai Associates, 2018 and others), both in scale and quality. It illustrates the utility of combining JVs with technology transfer arrangements. As stated earlier in the thesis, the requirement for technology transfer might also be a deterrent for some States to be interested in collaboration. Joint ventures between India and countries such as the Russian (historical and ongoing), USA, Canada, Israel, France and Netherlands exists since 2015. (Nishith Desai Associates, 2018: 24). This shift in DTIS policy towards co-development and -production occurred because the Indian Government realised that the domestic efforts were not adequate to fill the Indian military requirements for defence matériel. Thus the Indian DTIS moved into phase three of there development trajectory – i.e. self-reliance through co-production and later to

self-reliance through private sector participation. (Behera, 2016). These shifts resulted in significant liberalisation of the Indian DTIS policy, underwriting G-to-G agreements and JVs with several countries.

India uses JVs extensively as a driver of 'Make in India' DTIS policy and to encourage and facilitate the climbing of the production ladder through co-development, co-production, technology transfer and FDI arrangements. (Nishith Desai Associates (2018: 29-33), India (2019) and Behera (2016)). Annexure C of Behera (2016: 187 -190) provide an extensive list of approved FDI/JV projects with the Indian DTIS, both internal to the Indian DTIS and between the Indian DTIS and other countries. Distilled from these, India has JVs with Russia (mostly G-to-G), France, USA, Denmark, South Korea, Sweden, Israel, Spain, European multinational MBDA, UK and Italy (amongst possible others that are not in the public domain).

Joint venture arrangements is a specific opportunity for SA DTIS and India DTIS collaboration in terms of the South African Rooivalk attack helicopter, artillery systems and ammunition. However, the India-USA JV on the AH-64 attack helicopter has probably created a significant entry barrier for a specific SA DTIS Tier 1 OEM of the Rooivalk attack helicopter to the India market. It also further creates barriers for SA-India JVs for technology transfer and joint development of weapon and sensors for attack helicopters (typically those developed by Denel Dynamics) because these might not be permitted onto the AH-64 airframe.

Recommendations for more focus on M&A have been expressed by the Indian Government (e.g. the Kelkar Committee report, Revitalising Defence Public Sector Undertakings and Ordnance Factories) to facilitate the achievement of scale economies and increase the Indian DTIS international competitiveness. (Behera, 2016: 150). Examples of Indian DTIS involvement in M&A are the - "… Mahindra Group's acquisition of majority stakes in the Australian defence aviation companies, Aerostaff Australia and Gippsland Aeronautics and Bharat Forge's acquisition of a gun manufacturing plant from the Swiss company Ruag." (Nishith Desai Associates, 2018: 29-33). Let us now discuss the same aspects already discussed for the other BRICS States, for China.

3.6 CHINESE DTIS – AN INTRODUCTION

> *China's [DTIS] can be expected to remain highly resilient, providing it with considerable scope to develop and produce arms in the face of weapons sanctions. (Boutin, 2017: 39).*

Based on a perception of "strategic vulnerability" the Chinese Premier Enlai initiated a defence technology and industrial (amongst other sectors) modernisation programme at the start of the 1970s (Garnaut (2018: 29) and several other writers in Garnaut, Song & Fang, 2018). This was probably based on Premier Enlai's vision during the 1970s that informed a Chinese policy document State-owned Assets Supervision and Administration Commission (SASAC) of 2006 that reinforced the idea of state ownership as a pillar to the Chinese economy as well as seven strategic industries identified that requires sovereign state control and nine industries that requires strategic state control. These

strategic industries are defence, electricity[/power] production and distribution, petroleum[/oil and petrochemicals], telecommunications, coal, civil aviation and shipping." (Lardy, 2018: 335 and Song, 2018: 356-7). Therefore, Chinese DTIS are of strategic importance to the development of China.

During the mid-1970s China started to allow FDI. This initiative to modernise of the Chinese DTIS (amongst other economic sectors) was also expressed at the 1975 National People's Congress. The understanding that the Chinese DTIS was a crucial sector for Chinese economic development emerged during this period. "However, these efforts were fiercely attacked by radicals as 'capitalist' and, eventually, Deng was removed from all party and government posts." (Chen, 2018: 595). This public expression of defence as one of the pillars of Chinese economic development, and by implication the Chinese DTIS can be regarded as the first idealistic approaches to the development of the Chinese DTIS.

Currently, China is the second-largest defence industrial power (BusinessTech, 2018; Beliakova & Perlo-Freeman, 2018) – an opinion contested by Maiti (2018), Bitzinger, (2017), Bitzinger and Popescu (2017), Raska, (2017) and Fleurant, Wezeman, Wezeman and Tian (2016) based on SIPRI data - places China in third place[21]. SIPRI (2019), however, states that China, for the period 2014-2018, reached the 5th place in terms of international armament exports. During the periods 2004-2008 and 2009-2013 the Chinese armament exports increased by 195%, but only increased by 2.7% during the period 2009-2018. This provides a brief glimpse of the expansion that resulted from the 1970 policy shifts and initiatives and the classification in the SASAC 2006.

Strategically, the ranking of China is very important as consideration for collaboration and DTIS relations. It provides a glimpse of the success that was achieved by decades of investment and governmental support for the Chinese DTIS as an adjunct to the Chinese military (realist perspective) as well as an important sector to Chinese economic development (idealist perspective).

Investment in the Chinese DTIS has been (and still are) considerable, targeting increased standards for quality and technological sophistication. (Farley, 2017; Bitzinger & Popescu, 2017; Johnson, 2018). "China thus grew out of her "large arms importer" shoes and into her "large arms exporter" boots". (Rask, 2017: 55). Ambitions for self-sufficiency and domination probably regained new emphasis when considering the statements by Cliff, *et al*. (2011) in Haas (2019: 29), - "The 1991 Persian Gulf War sent shockwaves throughout China's military community", resulting in strategic shifts and greater emphasis on the modernisation of the Chinese military. "The United States' overwhelming dominance in that conflict led Chinese military leaders to push for advanced military technologies." (Haas, 2019: 29).

[21] "The best data we have regarding China's place in the international arms marketplace come mainly from two sources: the Stockholm International Peace Research Institute (SIPRI) and the US Congressional Research Service (CRS). SIPRI data for 2012-2016 shows China to be the world's third-largest arms exporter, with 6.2% of the global market. This performance places it behind the United States (the number one arms exporter, with 33% of the international arms market), and Russia with 23%, and slightly ahead of France (6%), Germany (5.6%), and the United Kingdom (4.6%)." (Bitzinger, 2017: 47).

The acceleration in the development of the Chinese DTIS is supported by a military budget of 1.11 trillion CNY for 2018 (a year-on-year increase of 8.1% increase and also the most extensive in 3 years)[22] to support the military modernisation program. (Legarda & Nouwens, 2018). Other indications of the focus on the Chinese DTIS development are increasing defence and security initiatives on the African continent as well as hosted the introductory China-Africa Defense and Security Forum in June 2018. (Legarda & Nouwens, 2018). The Chinese interest in the African defence market share is important to develop bilateral DTIS cooperation between South Africa and China but not the definitive factor.

The current Communist Party leader, Xi, is focussing on establishing a winning warfighting capability of the Chinese military (PLA) in order to create a world-class Chinese Defence Force by 2049. (Legarda & Nouwens, 2018; Kim, 2018). This insinuates intent for significant defence technology and industrial growth in support of the Chinese self-sufficiency and domination ambitions. (Yang, 2017). However, China commenced with the PLA modernisation at a very late stage (compared to Western nations) resulting in an increase in complexity and pressure on the Chinese DTIS ability to keep pace and absorb the learning. The pressure is further increased by the Chinese ambitions to compete militarily (and thus with DTIS capability and capacity) with the Western superpowers. (Boutin, 2017; Raska, 2017; Kim, 2018). Other factors that compound the pressure is the increasing tensions over territory and other geopolitical factors in the South China Sea Region; the potential military build-up aimed at re-annexing Taiwan; and military facilities in Djibouti. (Allen, 2017; Legarda & Nouwens, 2018; Kim, 2018 and Lineberger & Hussain, 2018). These developments fuels increases in defence spending of the neighbouring States (Allen, 2017; Legarda & Nouwens, 2018 and Lineberger & Hussain, 2018), gradually contributing to a negative security spiral amongst the Asian States. These issues will probably calibrate the balance between realism and idealism as the motivation for the development of the Chinese DTIS. For the SA DTIS, this balance is currently strongly tipped towards idealism.

Johnson (2018) states that the Chinese industrial sectors have penetrated the top ranks of the five leading exporting countries. This, in turn, focussed military-technical cooperative arrangements (bi- or multilateral) on becoming an effective political and economic instrument of influence. This provides China, currently, with real flexibility with which to achieve the desired PLA modernisation and ultimately "defence industrial autonomy" (Boutin, 2017: 40) or self-sufficiency. Boutin (2017) goes as far as labelling the Chinese DTIS structure as being in hybrid form (SOEs as well as market-related structures), exhibiting the effect of the more liberal DTIS policy set in motion in the 1970s.

22 "However, China is not transparent about its defense budget. For instance, some military R&D spending and foreign weapons purchases (notably of the Russian Su-35 fighter jet) are not included. China's civil-military integration further complicates calculations by blurring the lines between military and civilian budgets. Some estimates place China's actual total military spending at more than double the official figure." (Legarda & Nouwens, 2018).

Currently, the Chinese DTIS has established shipbuilding and armoured fighting vehicle production capabilities but still lack aerospace expertise. (Boutin, 2017; Bitzinger, 2017). Due to quality issues a trend developed of buying Chinese products (comparatively cheaply) and replacing Chinese components and/or systems with more technologically (better quality) components and/or systems – either developed indigenously or sourced from the West. Examples of this exist in Algeria, Thailand and Pakistan. (Bitzinger, 2017). This provides a snapshot of some of the issues facing the Chinese DTIS as it is climbing the "Ladder of Production" in the quest for self-sufficiency and possibly domination.

3.6.1 Chinese DTIS Synopsis

> *In 2014, China climbed into the [SIPRI] top-five arms exporters for the first time, overtaking the United Kingdom. Overall, between 1998 and 2017, Chinese arms transfers grew in volume by 211%. (Nouwens & Béraud-Sudreau, 2018).*

Historically, the Chinese DTIS has evolved from being a net importer of armament to being a strategic armament supplier. The Chinese DTIS companies are gradually exhibiting vast improvements in armament design and production quantity and quality. (Nouwens & Béraud-Sudreau, 2018). The manufacturing output of the Chinese DTIS is estimated at approximately US$362bn. China is projected to be the largest aviation market segment by 2024. (Lineberger & Hussain, 2018b). A section of this aviation market is obviously defence-related. China is currently able to produce and operationalise aircraft carriers as well as from a technology development perspective, conduct research in quantum-technology communications. (Nouwens & Béraud-Sudreau, 2018). Thus, the Chinese DTIS is climbing the "Ladder of Production" with intent. "Yet despite the astronomical figures, the Chinese state-owned defense industry has many underlying challenges common to corporations of its type." (Yang, 2017). This is important for the Chinese DTIS business strategy due to the fact that the Chinese DTIS is almost self-sufficient with ambitions to become a dominant defence technology and industrial power.

The Chinese DTIS modernisation and developmental improvements are supported by a very large Chinese defence budget (US$150.2 billion in 2017) (Lineberger & Hussain, 2018b). Nouwens and Béraud-Sudreau (2018) placed it at US$192.5 billion (2017). The difference in the estimates illustrates the difficulty of tracking Chinese DTIS development due to its non-transparent nature. The Chinese defence budgets are believed to be the 2nd largest globally (relative to the USA), of which a large percentage is consumed by the development of the Chinese DTIS. (Nouwens & Béraud-Sudreau, 2018). China increased the spending rate on defence at 5.2% year-on-year during the past decade with a projected 8.1% increase in the defence budget for 2018.

Broadly, the defence and technology industrial conglomerates that dominate the Chinese DTIS landscape are the Aviation Industry Corporation of China (AVIC) and the China North Industries Corporation (NORINCO) (Boutin, 2017: 41), China Shipbuilding Industry Corporation (CSIC), Aviation Industry Corporation of China (AVIC) and China State Shipbuilding Corporation (CSSC) (Yang, 2017).

A list of the top 20 Chinese defence industries are as follows according to Nouwens and Béraud-Sudreau (2018): AVIC, China South Industries Group Corporation (CSGC) and NORINCO (included in the top 10), CSSC (22nd on the list) China Electronics Technology Enterprise (CETC), CSIC, China Aerospace Science and Technology Corporation (CASC), China Aerospace Science and Industry Corporation (CASIC), China National Nuclear Corporation, China Nuclear Engineering and Construction Group Corporation. Most of these conglomerates have undergone significant consolidation over the past decade and more. For example, AVIC I and AVIC II and other subsidiaries merged into what is now known as AVIC. This was a concerted effort to make AVIC more competitive with Western counterparts, to drive innovative capacity and a quality product export focus. (Nouwens & Béraud-Sudreau, 2018). These are clear indications of intentions to dominate.

Some of these Chinese defence industries are now approaching the level of development and complexity of Western defence technology and industrial giants (e.g. Lockheed Martin, Boeing, Raytheon, General Dynamics, L-3 Communications and BAE and others). (Nouwens & Béraud-Sudreau, 2018). Note should be taken that not all the Chinese subsidiaries affiliated or owned by the 10 companies, mentioned above, has the ability to design, develop and manufacture military-off-the-shelf (MOTS) systems, equipment and/or components. Several subsidiaries manufacture dual-use systems, equipment and/or components (e.g. AVIC has 136 subsidiaries of which only 51 is MOTS-related companies). (Nouwens & Béraud-Sudreau, 2018). This civil-military integration, discussed in the next section, points to the availability of other defence technology and industry opportunities within the Chinese DTIS that could be capitalised on by the SA DTIS that could contribute to the broader economic development of the SA economy.

Then there are the defence industries classified as the “non-state defence-industrial sector”, e.g. Shaanxi Baoji Special Vehicles. (Boutin, 2017: 41). These are products of Chinese economic transformation over the past decade. Their establishment is regarded as incremental due to policy uncertainty; they support Chinese DTIS SOEs but are not regarded as extensions of these. (Boutin, 2017). These can also typically be included in the fold of dual-use technology and products.

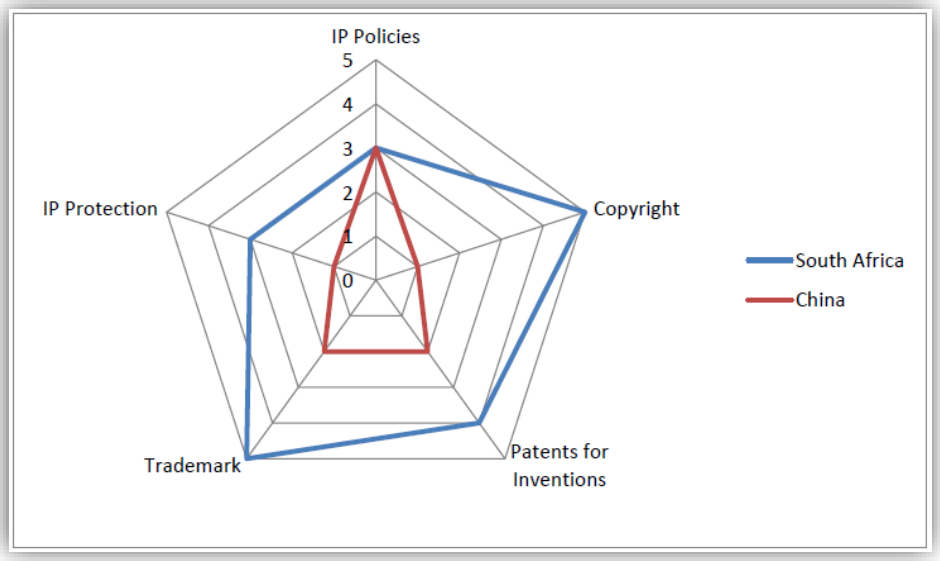
Another capability that should not be lost sight of is the development or support of dual-use infrastructure. Such infrastructure is, basically, most national transport infrastructure which has economic and military value. For example, there is a call for Chinese investment in commercial seaports from an economic development perspective, which could then be used as strategic forward support infrastructure for the Chinese military. (Kim, 2018: 3). As such - “[u]nder the banner of the Belt and Road Initiative (BRI), Beijing has pledged to invest more than $1 trillion in infrastructure investment across 60 plus countries.” (Kim, 2018: 2). This is a good example of a combination of realist and idealist approaches to the expansion of defence industrial capability for military purposes.

The Chinese DTIS product portfolio currently flourish in the African (Zimbabwe, Nigeria, Kenya, Morocco), Asian (Turkmenistan, Philippines, Thailand, Indonesia), Latin American (Peru, Mexico, Venezuela, Ecuador) and Middle Eastern (Saudi Arabia) markets due to its increasing capability to

catch-up with the leading competitors in the market space, US and Russia. (Raska, 2017; Yang, 2017; Parameswaran, 2017; Abbas, *et al.*, 2016).

Thailand's military chief Chalermchai Sitthisart made a contextually profound observation – "China had offered a better price, relative to others like Russia or Ukraine, adding that the most important factors were "suitability [and] price." Parameswaran (2017) conceptualise this as being easier to buy from Chinese than Western DTISs and possibly also better value for money. This confirms the pricing strategy followed by China (in combination with other techniques such as financial assistance, etc.), primarily to enter DTIS markets that are traditionally associated with the USA and Russia. These market strategies are designed to balance Western DTIS strategies that are based on technology niches. Pricing strategies are somehow hampered by the Chinese record for IPR misuse, which is a critical flaw in the Chinese business model for innovation. The relative inclined positions between China and South African IPR protection regimes are depicted in figure 3.4 by Zhang, 2012).

Figure 3.8: The Relative South African – Chinese Intellectual Property Rights Protection



Source: Zhang (2012: Appendix 1: 18)[23]

"Failure to protect intellectual property rights in the Chinese market leading to massive theft and piracy is constantly in the background." (Zhang, 2012: Appendix 1: 17). Thus, the SA DTIS will have to take note of the pricing strategy and strategies regarding technology transfer and IPR abuses when dealing with China. On the other hand, the SA DTIS will benefit from close cooperation with China on DTIS matters because of the expanding market segment being serviced by the Chinese DTIS. Balance between a desire for market growth, revenue generation and long-term sustainable competitive advantage (secure IPR) is of paramount importance.

The Chinese aviation, information and communication technology domains have experienced significant growth over the last decades. (Zhang, 2012: 173). Zhang (2012) also elaborate on other

[23] 5 indicates 'strongly agree' and 1 indicates 'strongly disagree'.

possible opportunities for collaboration between China and South Africa based on scientific and technological collaboration dating back to 1999. There is shared interest in several scientific and technological research domains – including (but probably not limited to) – "… bio-technology [*sic*], mining, astronomy, palaeoanthropology, renewable resources, new material, nanotechnology, agriculture, communication, environment and climate change, etc. (Zhang, 2012: 173). Note that there is no expression of specific defence technology cooperation among those listed. However, defence technology is known for research into nanotechnology, renewable energy resources, aviation, ICT and new materials.

Zhang (2012) is of the opinion and based on the SWOT analysis conducted that there are favourable opportunities for science and technology development and technology transfer between South Africa and China. The caveat is obviously the IPR protection issues when collaborating with China and possibly negative reactions from the West and other signatories to arms control protocols such as the Wassenaar Arrangement. With a synoptic view of the Chinese DTIS in the rear-view mirror, let us consider other facets of the Chinese DTIS landscape that could influence bilateral partnerships between the Chinese DTIS and that of South Africa.

3.6.1.1 Chinese DTIS Growth Barriers and Drivers

First and foremost, the Chinese DTIS is still very much centrally controlled by the Chinese State and will remain autarkic about such control because of the strategic nature of the Chinese DTIS. The Chinese Government wield significant control over the shaping of - "… corporate governance means non-state shareholders will always be at a disadvantage." (Yang, 2017). This leads to a lack of innovation and innovative spirit in the State monopolised Chinese DTIS. (Gady, 2015). Thus, G-to-G collaboration will probably render better access to the Chinese DTIS than via I-to-I initiatives.

A primary spoiler to (unprecedented) development and industrial growth is the relatively underdeveloped Chinese DTIS R&D and innovation capacities, specifically in the Chinese DTIS SOEs. (Boutin, 2017). For example, AVIC is regarded as the 2nd largest defence-related SOE with an international ranking of 7th largest in the world (2016), yet AVIC is hampered by critical weaknesses in innovation capabilities. (Nouwens & Béraud-Sudreau, 2018). This is compounded by, what is now an acceptable term for losing expertise and skills, continuous Chinese brain-drain. (Zhang, 2012). These conditions, according to Bitzinger (2017) seriously disadvantage the Chinese DTIS to become and/or remain competitive with the West, in particular with the development and production of advanced systems such as – "… supersonic combat aircraft, precision-guided weapons, airborne early warning aircraft, and long-range air-defence systems." Bitzinger (2017: 51-52). At a Tier 2 level of production, weaknesses remain in technology and industrial capabilities to produce aircraft engines, naval propulsion systems and combat management systems. (Nouwens & Béraud-Sudreau, 2018). These conditions are favourable for SA DTIS collaborative initiatives to fill in the gaps.

A possible growth spoiler for the Chinese DTIS is the tension that exists between the two distinct national interests – DTIS production self-sufficiency and DTIS progress (innovation and quality-

related). This tension is also exploited and driven by the necessary involvement of foreign industries and the non-State DTIS actors in China. (Boutin, 2017). However, the persistent dependence on foreign R&D support has the potential to discourage the development of the Chinese innovation centre of gravity. Foreign innovation dependency is also likely to undermine the industrial security, and thus the autonomy of the Chinese DTIS. (Boutin, 2017). This tension could possibly be resolved over time by a complete import substitution (total self-sufficiency in innovation and production); or the Chinese DTIS could accept that striving for total self-sufficiency is not more important than keeping pace with advances in technology, thus allowing increased collaboration and extended DTIS relationships. The latter thesis would be very favourable to the SA DTIS revival questions.

Bureaucracy within the Chinese DTIS seems to be a significant weight to carry up the "Ladder of Production". Raska (2017: 60) is of the opinion that some of the fundamental challenges to the development of the Chinese DTIS currently are related to – "… overlapping planning structures, widespread corruption, bureaucratic fragmentation, and most importantly, no real internal competition." Raska (2017: 60) add some barriers to innovation as critical deficiencies in the ability to ensure – "… structural strength, quality control and process standardisation". Gady (2015) posits that shortages in "innovative spirit" amplify Chinese DTIS bureaucratic fragmentation which – "... is a major obstacle to the development of innovative and advanced weapon capabilities because it requires consensus-based decisionmaking [*sic*] that requires extensive negotiations, bargaining, and exchanges." Corruption typically controls the information flow and decision-making dynamics within a hardened bureaucracy. (Gady, 2015). China is not immune to a lack of transparency and corruption. Other key features of the Chinese bureaucratic armament acquisition system are (and all considered barriers to sustainable growth within the sector) the absence of modern contract management and transparent pricing system that allows for good governance and efficiencies. Transparent pricing issues is a dividend of negative trust relationships between the PLA and the Chinese DTIS. The catalyst that keeps these features entrenched is endemic corruption, the extent of which is not quantifiable because of a lack of public reporting. (Gady, 2015). "The accelerating improvements in the output of the Chinese [DTIS] make the absence of any authoritative estimates of the industry's financial comparisons with other global defence groups all the more glaring." (Nouwens & Béraud-Sudreau, 2018).

Predicaments outline above does not prevent the Chinese DTIS to provide a complete range of platforms, systems and equipment to the PLA. It does, however, have a negative effect on the quality of these products. (Boutin, 2017). Illustratively, the Chinese WZ-10 attack helicopter is a Russian Kamov design and illustrate Chinese continuous tussle with DTIS development ambitions. (Reuben, 2013) The Chinese DTIS also exports only to a small number of countries (mostly developing countries who are cash-strapped). (Bitzinger, 2017). This, combined with a low capacity for innovation and quality, probably entrench China in its current market position. South Africa could possibly leverage its R&D and innovation capabilities in the design, development and manufacturing of the Rooivalk attack helicopter and associated systems in this market gap.

Then there is the continuous battle to gain a larger share of the armament market. The complexity of the battle is increased with factors such as poor buying power or extreme price sensitivity of the client-base (for example the sub-Saharan African States) and/or those States that are constrained by armament embargoes (for example Venezuela and Iran). (Bitzinger, 2017). Thus, what is considered a traditional Chinese DTIS market segment is also a spoiler inherently due to its precarious economic and geopolitical characteristics. However, traditionally Westward-looking States (e.g. the United Arab Emirates (UAE) and Kingdom of Saudi Arabia (KSA)) have recently procured Chinese manufactured armed UAVs. (Bitzinger, 2017). There are possible opportunities for selected SA defence and technology industries to cooperate with the relevant Chinese DTIS to break into this lucrative future market. The presence of the SA DTIS in the UAE and the distinct interest shown by the KSA in the SA DTIS are possible levers with which to revive the importance of the SA DTIS as a strategic DTIS partner in the context of BRICS.

The Chinese DTIS is also still prone to issues of information transparency. (Yang, 2017). Stated differently, poor communication and access to information challenges due to decades of autarky in the Chinese DTIS. "Publicly available information on the inner workings of the defense industry is scant, and knowledgeable individuals prefer to deal only with people well versed in the defense business. Insider trading is not only the norm, but also a necessity. Finding the right investment targets and knowing the PLA's demands as well as future trends within the armed forces require special connections that most investors simply do not have." (Yang, 2017). This information scarcity can also be seen in specialist portholes and institutes providing a comparative analysis of international DTIS. Nouwens and Béraud-Sudreau (2018) states in this regard that neither the SIPRI armament industry consolidated database nor the Defence News Top 10 database does not contain any data on the Chinese defence technology and industrial companies. These databases are considered to be primary open-source international defence industry classifications portholes. This lack of transparency is not favourable for bilateral cooperation as proposed by this thesis because of the required levels of trust that are being undermined by non-disclosure. Linked to this deficiency is the report published by the Government Anti-corruption Index classifying the Chinese DTIS as – "China's GI ranking in Band E places it in the "very high" risk of corruption category for corruption in the defence and security sector.' (See Figure 2.12 for a comparative world-view) (GI – China, 2015: 1).

"The chasm between the state-owned and non-public sectors is deep, and it will take time before defense executives are willing to share power with new owners based on fairness and mutual respect." (Yang, 2017). National security concerns are also typically used to maintain this chasm. (Yang, 2017). Within this chasm is entrenched corruption that undermines trust between the public and non-public companies and thus undermines the effectiveness of collaboration with potential international partners.

Other challenges that keep private equity investors cautious are the fact that the Chinese DTIS exclusively accepts RMB funding (Yang, 2017). This will make DTIS cooperation with South Africa cumbersome due to fluctuating exchange rates due to economic uncertainties in South Africa.

Fuelling arms proliferation in conflict regions such as Sierra Leone, South Sudan and the Democratic Republic of the Congo is severely frowned upon by the international community. Thus, the continuous supply of arms by China to these regions (whilst supporting the peace process) is unfortunate for the construction of bilateral cooperative arrangements with South Africa. This behaviour is problematic from an international relations and foreign policy perspective for South Africa and could inhibit defence technology and industrial relationship building. (Abbas, *et al.*, 2016: 24).

The above-mentioned growth barriers are compounded by the political (international relations) barriers erected, by specifically the West (typically NATO countries), restricting access to new technologies (military and dual-use) to fuel the growth ambitions of the Chinese DTIS. (Boutin, 2017). Other barriers to market penetration, in particular, Western armament markets, relates to hostility between the West (typically NATO countries) and China from an international relations perspective. Countries would rather import armament from Europe/USA in order to build or reinforce their international (trade and defence/security) relations with Europe/USA and in the same breath avoid the quality of technology produced by China. (Bitzinger, 2017). Thus by avoiding (cheap) Chinese defence technology and products States avoid the possibility of being locked out of access to higher quality, advanced NATO technology and products.

Maiti (2018: 7) provide a snapshot of the Chinese DTIS for at least the medium term listing some key advantages and strategic levers for the DTIS. These relate to the continuous nuclear threat emanating from North Korea as well as border protection of territories in the South and East Chinese Seas, the Chinese national ambition to grow into an international military superpower which goes hand-in-hand with established military self-sufficiency, and the Chinese Defence Science and Technology and Industry Plan (2016-2020) that aims at defence equipment development, exports and civil-military collaboration. Then there is the inertia provided by the fact that China is the second-largest defence spender (2017), the sixth-largest armament importer and the eight largest armament exported worldwide in 2017. This is combined with focussed dual-use technology expertise applied to modernise the PLA. (Maiti, 2018: 7).

Boutin (2017) states that - “China is an archetypical techno-nationalist state in terms of the extent to which national security concerns drive the promotion of autonomy in technological development and production, it has developed a unique approach to autonomy.” (Boutin, 2017: 40). This upward momentum on the “Ladder of Production” of the Chinese DTIS is facilitated and maintained by a number of factors. This momentum is supported by the Chinese - “… cumulative political, economic and military rise is reshaping global as well as regional geopolitics, including strategic alliances and the balance of power in East Asia, in ways that are inherently detrimental to established great powers, i.e. US interests and those of its regional strategic partners and allies.” (Raska, 2017: 60). China is a very large armament supplier to the defence forces of developing countries. (Bitzinger, 2017). As such, China is considered to be the biggest armament supplier to the African continent. (Bitzinger, 2017). Thus, the distinct link to the African market provides possible opportunities for cooperation on the African continent. The African defence market invariably suits the business model of the Chinese

DTIS which is mostly based on the provision of - “low-cost, affordable services and upgrade package” contracts. (Raska, 2017: 55). In this market segment, China remains a significant competitive force as a spoiler for Western (NATO) and Russian (historical Warschaw Pact) armament suppliers.

The Chinese DTIS exhibits technology and industrial capacities to ensure a complete supply chain of locally produced military requirements. This is significantly supported by a unique blend of defence industrial policy and strategy that provides the Chinese DTIS with enhanced autonomy. These two levers of the Chinese DTIS growth model results in another success driver – a DTIS that is very responsive to immediate requirements and very resilient against economic fluctuations. (Boutin, 2017). Linked to this is a Chinese DTIS structure driven by State-controlled innovation and R&D combined with very favourable price structures for the PLA. (Boutin, 2017; Raska, 2017). This provides the PLA with their requirements relatively quickly. (Boutin, 2017). These favourable price structures were extended African countries such as Nigeria, Zimbabwe and Sudan as a political lever to unlock access to oil and other minerals required by the Chinese economy. (Bitzinger, 2017). These barter-orientated tactics to market penetration are not yet approved for the SA DTIS but are called for in the DDIS 2017 as an alternative to traditional contracting practices. However, it may lead to foreign policy concerns in the international community from an arms control perspective (guns for minerals), compounded by the identity of the trading partner (China) which could result in embargoes on SA DTIS exports to Europe/USA. The South African economy cannot afford such negative exposure.

China also endeavours to progressively engage in benchmarking its technological progress and R&D initiatives against the levels achieved by counties such as Israel, Japan, Russia, India and the US. (Raska, 2017). This practice drives cycles of critical assessment internally and initiates continuous self-correction which fuels momentum increases in the modernisation of industrial capabilities, quality and other objectives. Raska (2017: 58) describes this increased momentum as increases in the “absorptive capacity” of the Chinese DTIS. Farley (2017) provides the following perspective - “China has also demonstrated a considerably greater capacity for capturing and integrating foreign (including Russian) technology, through both legal and illegal means, than the Russian or Soviet arms sectors could ever manage.” (Farley, 2017). Thus, the continuous drive to expand absorptive capacity will result in exponential Chinese DTIS modernisation and growth, especially if the State funding levels are maintained and export client list continuously expands.

China’s increased defence spending will positively impact international defence sector growth from 2018 for at least the medium-term. (Gates, *et al*., 2016). The obvious Chinese DTIS growth drivers are technology and products. The Chinese military has been tasked by the Chinese Government to focus on accelerated development of intelligence-related technology and AI. (Kim, 2018: 2). China is seeking to grow its industrial capabilities in the stealth fighter aircraft, aircraft carrier and anti-satellite missile sub-sectors of the defence market. This expansion is grounded in the Chinese ambition to establish an innovative, self-sufficient DTIS. The future will see considerable interest in - “… western assets, as emerging suppliers in China […] look to acquire and integrate the production systems, quality systems, processes and capabilities required to build to western

standards." (Gates, *et al*., 2016: 18). These ambitions correspond to the continuous focus by the Chinese DTIS on stealth and counter-stealth-, quantum radar-, cyber-, artificial intelligence-, and anti-satellite capability technology domains. (Haas, 2019: 39-40). These technology development focus areas have the potential for R&D collaboration on a bilateral level with the SA DTIS, in particular, research institutes such as the CSIR.

All of the above enables China to increase its competitiveness and thus continuously increase its market share with new clients. Some of these Saudi Arabia, Philippines, Morocco, Venezuela, Ecuador, Thailand, Peru, Mexico, Indonesia, Nigeria, Kenya and Turkmenistan. (Raska, 2017: 59). Having discussed the most important parts of the Chinese DTIS landscape, let us consider what strategic business levers the Chinese DTIS are favouring for potential DTIS growth.

3.6.2 Chinese DTIS Strategic Business Approaches and Levers

Defence-industrial autonomy remains a key facet of China's industrial security, despite its less critical post-Cold War security situation (Boutin, 2017: 40).

China has identified two significant gaps that require strategic attention. These are a comparative PLA capability backwardness and a perceived inability of the PLA to keep up with the shifting strategic requirements of China. (Raska, 2017). China also recognised that a modern DTIS is a strategic requirement for the PLA to remain relevant within the Chinese national interest. (Raska, 2017). Positioned to address these issues is the State Administration of Science, Technology and Industry for National Defense (SASTIND), currently the Chinese governmental agency for DTIS since *circa* mid-2015. (Gady, 2015). Reportedly, SASTIND represents a truly joint governmental initiative that underscores the importance of an integrated approach to the development of the Chinese DTIS. SASTIND is constructed around government agencies experts of several and various – "… public institutions including the Chinese Academy of Sciences, Chinese Academy of Engineering, the National Development and Reform Commission, Ministry of Education, Ministry of Science and Technology, Ministry of Finance and the PLA General Armaments Department." (Gady, 2015). This initiative is aimed at the strategic development of the Chinese DTIS, specific focus on technological innovation, in the Chinese quest to equal (self-sufficiency) or better (domination) the Western counterparts. Two strategic objectives for the development of the Chinese DTIS that should be noted and that would inform DTIS policy and the possible strategic business levers that will be allowed are -

- "[T]o catch up with the global military-technological state-of-the-art base by fostering indigenous innovation, mitigate foreign dependencies on technological transfers and arms imports, while leveraging civil-military integration to overcome entrenched barriers to innovation;" (Ji, 2016 in Raska, 2017: 56).
- "Beijing has specifically tasked the People's Liberation Army (PLA) to complete military reform and modernization by 2035 and to become a world-class military by 2050" (Kim, 2018: 1) that would be able to respond to national security issues. (Ji, 2016 in Raska, 2017 and Kim, 2018).

The achievement of these objectives as well as the massive strides towards stepping onto the last level of the "Ladder of Production" are greatly facilitated by funding increases for R&D, strategic leadership gate-keeping and higher levels of advanced foreign technology absorption capacity. (Gady, 2015).

There seems to be a broad agreement with the fact that China is investing extensively in its DTIS. Similar consensus exists that China is gradually improving on the quality of its military products, which seem to indicate that China is serious about its ascension to the position of a superpower. (Bitzinger & Popescu, 2017; Raska, 2017; Johnson, 2018; Maiti, 2018). However, the Chinese DTIS are self-sufficient in supplying the quantities as required by the PLA but still falls short of comparative (Western) quality objectives and standards. (Boutin, 2017; Raska, 2017). This self-sufficiency without technological progress traps the Chinese DTIS in dependency on foreign R&D and original technology. Although the State-control of the Chinese DTIS capabilities remains a Chinese national interest (autarkic policy objective); China also has a national interest in restructuring the Chinese DTIS to be able to fill the strategic gaps alluded to above.

The restructuring of the Chinese DTIS aims at transforming it into a State-controlled (autarkic), but liberalised strategic capability that incorporates aspects of - "… self-management, corporatisation, and commercialisation (or marketisation). [State-owned Enterprises] are encouraged to be proactive and have been granted greater operational autonomy, including in terms of developing collaborative arrangements with other enterprises. Corporatisation involves the progressive consolidation of SOEs into larger, more capable conglomerates." (Boutin, 2017: 41). Thus, the level of State-control will determine the position of the Chinese DTIS between liberal and hybrid DTIS policy. Raska (2017: 56) phrase this objective as "civil and military convergence" which became popularly known as "*Yujun Yumin*" or "[co-] locating military potential in civilian capabilities" - "… signifying the transfer of commercial technologies to military use, and calling upon the Chinese arms industry not only to develop dual-use technologies, but also actively promote joint civil-military technology cooperation." (Raska, 2017: 57). This introduces significant space in the Chinese DTIS ecology for joint venturing.

The intention of the Chinese Government is to create business space for collaboration between the DTIS and commercial industries in the quest to modernise the PLA. (Kim, 2018) The initiative is labelled - "civil-military fusion" and is distinctly linked to the "Made in China 2025 initiative to transform China into a self-sufficient technological powerhouse." (Kim, 2018: 2). This is very similar to initiatives by South Africa in terms of SA Inc. and those of India (Made in India). What should not be missed in the label 'Made in China 2025' is the short- to medium term timeline included. This signifies the small window of opportunity left to the SA DTIS to establish a role in the Chinese DTIS supply chains; even smaller than the Indian timelines stated earlier by Behera (2016) – "… by 2027 the Indian DTIS must be 70% self-reliant".

These DTIS policy objectives have been formalised in the various plans, but significantly, in the Medium and Long-term Defence Science and Technology Development Plan 2006-2020 – note the very imminent end-target date. It is envisioned to create and establish linkages and collaboration

amongst the Chinese DTIS and commercial (public) advanced technology R&D sectors. (Raska, 2017: 57). This confirms an internal focus on integration and collaboration as a recognised critical success factor for the Chinese DTIS. This internal focus will have a significant crowding-out effect for the SA DTIS to contend with.

Business levers that are currently promoted to be used by the Chinese DTIS, with which to facilitate the climbing of the "Ladder of Production" are - "… self-management, corporatisation, and commercialisation (or marketisation). SOEs are encouraged to be proactive and have been granted greater operational autonomy, including in terms of developing collaborative arrangements with other enterprises. Corporatisation involves the progressive consolidation of SOEs into larger, more capable conglomerates. China's [DTIS] is now dominated by ten conglomerates, including the Aviation Industry Corporation of China (AVIC) and China North Industries Corporation (NORINCO). The [DTIS] is being commercialised through the selective introduction of market mechanisms, with SOEs expected to be more efficient and competitive." (Boutin, 2017: 41). This corporatisation is supported by national policy labelled Civil-Military Industrial cooperation.

There is a call for more integrated Civilian-Military Industrial cooperation. Thus, CMI was adopted by the Central Commission (2018) with a plan for the construction of innovation demonstration zones in support of CMI. (Legarda & Nouwens, 2018). Civil-military integration (CMI) [also called civil-military fusion (Kim, 2018: 2)] industrial strategy for China (domestically known as *Yujun Yumin*) is categorised as of national strategic importance and thus in the national interest. CMI is also strategically associated with Chinese economic and geostrategic interests. (Raska, 2017).

Over and above the centralised State support for the Chinese DTIS, CMI as an industrial strategy aims to expand the scope of SOE R&D and production integration with other State Council agencies, universities and private industries in support of the modernisation of the PLA as well as Chinese economic development. (Legarda & Nouwens, 2018; Levesque & Stokes, 2016 in Raska, 2017: 57). The Chinese military Commander-in-Chief (Xi Jinping) is the gate-keeper for this Chinese DTIS reform initiative. There is a mantra circulating that prompt the Chinese DTIS to – "… to develop a military-industrial complex like the one in the U.S. […] where the private sector and the invisible hand assume the leading role." (Yang, 2017). In order to achieve CMI objectives, China DTIS adopted an initiative labelled *Hungai*, or mixed-ownership reform (MOR). (Yang, 2017).

MOR is positioned by the Chinese Government to provide solutions to perceived challenges resulting from wholly- or partially state-owned SOE. Some of these challenges are perceived to be associated with - "… soft budget constraints and shielded from competition, it is not a surprise that inefficiency, lack of innovation in certain areas, and mounting debt". (Yang, 2017). The MOR objective is to integrate operations, finance and expertise from the private sector into these SOE, thus relieving pressure on State coffers and accessing new expertise and thinking to drive innovation. There is also the importance of integrating the dynamics of market forces into the, up to now, shielded Chinese DTIS. These broad objectives place emphasis on a mixed-ownership business model for the future Chinese DTIS. (Yang, 2017). By introducing this kind of reform the Chinese DTIS is moving away

from an autarkic approach its DTIS and more towards a hybrid approach. A hybrid or liberal approach to the DTIS is more favourable from a SA DTIS perspective.

The MOR programme has at least three primary methods for implementation – (1) securitising assets for the purpose of raising funds; (2) stock options for employees; and (3) public-private partnerships. (Yang, 2017). The securitisation of State assets (in the form of research institutes and other national security concerns) will prove to be difficult from a national security perspective. (Yang, 2017). Thus the autarky giant raises his innovation stifling head. This is an age-old problem and mindset commonly found in the DTIS internationally. The third primary initiative – public-private partnerships (PPP) – aims at CMI to "…reduce technological redundancy and accelerate the exchange of dual-use technology". (Yang, 2017). The PPP initiatives will incorporate what is conceived as "defence conversion" and contracting commercial business. In support of this effort the PLA declassified in March 2017 in excess of 3000 dual-use technology patents and released most of these into the public domain to incentivise innovation and "defence conversion" (Yang, 2017), 4 038 military patents were declassified according to Legarda and Nouwens (2018), "[r]egistered within the previous three years, they were deemed especially conducive to civilian-military cross-pollination, in sectors including materials, measurement and testing, radar detection, and telecommunication technologies." (Legarda & Nouwens, 2018).

This all sounds very promising, however, the realities of underperformance of securitised assets, negative debt-to-asset ratios and less than the positive return on equity are but some of the issues that are hampering the MOR success. (Yang, 2017). This will weaken commercial investment confidence in the sector significantly. On the other hand, the declassification of dual-use IP unlocks possible opportunity for the SA DTIS to collaborate bilaterally to ensure some of these technologies across the virtual and ever-present chasm dividing design-development phases and manufacturing.

Several Chinese DTIS related strategic planning documents ("'13th Defence Science and Technology (S&T) and Industry Five-Year Plan'; '2025 Defence Science and Technology Industry Plan'; 'Made in China 2025' advanced manufacturing plan and the 2015 China Military Strategy") identify dual-use technology and material and knowledge in the international community; the acquisition thereof is prescribed by the CMI as of national strategic importance. (Raska, 2017: 57).

The Chinese DTIS still only have limited advanced defence-related R&D and innovation capabilities (Bitzinger & Popescu, 2017: 4), compared to the West. This, obviously, complicates the Chinese goal to compete militarily with superpowers such as the US and Russia. It also becomes very complex when consideration is allocated to the Chinese ambition of self-sufficiency in the entire PLA armament requirement. (Boutin, 2017). For example, - AVIC, as China's 2nd largest defence industry, is also the largest supplier of PLA matériel (air and naval), yet lack critical innovative capacity. (Nouwens & Béraud-Sudreau, 2018). China wants to overcome some of these national R&D limitations with the indigenisation of innovative capacity - "…China aims to circumvent the costs of research, overcome international political constraints and technological disadvantages, and 'leapfrog' China's defence industry by leveraging the creativity of other nations. This includes exploitation of

open sources, technology transfer and joint research, the return of Western-trained Chinese students, and, of course, industrial espionage, both in its traditional form (human intelligence) and, increasingly, cyber-espionage [and foreign company acquisitions]." (Lindsay & Cheung, 2015; Raska, 2017; Woo, 2018; Nouwens & Béraud-Sudreau, 2018).

Concerning the commercial practice of technology transfer; international companies that would like to enter the domestic Chinese market space are faced with the requirement to establish production infrastructure in China. This will obviously have to be accompanied by process knowledge transfer. Joint ventures with a Chinese SOE or private companies is a typical strategic business lever with which the establishment of such infrastructure can be facilitated. When established, such infrastructure, process and technology transfer will develop into a major competitor in a particular market. (Woo, 2018: 650). This is obviously problematic for any Government/industry/company that enter the Chinese DTIS with its process/technology niches because that same niches might in future compete with the originator in other markets if care is not taken with the original JV agreements and contracting regarding competitive marketing in traditional markets. Conversely, using JVs as a strategic business lever could provide new access to markets previously inaccessible, especially a market with the scope and capacity of China. Such JVs (liberal DTIS policy approach) breach industrial capability and innovation weaknesses to unlock long-term security of supply and leapfrogging design-development hurdles. Business trust plays a large role to enter such markets. Mutual beneficiation is also a coveted prize.

China's economic success is fuelling its DTIS to innovate and become more efficient and increasingly and progressively incorporate dual-use technology into the Chinese defence product supply chain (Farley, 2017; Raska, 2017), for example, Lenovo and Huawei (Boutin, 2017). This process of import substitution already started as far back as the 1960s with the Chinese political cessation with the Soviet Union. (Boutin, 2017). Because the dual-use technology is situated in the private industry there is an increasing focus on joint venturing (domestically and internationally) to integrate these technology portfolios into the traditional State-owned, military focussed industries. However, because of the lack of transparency and abuses of IPR by China, international collaboration assumes a precarious deportment. For example, Russia is increasingly less interested too - "… deepen its defence ties with China now, Russia would become a subcontractor of the Chinese military-industrial complex – something Moscow is keen to avoid." (Gressel, 2017: 35). When superpowers become sceptical of the advantages to be gained from the collaboration with China – then emerging economies such as South Africa should be very cautious.

Strategic business levers that will be employed to stimulate Chinese DTIS development is the encouragement of strategic partnerships between defence and the commercial sector and technology transfer. (Raska, 2017; Lineberger & Hussain, 2018b), without jeopardising State-control of national industrial assets (Boutin, 2017). Thus, by seeking defence-industrial self-sufficiency (Boutin, 2017) and combining it with instruments such as JVs (Boutin, 2017; Lineberger & Hussain, 2018b) culminate in nothing more than a hybrid approach to defence industrial relations. The approach is used to bolster

the lack of quality in military product lines by accessing foreign Original Equipment Manufacturers' (OEM) R&D capabilities in order to develop and grow indigenous Chinese DTIS capabilities that would assure Chinese DTIS production autonomy. (Boutin, 2017).

Commensurately, China also lowered some barriers to attract FDI. Foreign investors can now (2018) invest in free trade zones by means of 100% owned businesses of various types of design, manufacturing and repair capabilities. China also expanded the range of investment activities possible for prospective foreign investors in the aircraft industrial segment. (Lineberger & Hussain, 2018b). These could open the door for M&As.

3.7 FINDINGS AND CONCLUSIONS

The SA DTIS finds itself amidst a small group of very strong DTIS growth States, the BRIC States. The strongest BRIC growth States (Russia, India and China) provide scope for the SA DTIS growth if the SA DTIS can identify possible roles it could play within the expanding defence markets as well as identify prudent strategic business levers that fit the strategic business environment.

Realistically, opportunities can only be exploited if the BRICS partner States share certain characteristics and interests. As such, all the BRICS states currently exhibits aspects of an idealistic approach to DTIS policy, i.e. DTIS sustainability is linked to economic development without alienating the DTIS position as an adjunct for national militaries. Another characteristic that finds commonality amongst the BRICS States is that all they have adopted some form and measure of a liberal approach to DTIS policy. Most DTISs still protect their niche technologies as 'crown jewels'. This combined with liberal levers such as JVs, FDI and M&A probably position the entire BRICS group in a hybrid DTIS policy approach. These approach and policy commonalities provide the foundation for possible bilateral DTIS collaboration between the SA DTIS and other BRIC DTISs. Other characteristics that are shared by the BRICS States are also generally found amongst the international community, which could be perceived as enablers for future DTIS collaboration are (at least) –

- A strong reliance on Government as an investor, planner, customer, industry supporter and regulator. This positions G-to-G collaboration probably as the favoured channel with which to initiate bilateral collaboration.
- A common view that the DTIS is an integral part of their national defence capability and thus a primary instrument in foreign policy and national security. Therefore, the strong focus on modernising the national militaries directly affect the development of the DTIS. This creates favourable conditions for possible collaboration between the SA DTIS and BRICS DTIS.
- Significant efforts are afoot to modernise and keep national DTISs relevant in the 21st century by India, Russia, China and to a much lesser extent, South Africa. These modernisation ambitions and programmes are forcing traditional autarkic DTISs (e.g. Russia, China and South Africa) to adopt more hybrid approaches in support of DTIS development and growth. The hybridisation (and liberalising) of DTISs is very favourable for DTIS collaboration, especially if a particular DTIS has niche technology, processes or products to offer. As such, all the BRICS States promote the use

of JVs, technology transfer, FDI and M&A increasingly on the back of the understanding that they require access to new technologies and knowledge to be able to climb the "Ladder of Production" in leaps and bounds. The quest for self-sufficiency/dominance probably limits the use of M&A.

- All DTISs share the ambition to be self-sufficient. Some are ambitious to be dominant also. This provides short- to medium-term opportunities for the SA DTIS capabilities that can provide such niche technology and knowledge in support of the self-sufficiency ambitions.
- All DTISs have some or several Tier 1 technology and/or industrial capabilities complemented by (in some case) a plethora of Tier 2 and 3 capabilities. Again, the Tier 1 SA DTIS technology, knowledge and products provide opportunities for the SA DTIS to lever those into the international supply chains of the BRIC States that seeks them.
- The use of bilateral collaboration is promoted through the use of strategic business levers. The preference for bilateralism is probably based on the discretionary and securitised nature of defence business relations.
- Mergers and acquisition are used as a strategic business lever where States allows such activities.

Enablers that might result in selective collaboration between the BRICS States are -

- There are at least two groups of markets – those that have traditional linkages with European and USA markets (SA, India and Brazil) and those that do not/extremely little (China and Russia).
- There are two groups that support arms control as an international rule-based mechanism with which to govern unwanted proliferation. From a dual-use arms control perspective, the Wassenaar Arrangement – SA, India and Russia ratified that prescripts; China and Brazil are not signatories to the agreement. The researcher acknowledges the fact that there are several other arms control regimes. However, because there is such a large movement towards military/dual-use technology integration the Wassenaar Arrangement is of particular relevance.
- Respect for IPR will probably affect the decision to collaborate significantly. As such, the Chinese record regarding the abuse of IPR does not make China a favourable bilateral partner.

A vast dissimilarity that exists between at least South Africa and India, China and Russia is in terms of relative strength as per Womack's (2004 & 2006) theory of asymmetry. The technology niches once maintained by the SA DTIS have been surpassed by newer technology and thus provide very limited buffer capacity against the negative effects of asymmetry on competitive/comparative advantage within the BRICS alliance. The asymmetry is perpetually getting worse due to the poor funding for the SA military and DTIS and hence gradually erodes South Africa's ability to contribute meaningfully to bilateral defence technology and industrial collaboration with the BRIC States.

Another dissimilarity that exists between at least South Africa and India, China and Russia is in terms of the development path (ascending/descending the "Ladder of Production") in the quest for self-sufficiency and possibly domination. India, China and to a lesser extent Russia is rapidly ascending the "Ladder of Production" with targets to reach self-sufficiency ranging from 2025 onwards. Conversely, the SA DTIS is currently facing prospects of reversed development cycles as was

conceptually proposed in Chapter 2 of the thesis in the Conceptual Framework. This regression is the result of (amongst issues of corruption, poor management, State capture) the financial decline illustrated in Figure 1.3.; resulting in diminished capacities to invest in R&D, intellectual capital retention, DTIS infrastructure renewal and expansion. These negative market conditions drive the erosion of the national security defence capability and gradually increases national security risk because of the increased exposure to reliance on foreign defence matériel suppliers of technology, equipment, software, logistics, and maintenance and repair capabilities. Combined with the market conditions set by the 4th IR the SA DTIS are hyper-exposed to continuous job losses and highly skilled engineering and technical labour churn - both within the South African industrial labour market, but more concerning, into the international market). These dynamics severely hamper the development of the SA DITS as a possible preferred bilateral partner to the BRIC DTISs. The risk currently is being relegated to being a defence matériel client State rather than an integral and important part of the international (at least the BRICS) defence technology and industrial supply chains.

A similarity that results in crowding-out effects is the self-sufficiency programmes of various BRICS State – South Africa (SA Inc.), India (Make in India) and China (Made in China). These programmes focus distinctly on internal (domestic) collaboration and development as a first priority.

Another barrier to possible collaboration between the SA DTIS and those of BRIC are international travel regulations between the different countries. Geographically, the BRICS economic alliance is not geographically co-located (such as e.g. the SADC economic alliance and region). This makes free travel across borders a little bit more complex. Without Government intervention to de-bureaucratise travel and trade-related regulations for the DTIS (within the parameters of arms control) the development of successful JVs could be severely hampered or not viable at all. For South Africa, these bureaucratic barriers are compounded by B-BBEE requirements that is a strong barrier for small Indian companies to enter the South African market who cannot surrender a share of their company to a South African counterpart.

Then there is the small window of opportunities identified in the discussion above for role establishment in the DTIS supply chains of China (2025 self-sufficiency target) and India (2027 the target for 70% self-sufficiency). This leaves the SA DTIS with only short- to medium-term windows, which is problematic considering the current state of the South African economy and its DTIS. With these introductory findings lets us consider four questions that could be asked (based on the SRQ for the thesis) and were posed to the participants in Chapter 5 of the thesis.

3.7.1.1 **What role can the SA DTIS play in the BRICS defence technology and industrial sector?**

Over and above the enablers and barriers mentioned above, at least two groupings emerged from the case study – Brazil and India; and Russia and China. A possible SA DTIS role in the DTIS-related supply chains of Brazil and India seem to be the most plausible for the following reasons –

- The least amount of asymmetry present, specifically Brazil.

- Have a certain level of DTIS collaboration between the SA DTIS and Brazil and India, even if it is just as an export client.
- An overlap of DTIS market-related linkages with at least the USA, UK, France, Sweden and Italy (See Table 3.4 and 3.5 below).
- There does not seem to be an excessive risk of IPR abuses.
- Overlaps in Western military technologies and products
- The existence of the IBSA tri-lateral defence forum which facilitates defence cooperation, exercises and possibly technology exchanges.

A possible SA DTIS role in the DTIS-related supply chains of Russia and China seem to be less favourable for the following reasons –

- High levels of asymmetry between the SA DTIS and those of Russia and China.
- Very little (possibly none) historical DTIS collaboration.
- Very little (possibly none) historical DTIS export/import activity – driven by the fact that the SA military has a traditional Western-based technology ORBAT.
- Virtually no overlap of traditional UK, European, Scandinavian and/or USA market-related linkages.
- Strong drive to become self-sufficient and dominate combined with strong negative records of IPR abuses makes at least the Chinese DTIS predatory.
- Strong drive to become self-sufficient and dominate combined with a strong focus on exporting Russian defence matériel make Russia less than ideal as a bilateral DTIS partner.
- Within BRICS - both China and Russia dominate in several Tier 1 defence technology and industrial capabilities already and produce virtually the entire portfolio of defence matériel and services for their militaries and several of their clients. This has a significant crowding-out effect for any inward FDI and JVs. Initial JVs between the SA DTIS and Russia/China will render some short- to medium-term supply chain engagements but will in the long term probably lead to the SA DTIS becoming just another customer or entirely crowded out of the defence market.

So, the SA DTIS could possibly play a role as a technology and/or production partner within the DTIS-related supply chains of Brazil (short- to long-term) and India (short- to medium-term). There is possibly more scope to a more dominant SA DTIS role within any SA/Brazil DTIS collaboration. The SA DTIS still have (at least in the short- to medium term) competitive/comparative advantage in a number of technologies and products – e.g. combat vehicles, mine-protection technology, long-range artillery, ammunition, UAVs, a select portfolio of missiles, attack helicopter, etc. Brazil, on the other hand, has a strong focus on aerostructures and has strong linkages with Sweden in this regard. This linkage is shared by South Africa through at least the Gripen fighter aircraft club. The SA DTIS can play a significant role in India (in the short- to medium term) as a development partner for artillery systems, vehicles, mine protection, a very select portfolio of missiles, UAVs, etc. However, it will be very difficult to penetrate market segments already established by foreign DTIS such as those of

France, the UK and the USA. India, however, seeks more independence from Russia, which might provide short-term opportunities for the SA DTIS to collaborate with India. In the same vein, the UK/European and USA DTISs are monitoring the same Indian DTIS opportunities for exploitation. With the SA DTIS in its current state of disrepair competing with European and USA DTISs for these opportunities is almost unrealistic. The Western economies are also in a much stronger position to accommodate the offset requirements of India. Also, geopolitically, the NATO countries are motivated to penetrate the India market in order to crowd the Russian and Chinese initiatives out of the region. South Africa has no such ambition. The SA DTIS will also lose any ability to be a plausible/valuable DTIS partner (medium- to long-term) if the current erosionary funding conditions for the SA military and DTIS is continued. Last, and very importantly, several key South African policy documents express a preference for collaboration with the African States – not with the BRIC States. This might be based on the asymmetry in the South African-BRIC relationship and/or the complexity of managing such relationships with countries known to be devious industrial empire builders, such as China. It could also simply be that the SA DTIS has slipped too far down the proverbial "Ladder of Production" that the BRIC States are no longer interested in cooperation. This would be a strong position to take as the SA DTIS still owns and develops niche technologies, at Tier 1 and 2 level, in a small number of companies.

3.7.1.2 If these roles are considered plausible, based on the discussion in Chapters 2 and 3 of the thesis, then what would be the preferred type of strategic cooperation – bilateral or multilateral, and why?

The preferred level of inclusion articulated by various documents and authors is probably bilateral in nature. Although the BRICS States do not share borders or even geographic regions, care should be taken by the SA DTIS when cooperating bilaterally with the BRIC States about getting drawn into regional conflicts (e.g. China-Taiwan, Russia-Syria, India-Pakistan) based on the bilateral DTIS cooperation. As such, Brazil is not embroiled in any regional or other conflicts. It is for this reason that the involvement of the South Africa Government (i.e. departments such as DIRCO, DST and DTI) in setting up these bilateral cooperative agreements remain paramount from a national strategic perspective. It also highlights the importance of the SA Inc. approach.

From the discussion above, the following is a list that summarises the DTIS market coincidence between the SA DTIS and the BRIC States, which provide some insight as to the possibility for bilateralism based on shared DTIS markets -

Table 3.4: Table of Various BRICS Markets and Overlaps (non-exhaustive list)

BRIC States	BRIC Markets	BRICS Shared DTIS Markets - Opportunities for multilateral relations	SA Shared Markets – Opportunities for bilateral relations	SA Markets
Brazil	Malaysia, USA Indonesia	Indonesia	Malaysia USA	Brazil India Malaysia UK
Russia	India, Several African States	Vietnam	India	

	Vietnam China		Some African States	UAE Algeria Tanzania Nigeria Peru Several NATO Countries (RDM ammunition) Sweden USA Germany Italy Oman Pakistan Switzerland Columbia Romania Australia
India	UAE, UK, Belgium, Sweden Kenya, Vietnam, Philippines Russia, Bhutan, Ethiopia, Israel, Taiwan, Nepal Mauritius, Myanmar	Kenya Vietnam Philippines	UAE UK Belgium Sweden	
China	Thailand, Peru, Saudi Arabia, Nigeria Kenya, Philippines Indonesia Zimbabwe, Morocco Turkmenistan, Mexico, Venezuela Ecuador	Kenya Philippines Indonesia	Thailand Peru Saudi Arabia Nigeria	

*No attempt was made by this research to provide an exhaustive list of markets.

The *SA Shared Markets – Opportunities for bilateral relations* column indicate countries that could present opportunities for bilateralism between SA DTIS and BRIC DTISs to collaborate on the requirements for the foreign markets listed in the column. However, the discretionary nature of defence contracting is a severely limiting factor that would calibrate the potential for success of such initiatives.

The SA DTIS is only active in a limited number of countries based on the limited research into BRICS markets in this thesis. It is evident that the BRICs States do not have much in common from a market share perspective. This position the SA DTIS better for DTIS collaboration in a wide variety of countries outside the traditional SA DTIS market segments. Bilateral strategic business levers are probably the most suited for such collaboration to ensure discretion, IPR protection, and mutual beneficiation. Another reason for bilateralism as a preference is that there is existing bilateralism between some of the BRICS States already (i.e. SA-Brazil; China-Russia, India-Russia, SA-India) which complicates the establishment of multilateral BRICS DTIS collaboration of substance. The following table provides a sample of comparative data (non-exhaustive), from the secondary data used in Chapters 2 and 3 of the thesis, about BRICS bilateral collaboration with other nations –

Table 3.5. Comparison of Technology and Industrial Focus Areas (non-exhaustive list)

Complementarity	South Africa	Brazil	Russia	India	China
UK (BAE Systems)	X				
France-German (EADS)	X				
Rheinmetall (Germany)	X				
Sweden (SAAB)	X	X		X	
France (THALES)	X			X	
France (Turbomeca)	X				
Germany (Zeiss Optronics)	X				
France (DCNS)		X			
Italy (IVECO)		X			
Italy (Otomelara)		X			
Singapore (ST Kinetics)		X			

USA (Air Force)		X			
France (Dassault)				X	
France (Airbus Helicopters)				X	
USA (Boeing)				X	
Denmark (Terma A/S)				X	
USA (Lockheed Martin)				X	
Germany (RUAG Aviation)				X	
Israel (Elta)				X	
France (Segnere SAS)				X	
South Korea (LIG NEX)				X	
France (Raphael Advanced Systems)				X	
Israel (Isreal Aerospace Systems)				X	
South Korea (Samsung Techwinwon)				X	
UK, France, Italy (MBDA)				X	
Spain (SIPAL S.P.A)				X	
UK (Rolce Royce)				X	
Italy (Augusta Westland)				X	
Israel (Elbit)				X	

*No attempt was made by this research to provide an exhaustive list of bilateral engagements.

Corresponding to the limited market share amongst the BRICS States, the list above illustrates the extremely limited overlap in bilateral collaboration between the BRICS DTISs and the rest of the world. What it does show is the significant involvement of European DTISs in the SA-, Brazil- and India DTISs as was stated earlier. This possibly significantly affect the establishment of bilateral collaborations between the various BRICS States because of crowding-out effects.

3.7.1.3 Within the context of proposed bilateral relationships, which strategic business levers would be prudent for consideration to establish future bilateral defence technology and industrial partnerships between South Africa and the BRIC States?

The application of strategic business levers is highly contextual, dependent on a complex array of business factors. Much of this context was stated above. The use of strategic business levers is prevalent amongst the BRICS States, aiming at stimulation defence technology and industrial development to climb the "Ladder of Production" with vigour. These are concerned with reducing entry barriers to collaboration and development, encouraging industrial participation, investment and technology transfer stimulation, providing control and access guarantees for IPR and capabilities coupled to sovereign military and industrial capabilities.

There is limited evidence of a preference for M&A as a DTIS strategy amongst the BRICs countries – probably calibrated by the strong desire of the BRICS States for self-sufficiency and even dominance in defence technology and industrialisation. There is strong evidence of liberal/hybrid approaches to DTIS policies amongst all BRICS States, facilitating flexibility to allow for technological and industrial cooperation by means of JVs and FDI as examples of strategic business levers. These seem to be the primary vehicles (other than direct import and export) to acquire innovation renewal, to establishing new DTIS capabilities with and to support the foreign policy as well as military objectives and agility. There is strong evidence to suggest that the BRICS countries guard their traditional DTIS markets as a matter of national interest (from an idealist and realist perspective). There is also strong

evidence that the BRICS countries use their Governments to a lesser (SA and Brazil) or significant (China, Russia and India) extent in the quest for DTIS self-sufficiency. This probably makes G-to-G bilateral collaboration the most preferable channel for DTIS development initiatives. From a theoretical perspective, the following table is an approximation of which strategic business levers fit which role of government within the DTIS -

Table 3.6: Table of an Approximation of Which Strategic Business Levers Fit which Role of Government within the DTIS

Role		Lever	Example	Focus
Government as Investor	Facilitating Market Penetration & Attractiveness	Investment Levers Capability Levers	FDI (e.g. Defence Industry Fund)	R&D, Technology development, innovation, DTIS infrastructure development & maintenance, supply-chain integration and dominance
Government as Planner		Capability Levers	JV, M&A, Technology Transfer	
Government as Customer		Capability Levers	JV, M&A, Technology Transfer	
Government as Supporter of Industry	Determining Approach (Autarky, Liberal, Hybrid)	Investment Levers Political Levers Administrative Levers	FDI (Defence Industry Fund, Defence Budgets) Offsets (Foreign Policy Trade Policy)	
Government as Regulator of Industry		Political Levers Administrative Levers	Arms Control IPR regimes	

Note should be taken that the motive for using JVs as a strategic business lever within the context of a liberal/hybrid DTIS policy approach strives to achieve advanced and accelerated levels of development (discussed in Chapter 2 of the thesis) to unlock competitive/comparative advantage sooner than would be possible without international collaboration. At the same time, strategic business levers also lock collaborators into an interdependent supply chain relationship that diminish the level of self-sufficiency attainable.

3.7.1.4 **From the context provided by Chapters 2 and 3 of the thesis, what is the market niches/capabilities/products/services/technology/IP that the South African defence technology and industrial sector can contribute to establishing/enhance possible role(s) in the BRICS defence technology and industrial capability?**

The broad SA DTIS capability focus areas are summarised in the following table distilled from the discussion in this chapter –

- Command and control.
- Information warfare and cyber defence.
- Secure communications.
- IT, including data fusion.
- Intelligence-gathering sensor, analysis and evaluation.
- Target acquisition and identification.
- Radar (synthetic aperture radar).

- Unmanned systems (aerial, ground, surface and under-water).
- Missile and wider guided munitions.
- Night and poor visibility observation and engagement.
- EW.
- Tactical vehicles optimised for operations in the African theatre.
- Mine and IED detection and protection.
- Long-range artillery, precision bombardment and point target engagement systems.
- CBR defence, including the manufacture of military carbons and canisters.
- Battlefield medical care optimised for the African theatre.
- Modelling, simulation and stimulation.
- Test facilities and ranges.
- Additive manufacturing (e.g. 3D printing).
- Materials.

The SA DTIS technology and product development for the African market are probably based on unrealistic expectations. This opinion is from the perspective that the SA DTIS's ambition to penetrate a traditional and more-and-more Russian and Chinese markets is possibly misplaced considering the current South African economic and related DTIS disposition. Even the role for the SA DTIS to become an MRO agent for Russian and Chinese defence systems in Africa is probably a bridge too far. The Russians and Chinese DTISs generally do MRO (when required) themselves or provide just more of their surplus to keep their client-base locked in.

The opportunity could be locked up in dual-use products design, develop and manufacturing industries**.** These might be particularly attractive within a SA DTIS bilateral context because of less government control and regulation but with the added benefit that they are sometimes reasonably integrated with MOTS industries.

Dual-use infrastructure (such as test ranges and port facilities and infrastructure) is another primary resource that could be leveraged by South Africa. However, South Africa will probably be on the receiving end of development because of the strategic nature of some of its seaports (e.g. Richardsbay, Cape Town and Saldanha harbours). This could also prove advantageous to the South African shipbuilding industry such as Paramount Maritime (mostly dual-use in nature as this juncture). South Africa has some uniques test ranges (e.g. Alkantpan for artillery and the OTR for missiles) that could prove useful to missile developers such as Russia, China and India (risking significant negative foreign policy sanction from the West in the case of Russia and China).

The SA DTIS will thus have to employ a select combination of political-, investment-, trade-, administrative- and capability strategic business levers for each of the BRIC States. The selection will be calibrated by foreign- and trade policy, arms control requirements and the levels of risk attached to issues of IPR protection. From the embedded case study, it is evident that the establishment of bilateral DTIS cooperation would be the preferred relationships, probably based on the security and discretion required for national security concerns. The strategic business levers of choice would seem to be the establishment of JVs within which technology transfer can take place as well as joint design, development and manufacture of product systems. Under the current economic conditions, South

Africa would be hard-pressed to promote FDI. However, the SA DTIS might attract FDI which could assist with the development of the SA DTIS but will increase dependency on foreign DTISs. Although not entirely excluded, there seems to be a lesser preference for M&A because of its influence on control, ownership and decision-making. Mergers and acquisitions of DTIS capabilities will typically favour the State that has control and/or ownership and thus also that State's quest for domination. It also strips the other State from DTIS capability that may be a requirement to become self-sufficient – self-sufficiency being distinctly linked to foreign policy leverage and national security objectives. The SA DTIS still has some competitive/comparative advantage (at least the short- to medium term) in long-range artillery systems and ammunition, a select portfolio of missiles and UAVs, combat vehicles systems and mine protection, some unique test ranges.

3.8 EXPECTATION FOR THE NEXT CHAPTER

Chapter 4 discuss and describe the research methodology used for this thesis. It discusses the research philosophy, design and approach and the contextual factors that calibrated the choice of these. It provides insight into the reasoning for the document analysis used in this chapter whilst setting the tone for the research and analysis that follow in Chapter 5.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 RESEARCH PHILOSOPHY, METHODOLOGY, DESIGN AND METHODS

Research philosophies or paradigms, methodologies, design and methods are summarised very succinctly in Ngulube (2015) and Na (2015). Based on their work, an outline of the research philosophy selected for this thesis is discussed henceforth. The philosophical assumptions about the nature of knowledge are captured by ontology and epistemology. (Ngulube, 2015). "[O]ntology is the philosophical assumptions about the nature of reality", or stated differently, the worldview of the researcher (Easterby-Smith, Thorpe & Jackson, 2012; Saunders, Lewis & Thornhill, 2009 in Na, 2015: 58). It specifically elaborates on the researcher's disposition towards being subjective or objective. (Saunders, *et al*., 2009). Social reality, based on ontology, can thus be separated into the following ontological categories -

Figure 4.1: Ontological Research Assumptions

ONTOLOGY	REALISM	INTERNAL REALISM	RELATIVISM	NOMINALISM
Truth [Subjective (Sanders, *et al*, 2009)]	Single truth	Truth exists but is obscure	There are many 'truths'	There is no truth
Facts [Objective (Sanders, *et al*, 2009)]	Facts exist and can be revealed	Facts are concrete but cannot be accessed directly	Facts depend on the observer's viewpoint	Facts are all human creations

Source: Adapted from Easterby-Smith, *et al*. (2012) in Na (2015: 29).

There are many and varied contexts about defence technology and industrial strategies with which to penetrate or dominate market segments (subjective relativism) that is shaped by the approach of the researcher to the published data and industry experts (objective relativism). Thus, following the Easterby-Smith, *et al*. (2012) categorisation in Figure 4.1, the researcher adopted a relativist worldview for this thesis, combining the understanding that there are possibly many 'truths' and that these 'truths' will be shaped by the research questions asked, as well as the life and work experience of the researcher.

Epistemology, as the second philosophical assumption, is described as – "…'what is knowledge and what are the sources and limits of knowledge […] and 'what constitutes acceptable knowledge in a field of study' (Saunders, *et al*., 2009)". (Na, 2015: 59). Epistemological assumptions can be categorised into at least positivism and social constructivism according to (Saunders, *et al*., 2009;

Easterby-Smith, *et al*., 2012 in Na, 2015: 59). Consider the following comparative table for Positivism and Social Constructivism in Figure 4.2 –

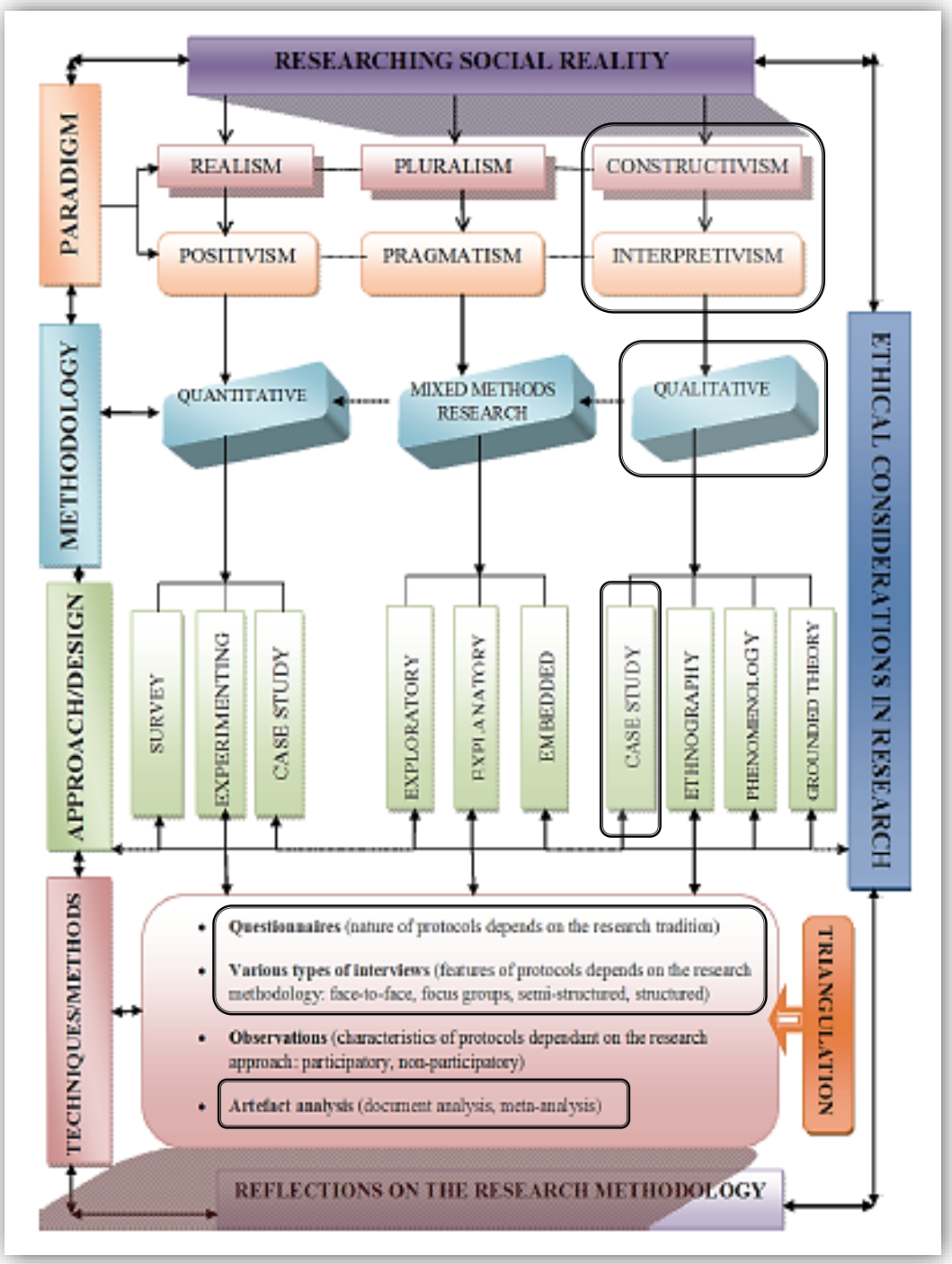
Figure 4.2: Epistemological Research Assumptions

	POSITIVISM	SOCIAL CONSTRUCTIVISM
The observer	Must be independent	Is part of what is being observed
Human interests	Should be irrelevant	Are the main drivers of science
Explanations	Must demonstrate causality	Aim to increase general understanding of the situation
Research progresses through	Hypothesis and deduction	Gathering rich data from which ideas are included
Concepts	Need to be de-fined	May include the complexity of 'whole' situations
Generalisation through	Statistical probability	Theoretical abstraction
Sampling requires	Large numbers selected randomly	Small numbers of cases chosen for specific reasons

Source: Easterby-Smith, *et al*. (2012) in Na (2015: 60).

The researcher adjusted his relativist worldview with social constructivism. The researcher forms part of the research area. The research is in the interest of the individuals and the organisation constituting the study area. The researcher aims at constructing a rich description of the phenomenon and makes theoretical abstractions where possible. The selected case study is based on one economic sector (defence industrial sector) with embedded case studies of the DTIS of Brazil, Russia, India, China and the RSA. The constructivist invariably adopt a qualitative research methodology, seeking to construct reality from the perspective of the individual and/or the experts consulted and is thus more aligned with subjectivism. The Positivist leans much more towards a quantitative research methodology due to it being associated with the objective realities typically found within the natural sciences which tend to be more fact-based and objectivist. In order to assist with the conceptual understanding of these paradigms consult Figure 4.3 for a graphical view of the relative position of these components in –

Figure 4.3: Research Paradigms, Methodologies, Designs and Methods followed by this Thesis



Source: Ngulube (2015: 129).

In terms of the larger stock of knowledge about the defence industry market landscape, the research will assume a protagonist disposition, endeavouring to inform the subject community about what the SA DTIS could possibly contribute (*vis-à-vis* what the SA DTIS is failing at) within bilateral defence technology and industrial partnerships with the BRIC States and which strategic levers could

be considered by the SA DTIS to better facilitate these partnerships. This provides a more positive outlook on the future, matching the intention of strategy.

To summarise, the researcher adopted a relativist worldview (ontological assumption perspective), adjusted with a social constructivist paradigm (epistemological assumption perspective). The researcher favour a qualitative research methodology and case study research approach/design that will render the rich description of the BRICS DTISs and the relevant strategic levers in play, whilst using techniques such as document analysis and questionnaires.

4.2 UNIT OF ANALYSIS

The units of analysis are the DTIS of BRICS States. Distinct sources of data or evidence about the unit of analysis are inherent in published data and the employees of and DTIS experts. Thus, document analysis was used to collect secondary published data on the unit of analysis. The researcher administered questionnaires (as a primary data collection technique) with open-ended questions posed to selected DTIS experts about the unit of analysis. This is consistent with the views of Grant (1996 a & b) and others that it is the individual that creates, stores and uses knowledge by various means. The unit of analysis can be graphically represented as in Figure 4.4 -

Figure 4.4: Research Area and Units of Analysis

Source: Researcher's compilation of information.

4.3 QUALITATIVE RESEARCH APPROACH

Most academics are aware of the ongoing and mature debate on the primacy of quantitative vs. qualitative research methodologies. Saldaña (2013) states that he prefers to approach human inquiry pragmatically to allow leeway in the selection process of the correct research approach for the inquiry

or research at hand. This thesis will use a qualitative research methodology based on the following opinion by Collins (1984) in Neuman (2011) -

"Words are not only more fundamental intellectually; one may also say that they are necessarily superior to mathematics in the social structure of the discipline. For words are a mode of expression with greater open-endedness, more capacity for connecting various realms of argument and experience, and more capacity for reaching intellectual audiences." (Neuman, 2011: 509).

Other authors that support similar arguments are Eisenhardt (1989), Leedy and Ormrod (2005), Flyvbjerg (2006) and Neuman (2011), favouring words and description as the vehicle to deliver analysis and findings with. "Instead of variables [closely associated with quantitative research], we examine motifs, themes, distinctions, and perspectives". (Neuman, 2011: 175). Eisenhardt (1989) aptly describes this as the answers to the question 'why?'. The qualitative research methodology is thus very useful for researchers aiming at describing the nature of certain situations, processes, relationships and systems (ontological assumption). Increased understanding of a specific phenomenon is achieved through the interpretative ability qualitative researcher (Leedy & Ormrod, 2005), thus allowing the qualitative researcher insight into the particular phenomenon in order to develop new concepts and/or theories.

Extending the opinions of Collins (1984), Eisenhardt (1989), Leedy and Ormrod (2005), Badenhorst (2007), Flyvbjerg (2006), Baxter and Jack (2008), Neuman (2011) – and many more support arguments that a deeper understanding of a particular phenomenon is achieved with qualitative methodologies. Badenhorst (2007) describes this approach as analysing and constructing arguments in a layer-for-layer approach, achieving a dense description of a phenomenon. Within the scope of this thesis, a thorough understanding and description of the unit of analysis and the contextual issues are important in order to reach findings on what the SA DTIS could contribute within bilateral defence technology and industrial partnerships with the BRIC States, due to the complex nature of this sector.

Limitations of quantitative research are closely related to the latitude allowed to the researcher in order to explore multiple realities (ontological assumption); interaction with the studied phenomenon (epistemological assumption); recognising values and biases affecting the phenomenon (axiological assumption); allowing contextually transformed language for descriptive purposes (rhetorical assumption); and to use deduction, "… induction, multivariate [*sic*], and multiprocess [*sic*] interactions [*sic*], and context-specific methods" (Lee, 1999: 6), qualitative research methodologies deal with these issues effectively. In support Neuman (2011: 214) writes - "Many qualitative researchers question the quantitative researcher's quest for standard, fixed measures and fear that such measures ignore the benefits of having a variety of researchers with many approaches and may neglect key aspects of diversity that exist in the social world".

Quantitative research typically aims at relationships identification (correlation) between variables. However, qualitative research provides the function to understand the reasons for such

relationships or correlation. (Eisenhardt 1989). Understanding and dense description of these relationships are critical for the development of the business strategy.

Quantitative research could test certain variables for significance, but would then ultimately discriminate against other variables that were not considered. Dense description, as conceptualised by the academic community should, therefore, provide a more accurate and relevant agenda that could be subjected to quantitative methods in follow-on studies to determine significance. (Putter, 2018). Concurring with Flyvbjerg (2006: 242) - "[g]ood social science is problem driven [*sic*] and not methodology driven in the sense that it employs those methods that for a given problematic, best answer the research questions at hand." In essence, qualitative approaches allowed the researcher to achieve results that could not necessarily be accomplished through quantitative approaches to research.

It is thus important to interact with the inhabitants of a particular social setting to have access to a specific understanding of the dynamics within that unit of analysis. Quantitative research methodologies are paramount in understanding the significance of the qualitative findings, but without the initial understanding of the dynamics of the space and its inhabitants there would be nothing to test quantitatively. (Putter, 2018). Thus, this thesis will employ a qualitative research methodology and questionnaire data collection techniques.

4.4 SINGLE EMBEDDED CASE STUDY RESEARCH DESIGN

Case study design dates back as far as the 1920s with its origins in sociological studies. Currently, most case studies use qualitative research approaches. (Badenhorst, 2007; Neuman, 2006 & 2011). A single case study design with embedded (or sometimes labelled nested) units will be used to analyse the BRICS DTIS by means of document analysis and questionnaires with DTIS experts.

Exploration and description are the key features of qualitative case studies designs and methodologies and allow the integration of a variety of data sources. (Baxter & Jack, 2008). These research designs are appropriate when - "… the focus of the study is to answer 'how' and 'why' questions [description and exploration]; … you want to cover contextual conditions because you believe they are relevant to the phenomenon under study, or (d) the boundaries are not clear between the phenomenon and context". (Yin, 2003 in Baxter & Jack, 2008: 545). Case studies also are considered appropriate where few studies have been conducted (Benbasat, Goldstein & Mead, 1987; Eisenhardt, 1989; Guy, 1994) and for inductive reasoning. Gay and Weaver (2011: 27) write - "… inductive reasoning, by its very nature, is idiographic (i.e. relating to a particular situation), more open-ended and exploratory [why?], especially at the beginning. Facts come first, then theory. The most important preliminary task is to gather all available information (data) about the situation [or case]".

Before you can attempt 'how' and 'why' answers/questions - the researcher will invariably be faced with answering questions about 'what' - *What is the theoretical strategic motive(s) that inform (bilateral) defence technology and industrial partnerships? What international DTIS facets are shaping the defence technology and industrial strategic business landscape that can be*

conceptualised as strategic levers (or barriers) to possible bilateral partnerships? The researcher asks 'which' and 'how' questions - *Which strategic levers are used by the DTIS of BRICS States and to what end? How and what can the SA DTIS contribute to the achievement of bilateral strategic objectives, using bilateral defence technology and industrial partnerships with the BRIC States?*

Neuman (2006: 40), Leedy and Ormrod (2005: 135), Badenhorst (2007) and others are of the opinion that case study research involves the examination of - "individuals, groups, organisations, movements, events, or geographic units" and/or components of these and how they relate to each other over a specific period of time and in specific contexts. The BRICS DTIS exhibits most of these components and more.

Central to qualitative case study research is expert-, context-specific and dependent knowledge. (Flyvbjerg, 2006). From a constructivist[24] perspective, Yin (1994: 13) states that case studies are a form of an - "… empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident". Baxter and Jack (2008) echo this opinion. Thus, the researcher used case study research due to its suitability to explore and describe which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States?

Theory building results in overlaps of data analysis and collection. (Eisenhardt, 1989). Eisenhardt (1989: 538) argues for the - "… joint collection, coding, and analysis of data" to be able to build sound theory. Such an approach enables early analysis and flexibility to the process." "A code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data." (Saldaña, 2013: 3). Theory building allows for changes to the data collection process to uncover emergent themes not evident in the initial stages of the collection strategy formulation. (Eisenhardt, 1989). This makes it possible to expand the research with more cases, questions to questionnaires, observational data and interviewees as the research unfolds (Eisenhardt, 1989 - citing several authors). This does not, however, provide a licence for unsystematic execution (Eisenhardt, 1989), which would allow the researcher to drift beyond the aim of the study.

"The ability to look at sub-units that are situated within a larger case is powerful when you consider that data can be analyzed *within* the subunits separately (within case analysis), *between* the different subunits (between case analysis), or *across* all of the subunits (cross-case analysis). The ability to engage in such rich analysis only serves to better illuminate the case." (Yin, 2003 in Baxter & Jack, 2008: 550). Then there are contextual issues to consider - "All research questions, methodologies, conceptual frameworks, and fieldwork parameters are context specific [*sic*]." (Saldaña, 2013: 2). This made the adoption of a qualitative research approach more prudent. About coding

[24] Constructivist's paradigm "recognizes the importance of the subjective human creation of meaning, but doesn't reject outright some notion of objectivity…One of the advantages of this approach is the close collaboration between the researcher and the participant, while enabling participants to tell their stories." (Baxter & Jack, 2008: 545).

during the analysis process – "… whether you choose to code or not depends on your individual value, attitude, and belief systems about qualitative inquiry." (Saldaña, 2013: 2). The researcher thus used this latitude to analyse the data collected.

Because the unit of analysis consists of five States (Brazil, Russia, India, China and South Africa) it is suited for a single case study design with embedded units. This enabled the researcher to explore the case (BRICS defence cooperation with specific emphasis on DTIS) while considering the interaction and management complexities between the five embedded units. The researcher remained vigilant against the – "… pitfall that novice researchers fall into is that they analyze at the individual subunit level and fail to return to the global issue that they initially set out to address." (Yin, 2003 in Baxter & Jack, 2008: 550).

This thesis thus employed a single embedded case study design and a qualitative research methodology. The unit of analysis is very complex and extremely contextual. The approach allows 'why', 'which' and 'how' questions to be answered about each embedded unit and how they possibly interact bilaterally and multilaterally with specific reference to defence industrial activity. Data to support the research is available from numerous sources and experts.

4.5 DATA COLLECTION

A literature study using document analysis techniques was used for the first part of the research. A literature study was conducted based on primary data extracted from relevant academic literature and research regarding defence industrial strategies and futures in general and then focussing on the defence industrial capabilities of BRICS states. Primary data collected by questionnaires focused narrowly on the research questions. "The qualitative method is chosen for this study as it facilitates an interrogation of secondary and primary resources to gain in-depth understanding of the relationships and their context." (Babbie & Mouton, 2007: 270 in Sithole, 2015: 13). The strategy is not aimed at a complete saturation of the subject field because of time constraints for the research as well as the potential to deviate from the purpose of the study.

Reputable databases such as Emerald, Google Scholar, Oxford Journals, EBSCO and Proquest were searched for data. The world-wide-web was also be searched for market reports and analysis using the Google search engine. Search keywords were restricted to A&D industry, defence industry, arms industry, armament industry, BRICS, DTIB, DTIS, South African defence industry, SADI, Armscor, and combinations of these. Fortunately, published material on defence industries and their strategies are in abundance.

The researcher concentrated on document analysis of the latest market analysis reports of the key market analysis consulting firms internationally such as Deloitte and Touche, McKinsey & Co, KPMG, PWC, Earnest and Young - based on the assumption made by the researcher that the most current defence industry market forecasts, trends and strategic analysis will be captured in these. Other in-depth studies were used that provided theoretical background and supporting views from a

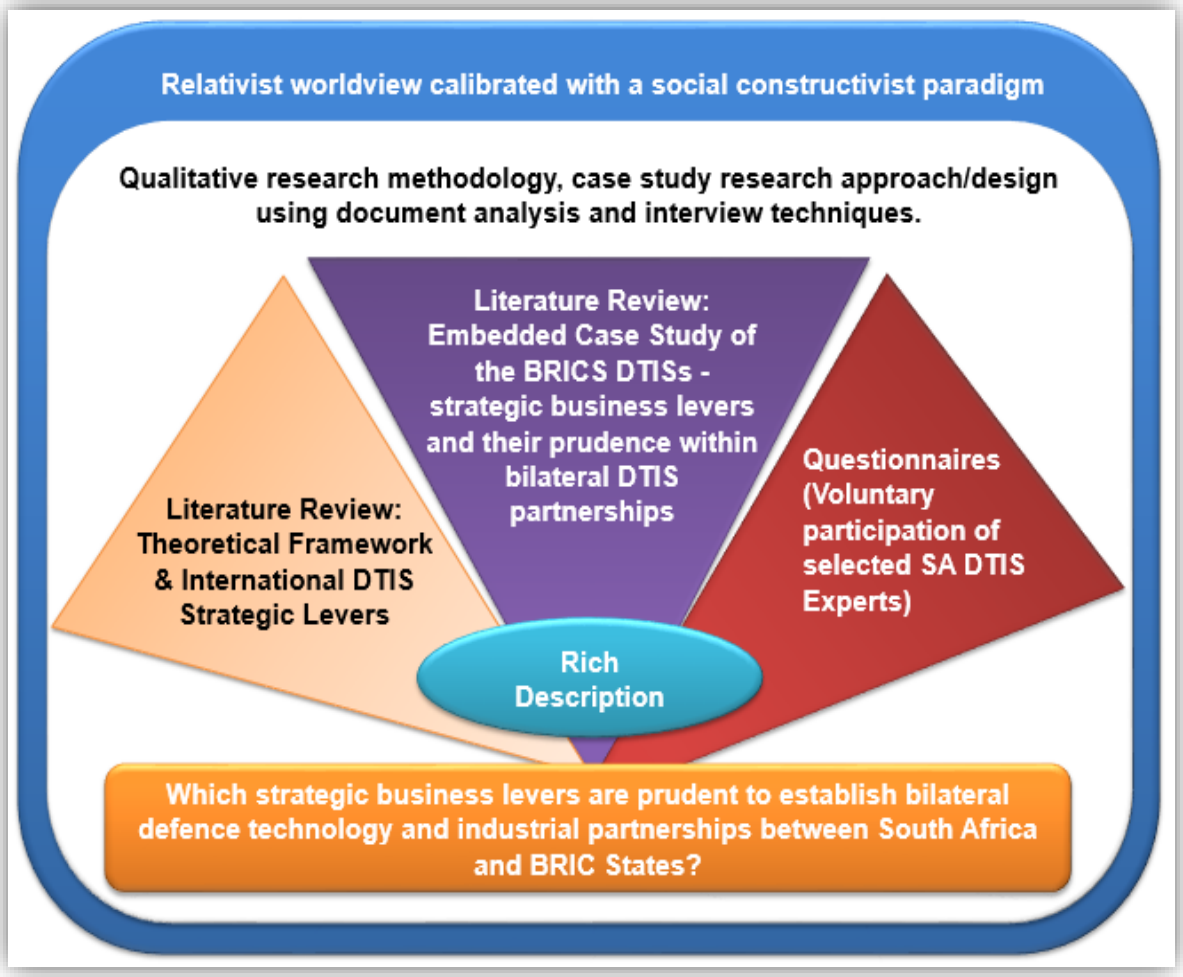
triangulation perspective. Current reporting from defence or defence industry-related news vendors was used to assess progress and provide the latest perspectives on defence industrial activity.

The primary source for data was from questionnaires using a random (any gender, age and/or cultural group) but purposeful (defence industry experts and academics) sample from within my LinkedIn network. LinkedIn is an Internet-based professional networking application that allows user contact with (almost) any registered person using the application. The use of this application provided the researcher with access to possible participants based abroad. Another advantage of this application is the immediate (sometimes abbreviated) view of the potential participant's expertise profile and thus suitability as a participant. It does not guarantee participation just because the potential participants, contacted via the application, was/is in the researcher's LinkedIn.com network. Participation would be pledged by potential participants but, in many cases, not honoured. The application did, however, render a small sample of experts, locally and abroad, from various backgrounds and industry contexts. This provides a measure of rigour to the findings of the thesis.

The researcher considered conducting interviews using the same questions where potential participants do not want to participate in a questionnaire. For the purposes of this thesis, interviews or questionnaires would have achieved the same objective. The researcher approached each potential participant individually (assuring anonymity) for interest in providing opinions on four research questions. This approach was embraced by the potential participants without any request for an interview as the alternative. In a certain sense, data collection by means of a questionnaire was less cumbersome because no member-checking was required and the correspondence could be completed electronically. Questionnaires also provide the convenience of brevity, i.e. people prefer to write much more concise than would be the case with speaking in an interview. Time constraints resulting from the requirements of the Security and Defence Studies Programme (this master's degree is part of) did also, to a certain extent, steered the method of collection towards a questionnaire data collection technique (rather than a physical interview) in order to remain flexible and accommodative in terms of time management.

Questionnaire data collection only commenced once the literature studies (Chapter 2 and 3 of the thesis) have been completed (at least in the first draft). This sequencing assisted the researcher in the discovery and learning about the subject matter and contexts which enabled the researcher to formulate relevant questions for the questionnaire. In order to extract qualitative options as input to the research questions, the researcher used an inductive reasoning process in conjunction with the semi-structured questionnaires (open-ended questions). Semi-structured questionnaires thus formed an important base for latitude in expression providing a narrative for coding and aggregation. In order to facilitate expressive latitude more effectively the number of questions was limited to four open-ended questions. The purpose of questionnaires is linked to the concept of dense description and the creation of a deeper understanding of the phenomenon. Conceptually, rich data can be extracted from questionnaires as described by Maxwell (2009).

Figure 4.5: Conceptualisation of the Data Collection and Analysis



Source: Researcher's compilation of information.

In the case of interviews as a data collection technique, verbatim transcription is required to ensure all possible nuances are captured for processing and triangulation. (Maxwell, 2009). If interviews were used the data from the interviews would have been documented with recordings and transcripts. In order to assure data and context accuracy, the transcriptions would have been verified and member checked with each participant to construct enhanced clarification and correct errors.

The researcher respects the confidentiality, privacy, anonymity and any other rights identified of participants. Participation remained voluntary throughout the process and participants could withdraw their participation at any point in time. (Babbie, 2010). Participants were required to sign a consent (consent form), thus allowing the researcher the use of the data for the thesis. The originally completed questionnaire was scanned (where necessary) and is kept safe along with signed consent - as per the university ethics requirements.

Open-ended questions were the preferred technique to allow the exploration of the research problem. It allowed the researcher to find more elements relevant to the research problem that might not otherwise have been revealed by using quantitative methods. The researcher drilled down deeper into the social reality, extracting understanding that supports the inductive reasoning process to

construct findings and conclusions. There was no requirement for follow-up questions or clarifications. Data collected and analysed during the literature studies (Chapter 2 and 3 of the thesis) and questionnaires form the basis for the findings and recommendations of the thesis. The data collection and analysis process can be conceptualised as in Figure 4.5.

4.5.1 Sampling

Purposive sampling was used for the semi-structured (open-ended questions) questionnaire. Zhang (2012: 181) successfully used seven experts for the research about the relative innovation capacities of South Africa and China. The researcher aimed at obtaining primary data from defence industries, research institutes and defence- and/or defence industry analysts across South Africa and possibly abroad. This approach rendered responses from 18 experts from various defence and security industries, defence analysts as well as some academics in the field. They are listed in Appendix A of the thesis. This type of sampling is particularly useful for exploratory and field research. (Neuman, 2011). Purposive sampling equates to non-random sampling "…in which the researcher uses a wide range of methods to locate all possible cases of a highly specific and difficult-to-reach population". (Neuman, 2011: 267). A typical requirement is that the researcher must be in the position to judge the relevance of the sample selected in the end. The sampling strategy for the selection of the participants was based on position in the SA DTIS.

The strength of the approach is in sampling experts of the defence technology and industrial sector. The weakness of this approach is in the fact that the sample immediately excludes the greater part of the SA DTIS personnel and their understanding and expectations of what might enhance the SA DTIS. It also excludes providing questionnaires to the operational level of SA DTIS employees. However, based on recommendations by the participants; other participants were considered – some of which provided valuable opinions. These did not make the sample size unmanageable or unnecessary drifting away from the purpose of the study.

4.5.2 Qualitative Data Analysis and Rigor

Once the data was collected, analysis followed. The analysis allowed for codifying qualitative data into - "… conceptual categories to create themes and [or] concepts". (Neuman, 2011: 510). Dey (1993: 31) states that - "… the core of qualitative analysis lies in these related processes of describing phenomena, classifying it, and seeing how … concepts interconnect". The analysis permits the researcher to enhance understanding and knowledge whilst broadening the theory. (Neuman, 2011: 507). Data analysis is the central activity enabling theory building within case studies (Eisenhardt, 1989). The constructed theory from case study research is -"… often novel, testable and empirically valid". (Eisenhardt, 1989: 532). Collection techniques, the data and the analysis thereof aimed at enhancing the quality of the research and the rigour of the method. Lee (1999: 154-155) supports Yin's four standards for quality, rigorous qualitative research. These are reliability, construct validity, internal validity (not for descriptive or exploratory studies), and external validity.

4.5.3 Reliability

Qualitative research reliability can be enhanced with the use of multiple data collection techniques such as questionnaires, interviews, photos, document analysis among others. (Neuman, 2011). The researcher endeavoured to make maximum use of authoritative authors and organisational reports on the DTISs. The material used was exclusive to the public domain (not restricted in terms of access) to ensure the repeatability of the research (Lee, 1999) at any time. This was combined with DTIS experts and academics, locally and abroad – as was briefly discussed in section 4.5 Data Collection.

4.5.4 Validity

Qualitative research aims at generating trustworthy, authentic and valid findings (Schwandt, 2007; Baxter & Jack, 2008; Marshall & Rossman, 2011; Neuman, 2011). Maxwell (2009: 236) states - "Qualitative studies generally rely on the integration of data from a variety of methods and sources of information [such as documents, observation, questionnaires and interviews] a general principle known as triangulation (Denzin, 1970; Denzin & Lincoln, 1994)". This understanding is supported by Yin (2003) in Baxter and Jack (2008: 554) and Neuman (2011); thus facilitating the convergence of ideas and findings and thus the quality of the data (Baxter & Jack, 2008; Lee, 1999). Maxwell (2009) contends that such a strategy diminish possibilities of concentrating on the specific method's systematic biases or limitations in the researcher's conclusions. Triangulation provided the thesis with an enhanced assessment of the validity and generality of explanations and findings.

Lee (1999) proposes the construction of sequential logic in support of validly, making it possible for a case study reader to re-construct the sequencing of the logical pattern. When this can be achieved with considerable clarity and certainty a positive case can be made for the achievement of construct validity. If construct validity can be established it will increase the robustness of opinion. (Lee, 1999). This was achieved through a logical pattern on research and analysis and triangulating facts, statements and opinions where possible.

4.5.5 General Applicability

"A purely descriptive, phenomenological case study without any attempt to generalise can certainly be of value in this process and has often helped cut a path towards scientific innovation". (Flyvbjerg, 2006: 227). Flyvbjerg (2006) is thus pro allowing both generalizable and specific knowledge to contribute to the body of knowledge of a specific subject field. Although the findings of this study might be specific to the SA DTIS; the fact that BRIC DTIS functions within the same market contexts, some of the findings might be applicable to these industries.

4.6 EXPECTATION FOR THE NEXT CHAPTER

Chapter 5 discuss and analyse the responses of the participants to the three broad statements, as outlined in the research methodology for this thesis. These statements were informed by the

literature studies (Chapter 2 and 3 of the thesis) and hence the sequencing of the research, first completing the said literature studies before the questionnaire process commenced. Chapter 5 discusses and provides analysis and findings of the primary data collected by means of questionnaires.

CHAPTER 5: PRIMARY DATA, ANALYSIS AND DISCUSSION

5.1 INTRODUCTION

To balance the large volume of theory and applied secondary data provided in Chapters 2 and 3 of the thesis, Chapter 5 provide primary data from DTIS experts from various backgrounds, organisations as well as countries. Using interviews as a method to collect primary data, as was stated in Chapter 4 of the thesis, would have excluded the possibility to collect such data from experts abroad. This limitation was overcome by using questionnaires that could be emailed anywhere in the world.

5.2 PRIMARY DATA: PERSPECTIVES, DISCUSSION AND ANALYSIS NARRATIVES

The primary data collected rendered discussion narratives from 18 participants. Fifteen of the participants provided permission to be used as a referenced source. Three participants opted to remain anonymous and thus appear coded (Anonymous Participant – AP) in the discussion that follows. The process followed also facilitated access to participation from abroad. As such, responses were received from Australia, Saudi Arabia and the USA. Responses were received of a period of approximately a two-month period, reflecting the availability of time to participate in the research. The discussions varied in the level of density achievable, but none the less rendered contextual insight in some cases and deep description in others. See Appendix 1 for the list of participants and amplifying details of their suitability to provide insight on the subject matter. The participants represent the following –

- Three participants (11% of the sample) are represented by defence analysts. These analysts are actively involved in journalistic reporting on the SA DOD and the SA DTIS and related developments in defence markets. One of these analysts were actively involved in the drafting of the SA DR 2015 and the Draft DDIS 2017.
- Three participants (33% of the sample) are represented by retired senior management level South African military officers (army and air force). Most of these officers are also currently (or have been in the past) employed by defence companies.
- Two participants (11% of the sample) are foreign military officers (army and navy).
- Six participants (33% of the sample) are represented by defence industry and technology specialists and captains of industry, one of these participants (5% of the sample) are foreign-based. All these specialists have intimate knowledge of the South African military requirements and SA DTIS development trajectory.
- Two participants (11% of the sample) are academics. One of these participants was proposed as experts in the field of knowledge by participants initially approached by the researcher. The other expert was a senior military officer, academic, civilian defence policy expert and currently a board member of the only South African armament contracting agency.
- One participant (5% of the sample) is an expert and Board member of the South African armament contracting agency.

These participants were contacted through the researchers LinkedIn profile (www.linkedin.com) and by email. Not all the potential participants the researchers contacted in this manner responded. Some of the respondents made it clear from the onset that the subject matter did not form part of their field of expertise, but referred me to other possible experts, e.g. Prof Haines. Prof Haines did not form part of my initial call for participation based on my LinkedIn network but was suggested as an expert on these matters. Prof Haines subsequently participated. All responses were received via email and permission was confirmed via email. Some responses were typed into a return email. This latitude was expressly provided to participants in order to make it as easy as possible to provide responses, anywhere at any time. The strategy provided excellent results. Other participants found the time to respond on an MSWord document which was attached.

Semi-structured questionnaires, using open-ended questions, forms an important base for latitude in expression providing a narrative for coding, identifying themes, and aggregation and niche ideas. In order to facilitate expressive latitude better the number of questions was limited. The questions are as follows -

- What role can the South African defence technology and industrial sector play in the BRICS defence technology and industrial sector?
- What would be the preferred type of strategic cooperation – bilateral or multilateral, and why?
- Which strategic business levers (e.g. technology transfer, mergers and acquisitions, foreign direct investments, joint ventures, partnerships, etc.) would be prudent for consideration to establish future bilateral defence technology and industrial partnerships between South Africa and the BRIC States – and possible reasons for this?
- What are the market niches/capabilities/products/services/technology/IP that the South African defence technology and industrial sector can contribute to establishing/enhance possible role(s) in the BRICS defence technology and industrial capability?

Responses to these four questions follow providing perspectives from the experts that participated in the research.

5.2.1 Strategic Context

For the SA DTIS to remain relevant in the defence market future it will have to invest more in - "… emerging technologies associated with cyber-security resources, which include artificial intelligence, robotics, Internet of Things (IoT) and other associated technologies." (Khanyile, 2019). Khanyile (2019) is of the opinion that African conflicts are going to monopolise conventional warfare and the rest of the developed world is going to focus on cyberspace as the next frontier for warfare. "The new Cold War fault-lines are increasingly being drawn along economic lines, but these are likely to be bolstered through techno-military resources. Given South Africa's geostrategic position and the fact that its global outlook happens to straddle both the east and west hemisphere, it could attract or suffer collateral damage as the US, China and Russia exact pressure on one another [with consequential spill-over into the SA DTIS]. The US regards the whole of the Americas, which includes

Brazil, as its area of influence. It is poised to counterbalance anything that China and Russia seek to do in the east. Therefore, Brazil, according to some US defence analysts, is regarded as a geostrategic delinquent that needs to be reined in. This is further exacerbated by the on-going internal political strife in that country. In [the] east, China and India will be the 2nd and 3rd largest economies in the next 15 years which implies that South Africa is in the right company and it has to focus its energies in learning more on the afore-mentioned technologies [cyber, artificial intelligence, robotics, Internet of Things (IoT) and other associated technologies], while encouraging its BRICS partners to set up shop in South Africa. This will help revive [the SA] industrial base, thus keeping the engineers and other specialists in the country." (Khanyile, 2019).

Wyatt (2019) states that BRICS as an economic alliance was the brainchild of a Western economist and that the alliance seem to be very inactive. Wyatt (2019) asks some interesting questions from a different perspective with whether the SA DTIS want – "…to play a role in the BRICS defense technology and industrial sector?" This question is on the back of the relevant market potentials – East vs. West. Wyatt (2019) is of the opinion that the West has a much larger market potential. Mathieson (2019) provides a pseudo-answer to the pondering of Wyatt (2019), stating categorically – "Defence has been a critical element in the establishment of BRICS. Being of a strategic nature, the defence workgroup was one of the first to be established. The driver was the then Minister of Defence, the Hon Lindiwe Sisulu and [former Defence Secretary] Mr January Masilela (SoD) and attendance at the workgroups was always very well supported by all senior officials and DoDs. Without the significant and established defence technology and industrial sectors of each nation, I doubt that there would have been grounds to explore issues of mutual interest and development co-operation. Despite Russia and China, being much more advanced than the other three nations, there was still a willingness to find areas of mutual co-operation. I would categorically state that without the trailblazing of the Defence Co-Operation, there would have been very little co-operation in the other industrial sectors." (Mathieson, 2019).

From a geopolitical perspective, Wyatt (2019) states pessimistically that due to IPR abuses, illicit technology transfer and other questionable business practices, partnerships in any form with China and Russia will render relations with the other BRICS States untenable. It will also destroy any possible opportunities for DTIS relations with the West (i.e. USA and EU). This situation is further complicated by a SA DTIS track record showing regular underperformance. "The failure to find a viable market for the excellent Rooivalk attack helicopter, despite its impressive capabilities, being one of the most prominent failures. True, anti-mine technology and experience gave Pretoria's defense industry an advantage when U.S. forces had an urgent need to replace their highly vulnerable troop carriers in Iraq. But one cannot count on desperate customers for a successful business model." (Wyatt, 2019).

The role of the SA DTIS cannot be conceptualised with ease due to the erosion of the Denel core capabilities since *circa* 2015, which have been compounded by the extreme surgery on the South African Defence budget. It is difficult to comprehend the transition from the development-orientated

DR 2015 to the current state of diminished defence and SA DTIS capability. Limited SA DTIS capabilities have survived the run on the defence budget. Those SA DTIS capabilities remaining is owned by the private sector and are export-orientated. These privately owned defence technology and industrial companies are also not motivated by the geopolitical ambition of the South African government, nor by the developmental agenda of BRICS. They are driven by age-old concepts such as market-related [ROI]. Without a 40-50% domestic Government support to the SA DTIS the demise of many of these (certainly the parastatals such as Denel) is almost certain. (AP03, 2019). This statement by AP03 clearly emphasises the role of Government in their respective DTISs. AP03 (2019) states further that without Government support (in an integrated manner as was discussed earlier in the thesis), defence businesses will shift their focus to the export market. This may result in the SANDF becoming import-dependent, i.e. the SA DTIS will have nothing to contribute to alliance such as BRICS from a DTIS perspective. The SANDF will thus be rendered a mere export client of its alliance partner States (BRIC) with no strategic DTIS role to play in the international DTIS market.

AP03 (2019) stated a number of considerations that are paramount to the strategic sustainability of the SA DTIS -

- Virtually all strategic defence technology and production contracts are concluded on a G-to-G platform. This refers to the SA Inc. concept that promotes an integrated governmental role and approach to defence business and the development of a domestic DTIS. AP03 is of the opinion that the USA, UK, France, Turkey, China and Russia are using this approach competitively on an international scale. Such interaction is facilitated at the national executive level – i.e. the President.
- Political will must drive the success and sustainability of the national DTIS. This must be combined with national pride in the national defence capabilities and forces and the associated domestic DTIS's ability to produce sovereign (Tier 1) technology and product systems.
- These two initiatives and approaches must be reliably funded based on long-term, stable, nominal defence budget allocations. As such, the UN guideline for a sustainable defence budget is approximately 1.8% of the national GDP. In order to sustain a developed DTIS, this percentage may exceed the 2% of GDP threshold in order to make it sustainable.
- Funding should be underwritten by a comprehensive and stable defence policy that define technology and industrial production domains where sovereign independence is of vital importance. This policy must inform a long-term technology and capability demand plan that is linked to adequate funding.

AP03 (2019) stated categorically that there is no evidence of political will and/or adequate levels of funding by South Africa and Brazil since *circa* 2015. This severely hampers the sustainability of the respective DTISs. This situation is in striking contrast to the political will, budget levels and policy of Russia, China and India – thus fueling the asymmetry amongst the BRICS States from a DTIS perspective. Wyatt (2019) summaries this asymmetry very aptly with the following statement – "Formal structures, functions or treaty permission or obligations are virtually non-existent for BRICS as an

organization. It is an [good] acronym and was an interesting concept, but the members are so disparate and have wholly different political and economic models to make substantive cooperation challenging. From state-controlled totalitarian regimes in Beijing and Moscow to developing markets with significant state control and a habit of parastatal monopolies like South Africa and Brazil to a wildly chaotic capitalist marketplace in the world's largest democracy in India, political and economic systems are not in alignment." This is a bleak picture indeed. This asymmetry and the need to mitigate its effect on relations building is recognised by several participants, e.g. Mathieson (2019), Barker (2019), Pelser (2019), Martin (2019), Minnie (2019) ,AP01 (2019), Kruger (2019), Khanyile (2019) and Heitman (2019) throughout this Chapter of the thesis. It also matches the findings of Chapter 2 and 3 of the thesis. This asymmetry is also possibly a primary contributing factor to the requirement for a careful understanding of the different stages of development the different BRICS DTISs find themselves in, what the prudent level of inclusiveness (bi- or multilateral), which portfolio of strategic business levers should be applied on a case-by-case basis within which technology and/or capability portfolio. Now let us consider the four questions posed to the participants.

5.2.2. What role can the South African defence technology and industrial sector play in the BRICS defence technology and industrial sector?

Khanyile (2019) conceptualises the SA DTIS role through a geostrategic lens. Khanyile (2019) is of the view that South Africa is an important BRIC partner although it only ranks 31st in GDP comparative listing (China – 2nd, India – 7th, Brazil – 9th and Russia 12th). This also restricts South Africa's defence and DTIS spend considerably compared with the BRIC partner States. Khanyile (2019) is of the view that South Africa does have infrastructural enablers that could provide the BRIC States with a very suitable entry point into the African continent. Further, Khanyile (2019) states that South Africa is – "… geostrategically well-located for transshipments and navigation between the east and west hemispheres and easy access to Antarctica, and it enjoys a certain level of moral authority due to its association with global icons and Nobel Peace Laureates." This might be so, but it does not guarantee the SA DTIS a place at the BRIC DTIS table.

Khanyile (2019) counter the researcher's pessimism, stating the SA DTIS was at the receiving end of much development pre-1994, successfully employing - "…advanced sanctionsbusting [*sic*] mechanisms, especially in the defence space. Khanyile (2019) discourage, what he labels, "… a posture that seeks to impose its defence products and services within the BRICS family". And certainly, from the discussion in Chapter 3 of the thesis, South Africa is not in a position to do so. Khanyile (2019) recommends building – "… partnerships for co-development and providing access to reciprocal markets. Most of these countries already have advanced technologies for own consumption but South Africa could help complement their IP assets in selected areas." (Khanyile, 2019). This statement reinforces the sentiment that a selected portfolio of technologies could be leveraged, probably within a JV setting, on a bilateral platform.

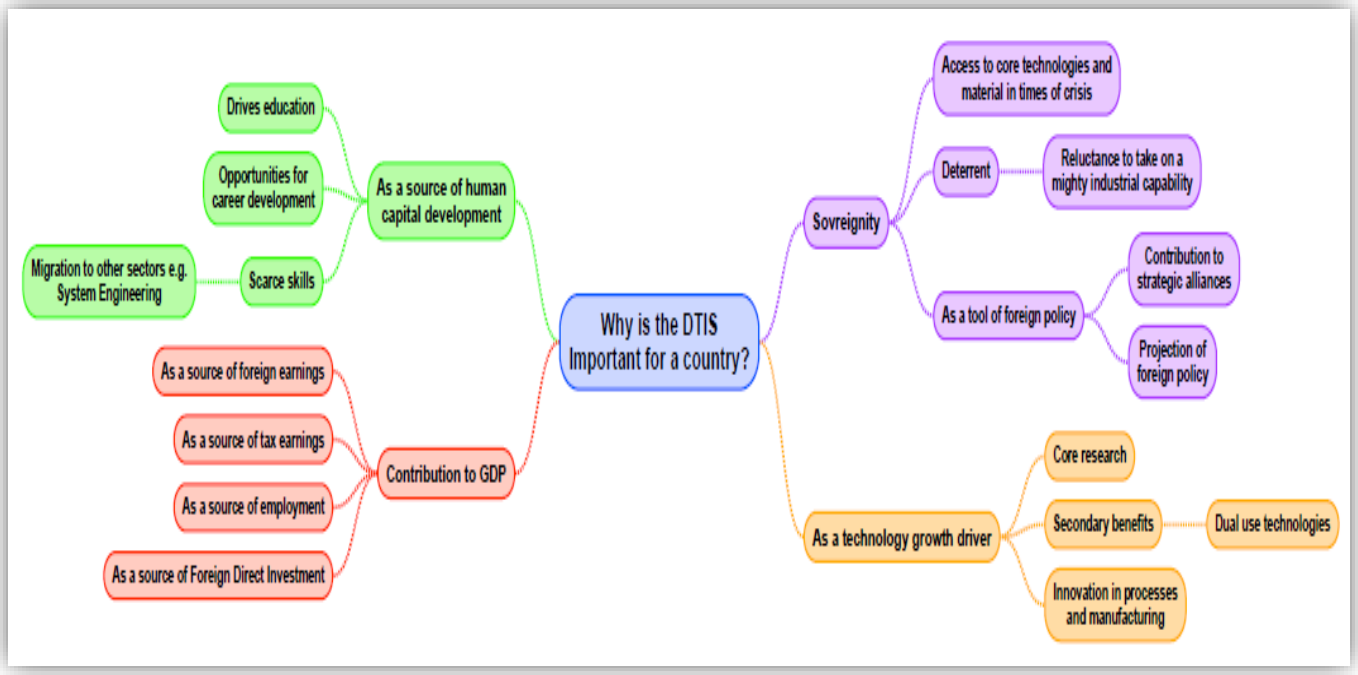
At a more abstract level, Mills (2019) constructed a mind map of elements that could be deemed important for the SA DTIS (possibly also other countries). The perceived importance of the DTIS for South Africa can thus be conceptualised as what role the SA DTIS can/should play in South Africa as well as a contributor to the BRIC States. Mills (2019) separate these roles (probably not intentionally) into economic factors (idealist perspective) and a more realist perspective (Figure 5.1).

Mills (2019) divides the economic roles of the SA DTIS into sources for intellectual capital development, growth of the gross domestic product (GDP) and technology growth drivers. The SA DTIS in the role of human capital development contributes to education and the development of scares skills. It is thus an incubator for career opportunities that enable the labour component of the SA DTIS to become mobile and enable them to be useful to virtually the entire economy when migrating through sectors, possibly based on technology and industrial programmes and projects requiring skills and expertise. This role obviously contributes to the growth of the GDP. With skills, development and education are accompanied by employment and the responsibly to contribute to the tax earnings of the State. The SA DTIS, as a spin-off from innovation and product development, attract FDI and foreign currency which contribute to the cycle of development domestically. Foreign direct investment is a growth driver technology development and innovation. It funds the ability of the SA DTIS to conduct scientific research for new technologies, products and processes. Process innovation is extremely important for Tier 1 (and to a certain extent Tier 2) industries. Thus, if the SA DTIS want to transform Tier 3 and 2 industries into Tier 1 industries as part of the ambition to be self-sufficient again or add to the self-sufficiency of a BRIC State then FDI and innovation play a large part. Many militaries increasingly make use of dual-use technologies due to the cost implications of MOTS technologies and equipment. With dual-use industrial development in South Africa, contributions are made to the South African economy in general but also to the SA DTIS and its ability to contribute to BRIC DTISs. It allows the SA DTIS to compete better in the international DTIS market because of better cost differentials.

When the SA DTIS is linked to the sovereignty of the State there are flavours of realism. This realism manifest in the form of deterrence, support to foreign policy and secure access to critical technologies. It is also usually these ambitions that fuel the autarky component of DTIS policy. The role of the SA DTIS in foreign is also linked by Mills (2019) to the ability to project national foreign policy and importantly, form international partnerships.

Both the idealist and realist perspective provided by Mills (2019) is supported by the literature studies (Chapter 2 and 3 of the thesis) (Chapter 2 and 3 of the thesis). The SA DTIS should be able to play a role in the BRIC DTIS from an innovation perspective, niche products and processes, and scares skills perspectives. Although not stated by Mills (2019), JVs and the use of technology transfer could be the business levers used to enter the BRIC DTISs to establish South Africa as a valuable alliance partner.

Figure 5.1: Mind map: The Importance of the Defence Technology and Industrial Sector for the country?

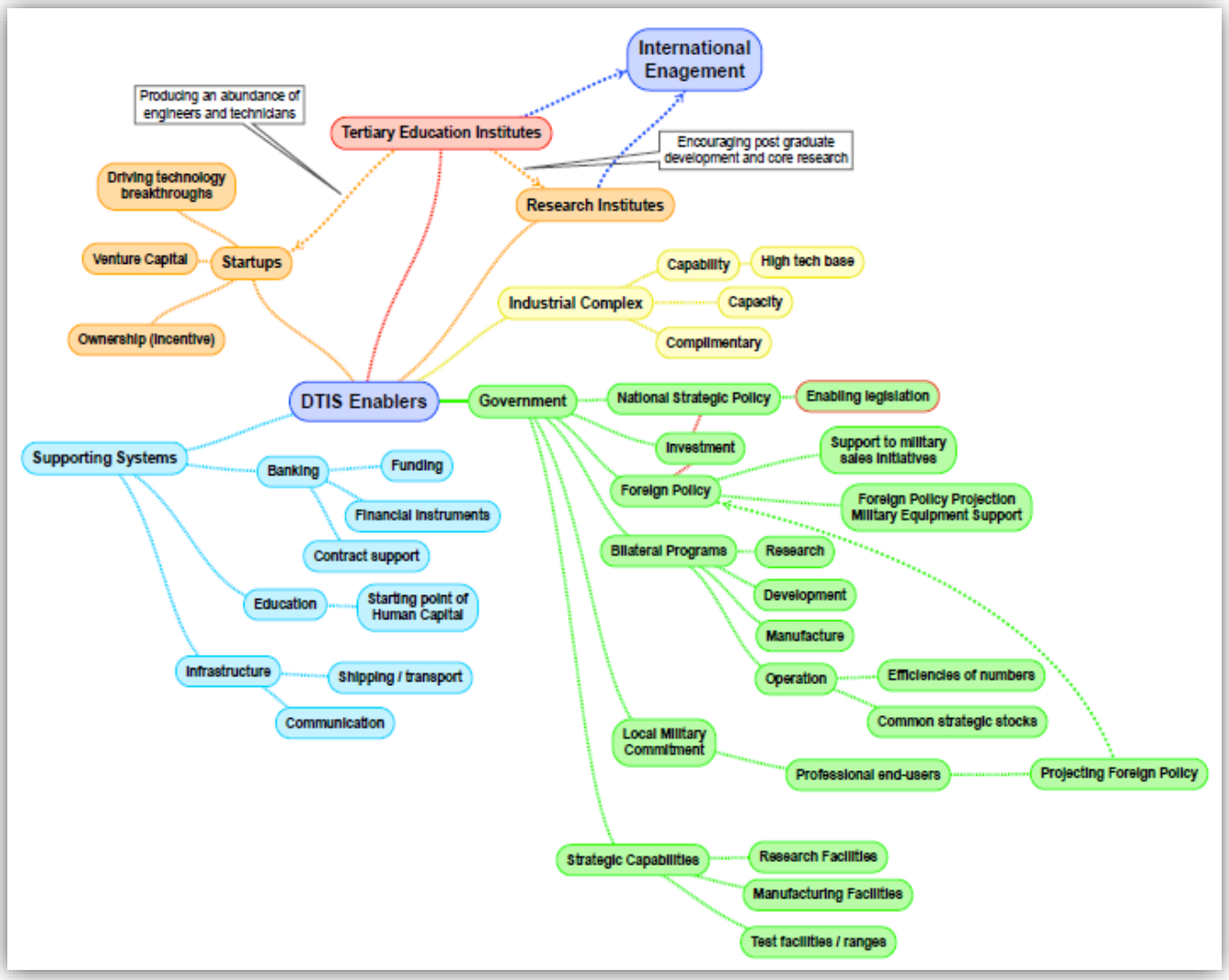


Source: Mind map provided by Ralph Mills (2019).

With the role of the SA DTIS in South Africa and possibly for the BRIC States discussed - Mills (2019) conceptualised a number of enablers of these SA DTIS roles. Government is perceived to be the foreign- (bilateral engagements), economic policy (FDI) and military capability provider for South Africa. The government is thus the premier agency that provides the enablers within which the strategic business levers are managed. Critically mentioned by Mills (2019) is the notion of bilateral engagements enabled by government but also by the Tertiary Education platforms and Research Institutes (e.g. the CSIR). These bilateral partnerships should aim at establishing and conducting research, design, development and production for the purposes of economic growth and supply security. These, as discussed in the literature studies (Chapter 2 and 3 of the thesis), provide States with foreign policy and military flexibility – especially if self-sufficiency is reached. Without a domestic industrial and technology complex, economic growth and related development are hindered as well as dependence on foreign supply increase. Some of these enablers are captured in Figure 5.2.

The next number of responses deals with the question of the role of the SA DTIS in BRIC more practically. Definite protagonist and antagonist positions are taken. Many of the participants share the concern that is aptly contextualized by Martin (2019) in the following statement - “South Africa’s aerospace and defence industry is facing a tough time as it battles with a shrinking economy, declining defence budget and is struggling to recover from the capture of Denel, which has had ripple effects through the industry. Investment from BRICS countries would be immensely useful in keeping the industry afloat and opening up new markets.” (Martin, 2019).

Figure 5.2: Mind map: Defence Technology and Industrial Sector Enablers



Source: Mind map provided by Ralph Mills (2019).

From an antagonist perspective, Jooste (2019) stated that the SA DTIS has to be realistic about the erosion of the technology and industrial base over the past number of years. However, the SA DTIS can still play a role in providing technology solutions, integration and upgrades to existing systems. Jooste (2019) is of the opinion that the SA DTIS has little to offer in terms of Level 6 systems (i.e. Tier 1 system). AP03 (2019) share this concern in much more detail. AP03 (2019) stated that SA DTIS is no longer an internationally competitive sector. AP03 (2019) is of the opinion that Russia, China and India do not perceive the SA DTIS as an advantage multiplier. Five to ten years ago, before the onset of the rapid deterioration of the Denel capabilities, the SA DTIS might have had a chance to play a DTIS-related role in the BRIC. Since *circa* 2015, South Africa and Brazil are currently perceived to be passive partners in the BRICS. (AP03, 2019). "A defence industry that is not used by its home defence force becomes a normal commercial operation (ROI only) not at all interested in geopolitical posturing like the BRICS topic." (AP03, 2019).

As stated by AP03 (2019) above, the SA DTIS is in a negative spiral towards unsustainability due to inadequate funding levels that could sustain long-term R&D. As such the SA DTIS is currently selling technologies that are estimated to be 15-20 years old. (AP01, 2019). According to AP01, the BRICS economic development vehicle could provide a possible means to revitalise the SA DTIS. AP01 (2019) is of the opinion that joint development on large scale projects, skills development, capability transfer, market access, R&D and the creation of specific centres of excellence could possibly be considered. AP01 state the caveat that the success of such collaboration is contingent on adequate levels of funding, which, in AP01's opinion is not readily available. Then there is the critical issue of IPR protection and ownership. The SA DTIS also seem to overvalue their IP portfolios (AP03, 2019), placing a significant strain on the conclusion of partnerships and contracts.

Barker (2019) acknowledge the fact that the SA DTIS has taken some steps down the 'Ladder of Production' and thus away from being self-sufficient. This will severely hamper possible roles for the SA DTIS in the sectors of the BRIC States. Barker (2019) is of the opinion that geostrategic considerations (e.g. resources and geography) for the inclusion of South Africa into the BRICS alliance far outweigh strategic industrial considerations. Barker (2019) and Pelser (2019) allude to the asymmetry in potential SA/BRIC bilateral relationships. Notwithstanding these two issues, Barker (2019) states - "Despite the fact that the RSA Defence Industry is a mere shadow of its 1980/90's capability [regression], there remains niche areas and small centres of excellence that could contribute to the BRICS defence technology and industrial sector.

Martin, (2019) is also more protagonist than AP03 (2019) and Jooste (2019) and sharing some of the sentiments of Barker (2019) - stating that the SA DTIS still possess much "… skills and technologies that could be shared with BRIC partners for mutual beneficiation. This optimism is shared by a number of other participants in this research. "All BRICS countries have capable aerospace and defence industries. In spite of its small size, South Africa has a remarkably strong defence industry that is ahead of some of its BRICS brethren in terms of unmanned aerial vehicles, artillery and missiles. Whilst Russia and China are mostly self-sufficient, India and Brazil could benefit most from collaboration in the defence sector. In fact, Brazil is already cooperating with South Africa, on the development of the A-Darter fifth-generation air-to-air missile, which will be fitted to both Brazilian and South African fighter jets. South Africa's Denel Dynamics is leading development, with assistance from Brazil's Avibras, OptoEletronica and Mectron (now part of Odebrecht Defence and Technology). Brazil and South Africa are looking at a follow-up missile for their militaries. To India, South Africa exports defence electronics (notably IDAS self-defence systems for military helicopters) whilst India has shown interest in South African missiles, small arms and artillery." (Martin, 2019).

"South Africa's aviation industry is smaller than all other BRICS countries [asymmetry]. There is potential for BRICS nations to invest in some of South Africa's aviation projects such as the Small African Regional Aircraft (SARA) or to buy the Rooivalk attack helicopter. BRICS nations could also invest in South Africa's growing space industry, which has built a number of mostly small satellites. Denel Spaceteq is building an earth-monitoring satellite as part of an African satellite constellation, but

progress has been slow and funding minimal, making it an ideal project for partnership. BRICS countries are already partnering on at least one space initiative. In 2017 the South African National Space Agency (SANSA), the Brazilian Space Agency (AEB), the State Space Corporation "Roscosmos" (ROSCOSMOS), the Indian Space Research Organization (ISRO) and the China National Space Administration (CNSA) formally joined forces to create the BRICS Remote Sensing Satellite Constellation." (Martin, 2019). This is a good example of multilateralism in action with some good opportunities to use FDI as a strategic business level.

Barker (2019) states - There is no doubt that the capabilities of Brazil, Russia, India and China are orders of magnitude more superior [asymmetry] although the research and development and also the production facilities of the RSA, Aerosud, Denel, Paramount and the CSIR, still retain the potential to contribute in R&D and Manufacturing [moderating the asymmetry]." […] The challenge to South Africa in any BRICS cooperation, lies in the experience levels of the RSA Defence Industry that have been whittled away [intellectual capital flight] over the past 15 years and with Defence spending approximately 0.9% of GDP [government as investor], and no SANDF demand for increased R&D or capital replacement programmes [government as customer]. The RSA [is] out of synch with BRIC partners who all have extensive military modernization programmes while the SADF [*sic*] budget is trivial and invested mainly in salaries (60%) leaving insufficient scope to grow defence technology and industry budgets. Could there be a time or situation in which the RSA could be asked to leave BRICS because of its perceived inability to match the BRIC countries' growth? So, because of the regression of capabilities and experience, South Africa will in all likelihood only be able to operate as a Tier 3 level supplier of R&D or components due to limitations in production rate and labour costs." Pelser (2019) states that it is difficult to visualise integration into BRIC in a "… meaningful way with Russia and China through BRICs. [The SA DTIS] would just disappear in it, and we would remain a technology colony." (Pelser, 2019). Martin (2019) share some of this sentiment - "Another important consideration is that countries often do not want to share certain capabilities with other nations due to concerns for national security, sovereignty and to safeguard their industries. For instance, China is notorious for copying/reverse engineering other nations' aerospace and defence technologies, making many companies think twice about working with China or even selling its finished products." This concern is also widely expressed in the published literature as discussed in Chapter 3 of the thesis. It will most certainly be a large contributing factor for the discouragement of SA DTIS collaboration (in most forms) with China.

Another protagonist, Haines (2019), is of the opinion that – "Currently there is a good deal of bureaucratic inertia in developing new industrial and DIB projects." The role of the DTIS is determined by Governmental endorsement. This endorsement can be quantified when looking at investment trends. In the case of the SA DTIS investment has been on the decline, literally, for decades. These investments also depend on the exploitation of opportunities. (Haines, 2019).

Haines (2019) acknowledge, what he calls, "considerable stock of technological know-how; social capital; and transferable expertise" in the relatively small SA DTIS with an uncanny ability to

generate exports as well as cooperation agreements. In terms of possible contributions to BRIC industrial capabilities, South Africa does have "expertise and technological know-how" to contribute. Cognisance must be taken of the fact that in modern defence technology and industrial production encompass a substantial portfolio of - "… spin-in and spin-off of commercial products and services. Also, in South Africa and elsewhere, there is a significant interplay between the digital & creative economy sectors and defence industries." This statement refers to the dual-use nature of defence technology and products. These seem not to be very well explored and appreciated internationally and also not in South Africa.

Haines (2019) is of the opinion that there are several investment opportunities available for the BRICS States as well as in regional and/or international value chains – including the civilian aerospace economic sector. To realise these opportunities, though, Governmental commitment is required. Added to this requirement, and possibly compounding the inability to exploit opportunities, is what Haines (2019) perceive as the South African non-committal to a sustainable (current) SA DTIS. South Africa is focussing on the future of defence technology and industrial capabilities, typically and currently those inherent and as promised by the 4th IR, However, " [a]s the high performing Asian economies show us, one can't easily shift to a substantive 4th IR if we have maintained and grown existing industrial infrastructure and capacity." (Haines, 2019).

Du Toit (2019) cautions strongly against the notion of an - "BRICS Defence Technology and Industrial Sector" – in other words, multilateralism. Du Toit (2019) states that such an ambition is destined to fail. Du Toit (2019) base his strong conviction about this on the fact that the BRICS States does not share national interest and in particular, national interests in the "… sensitive defence and security sector". "This [divergent national interests] is already manifest in the economic space which is largely transactional, and I dare say, would be greatly magnified in the defence sector".

"Moreover, from the South African perspective, where much of its technology is traditionally sourced or integrated with Western defence R&D organisations and companies, any attempts to work with China and Russia on sensitive technologies could cause significant security and IP concerns, which in turn could be counterproductive and could impact both South African access to Western technology and equipment and adversely impact on South Africa's ability to sell into Western markets. This would not, however, be the case with co-operation with either Brazil or India, which like South Africa, co-operate with Western Defence technology and industrial sectors. In short, South Africa and individual companies would need to weigh up very carefully where it wanted to position themselves. And this might be different for individual companies." (Du Toit, 2019).

Heitman (2019) agrees with the view of Du Toit (2019) that multilateralism within the context of BRICS DTISs is probably not possible due to issues of national interest and possibly others. Heitman (2019) base this view on the geopolitical (and possibly others) tensions between China and India and China and Russia. Some of these tensions were also described in Chapter 2 and 3 of the thesis. Heitman (2019) goes as far to project that BRICS as a multilateral alliance will "very soon run out of steam as an entity". Heitman (2019) base this projection on the notion that BRICS came into being

as an 'anti-USA grouping'. However, Brazil and India are continuously moving closer to the USA (and by implication NATO) in terms of dependency on defence equipment. Other disparities amongst the BRICS States relates to economic development, or more accurately in the case of South Africa, the lack of development. Brazil seems to be in a similar predicament. Russia only remains relevant as a DTIS role player internationally due to its nuclear capability, according to Heitman (2019). That leaves only (really) China and India as possibilities for bilateral DTIS relations.

Heitman (2019) also highlights the asymmetry between South Africa and the rest of BRICS. He states – "[BRIC] brought SA on board to add an African member for their own purposes and because here the lights and water work, so it is a more pleasant place from which to venture into Africa than, say, Addis [Ababa]."[25] Myers (2019) adds another cynical perspective – "It seems that South African businesses trying to do business in Africa also have limitations imposed by foreign powers who fund African governments through various means and have a significant "say" in how this money is spent, or that are "gifting" training or equipment and services to African countries, meaning the commercial offering such a service or product is no longer required or attractive to the African client – why buy a patrol boat from South Africa when the Chinese government gives you four for free (Ghana 2017), or why train your IEDD operators when the US will put a military or FBI team in-country for free (Liberia 2017)?" Of course, if this is indeed a fact, then it would be very difficult for the SA DTIS to play a meaningful role in the DTISs of the BRIC States, let alone become a strategic asset to any such bilateral relationship.

Heitman (2019) frame the future of the SA DTIS on the verge of collapse, with only some MRO capabilities surviving. Thus, taking the SA DTIS down to a Tier 3 capability and dependent (again) on foreign supply. Heitman (2019) also contends that the DDIS 2017, of which he was a co-writer) has been rendered (almost) irrelevant due to SA DOD budget cuts impacting severely on the SA DOD acquisition budgets. Heitman (2019) also cites the lack of urgency by the Government to intervene (even if just from a funding perspective) into the imminent collapse of the SA DTIS.

Heitman (2019) does provide some positive views, based on the assumption that the RSA President intervene and the SA DTIS do not collapse. Heitman (2019) points to elements within the electronics domain that the sections of the SA DTIS might still have some comparative/competitive advantage. Yet, he also acknowledges that on most other technologies and products Russia, India and China remain far ahead of the Sa DTIS. Brazil, on the other hand, might hold some opportunity for a meaningful DTIS bilateral relationship – which will facilitate continuous access to the NATO market segments. In this regard Heitman (2019) states – "Brazil would be a potential development partner – they have more money and muscle than we (despite the present problems), are behind us

[25] Rupiya (2019) stated in a classroom setting and lecturing on International Political Economy that South Africa was brought into the BRICS fold because of the South African potential to provide a gateway into Africa. Notshulwana (2012: 8) states - "By joining the BRIC countries, South Africa also hopes to become the gateway for the BRIC countries' entry into Africa."

in areas like guided weapons and most EW and have some quite similar requirements. [Brazil is] also already partners in the A-Darter project and have expressed interest in the further development of Umkhonto and Marlin – and there is potential for some two-way traffic: they know far more than we about ship-building and Embraer may be a model to emulate, albeit on a smaller scale. There is real potential in cooperation with Brazil. But there is also a caveat: the government sold off to private enterprise one of the companies working on the A-Darter project, and they have been trotting around trying to peddle that technology, which has rather soured things here at Denel Dynamics and in the intelligence world. Despite that, I would favour continued and expanded cooperation – assuming that we will have anything with which to cooperate." Goosen (2019) also supports the leveraging of EW niches in Brazil but also India.

Heitman (2019) also place some confidence in bilateral DTIS relations between South Africa and India. He states – "I believe there is also potential in India, despite their massively larger defence industry. They still believe that South African artillery, ESM/ECM and communications equipment are better than anything they can produce, hence the good exports in the latter two fields, the former having been soured by the behaviour of some Denel people on a visit there, to the extent that their foreign ministry formally wrote to complain, and their MoD advised us that the would love to buy our equipment, but only G-to-G, not directly from Denel. Looking forward the greatest potential will lie in joint ventures rather than simply selling equipment. SA companies are put off by the 'Make in India' regulations, but overlook that the Indians recently modified that to the extent of allowing 100% foreign ownership in most sectors of the industry. One thing we do not seem to understand that the 'half-life' of much current and future defence technology is so short that there is little point in holding onto it for dear life. In most cases, we would do better to sell it and move on to the next generation. I would expect aspects of secure communications equipment and EW systems."

On Russia Heitman (2019) holds the following views – "Russia does not have much interest in our equipment, although they have bought some sensor turrets from Hensoldt Optronics for, I believe, UAVs. I am not convinced that we have much to offer them. On the other hand, there might be potential for SA companies to integrate some equipment and subsystems to modernize Russian equipment and 'westernise' it to an extent. That could, however, draw negative attention from the US and probably also from our European equipment suppliers, which would be bad news for the SANDF. It is also relevant to remember here that Russian helicopters have twice signed agreements with Denel to establish MRO capability for their aircraft in SA – Denel invested some R60 million but the Russians never did come to the party. They have since signed a similar agreement with Angola. Also worth remembering that Algeria returned a large batch of I think it was MiG-29s that had been sold to it as new-built but turned out to be second hand. And we must remember the negative noises Russia made when ATE (now PAT) upgraded the Algerian Mi-24s. They would not be partners in any sense of the word. As one example of where we might give away too much, Russia tried quite recently to buy some long-range 155 mm ammunition from RDM. Their order was declined because the batch was so small – if I recall correctly fewer than 100 rounds – that it was clear that the only purpose was to gain direct

insight into the ammunition. What is particularly interesting is that it suggest that SA is ahead of Russia – past masters in artillery – at least in artillery ammunition development."

China, the country that shows the most potential from the perspectives provided in Chapters 2 and 3 of the thesis, do not exude any promise according to Heitman (2019) – "… China's only real interests would lie in - i. Selling us over-priced, low-standard equipment (viz their bid for the Biro OPV, which I gather was to a lower specification and lower standard but 20% more expensive than the Damen offer. Hence the egg dance that finally cost the Navy the OPVs it needs; and ii. Obtaining SA technology and insights to westernise their equipment and to develop their doctrines. That is why they hired three senior SAAF Gripen pilots on what I believe are very nice contracts, which see them working in part as test and development pilots. The problem with dealing with the Chinese would be twofold, one part being the ire of the US, which could cost us dearly given that we still have US bits and pieces in much of our equipment, and the other being that they would rob us blind, as they have done all over the world (not that I blame them, I would probably do the same, and so did we during the embargo years); as things stand, you will find a school of thought that the break-in and theft of computers at what was then Denel Aviation was done by or on behalf of the Chinese. Most of the material on the stolen computers related to the Rooivalk, and I have had people point out some interesting similarities between it end their recent attack helicopters. iii. Like Russia, they would not be partners but exploiters."

Heitman (2019) is of the opinion that the SA DTIS can play a role in Brazil and India, also supported by Goosen (2019) from a technology perspective. This view is shared with Du Toit (2019). Heitman (2019) state – "i. [The SA DTIS] have something real to offer Brazil and India and there is potential there for the SA industry – and for the SANDF as they produce some stuff that we do not or are not particularly good at or lack the required economies of scale. They will want technology transfer and there will be – certainly on the part of India - some level of industrial espionage and - as demonstrated by the one Brazilian company – some level of dishonesty, but that's hardly unusual in the world of big business. Despite that, there is potential for partnership in the real sense and we must remember that that was part of the intention on forming IBSA[26], which seems to be overlooked in the hoopla we make of BRICS, ii. [The SA DTIS] have little to offer Russia and China except insight into western equipment which could cost us access in the future; and we would lose IP to China, although that would in reality only hurt in some sectors and if they then turned it around and competed with us using that IP, which they probably would, iii. So there are two roles [the SA DTIS] can plan within BRICS in the defence industry sector – partner with Brazil and/or India". Heitman (2019) points out that bilateral DTIS relations with China and Russia harbour risk for South African relations with the Western States and their industries.

Comparatively speaking, Minnies (2019) is of the opinion that the SA DTIS does not enjoy priority from a SA Presidency and Ruling Party perspective as is the case in China, Russia and India. This is

[26] Also referred to in Notshulwana, M. (2012: 5) as the – "India-Brazil-South Africa (IBSA) Dialogue Forum".

somewhat disconcerting because of the identified role of government in the sustainability of national defence technology and industrial sector. “The Butter compared to Guns lobby tends to be much closer to the heart in the SA public psyche. This mostly because of historical, political, social reasons. Understandably, the military industry was much more appreciated and supported during the Apartheid government.” (Minnies, 2019). Thus, without the effective execution of the roles of Government within the development and sustainment of the national DTIS, these capabilities increasingly find it difficult to penetrate markets to contribute to the national economy and to the defence capability.

Another factor that crowds the defence and DTIS lobby out of the BRICS multilateral agenda, according to Minnies (2019), is the fact that the DTIS is not understood to be a primary job creator, but rather a scares skills incubator. The SA Government is socio-politically attuned to mass job creation in e.g. the mining and agricultural economic sectors. These are large revenue generators as opposed to the DTIS. However, failing to balance these national priorities will, in the long run, result in the deterioration of the SA DTIS to a Tier 3 (irrelevant) capability and strategic dependence on foreign imports of defence matériel with important negative ramifications for foreign policy autonomy.

Minnis (2019) is, however, of the opinion that the - “SA Defence Industry can stand toe-to-toe to Brazilian, Indian, and Chinese industries as SA defence capabilities cut across wide areas in defence technologies with only the Russian Defence industry surpassing SA defence industry.”

Foreign policy and economic risks also loom (from particularly the USA and Europe) if attempts are made by the SA DTIS to collaborate and/or support the Chinese defence technology development. Minnies (2019) agrees with views Heitman (2019) and Du Toit (2019) that Brazil offers the most viable option for bilateral DTIS partnership. However, Brazil does not present an equally lucrative market as can be found in China and India. “So for SA in BRICS, most of the opportunities with least complications would be with Brazil who would need a wider host of technologies from us but whose economy remains to be in a slump. SA have immediate opportunities from India for specialised light infantry weapons. Too much Indian competition exists for SA military vehicles but the possibility for Hoefyster could be investigated?” Then there is the risk inherent in business with China in terms of IPR. “It’s expected that major exports to India and China would coincide with a demand for transfer of technology. (Minnies, 2019).

Kruger (2019) takes a different tack, i.e. a technology/services/production role - to describe possible roles for the SA DTIS in the BRIC DTIS. Kruger (2019) imagine the following roles -

- Niche technologies across BRICS (e.g. “EW, Radar, Secured Tactical Communications, Mine and IED vehicle protection”).
- “Converting operational realities and requirement into systems solutions (System Engineering and development).
- The industrial sector can contribute to rapid prototyping capability and industrialization. The industrial sector is not geared for volume production.

- Joint acquisition, support and operational activities to be executed through multi-party government-to-government/industry-to-industry participation.
- Technology transfer endeavours through dedicated programs of mutual interest.
- Defence production requirements in terms of large scale production."

Myers (2019) propose a service role for the SA DTIS in terms of training, mentoring and capacity building. Myers also foresee that the sale of systems, sub-systems and software (typically those alluded to above within the bounds of arms control.

Looking towards the future, Minnies (2019) ask the question – "So what areas do these BRICS partners need and what are we prepared to offer. What technologies can we offer to replace the existing providers in those markets? It also depends on how deeply invested the partners already are which would make it difficult for them to switch to new systems. A good example of this is that the Indian market has a huge appetite for Artillery weapons but they have invested heavily into Russian systems that would make it very difficult to switch to Denel equipment." (Minnies, 2019). This crowding-out effect is probably relevant in several capability areas for India (France and Russia, amongst others) and Brazil (strategic collaboration with the USA and Israel amongst others). Minnies (2019) is of the opinion that Russia might construe attempts of the SA DTIS to penetrate the Indian market as an "irritant". "China and India could be in need of major areas of technologies but our offer would be at the cost of Russian technologies." Finally, Goosen (2019) states that from an R&D (and innovation) perspective very little technology collaboration is taking place with the BRIC. There is, however, – "… business in Brazil to provide them with a test and measurement facility on their M200 radar [programme]." This reduces the SA DTIS role to that of R&D development collaboration.

5.2.3. What would be the preferred type of strategic cooperation – bilateral or multilateral, and why?

"By its very nature, BRICS has a strong economic agenda but defence gets incorporated more for convenience and expediency than necessity." (Khanyile, 2019). BRICS is a multilateral economic alliance which could be strengthened [and possibly diversified] by means of – "… bilateral agreements that are issue-specific or capability specific for any of the arms of service (land, air or maritime). If it is focused at a granular level (like special forces equipment) it is likely to yield fruit." (Khanyile, 2019). Increased granularity also assist with driving down complexity and increasing control over specific areas of collaboration.

"One would surely proceed with both types of cooperation as we already have bilateral deals and cooperation in place. Multilateral cooperation shouldn't rule out bilateral cooperation on certain ventures." (Haines, 2019). However, most participants (Minnies, 2019; AP01, 2019; Wyatt, 2019; AP03, 2019; Jooste, 2019; Kruger, 2019; Martin, 2019; Khanyile, 2019; Mathieson, 2019; Myers, 2019; Goosen, 2019) state simply that bilateral collaboration is more preferable. Goosen (2019) states simply – "[B]bi-lateral is difficult to achieve multilateral is rather impossible- both RSA and Brazil

realised that India's scale and scope are far larger than ours, with a strong focus on local development and manufacturing."

Kruger (2019) state two reasons -

- "Multilateral should be avoided – Russia and China, with India short on their heels, is world powers and each in their own right overwhelming South Africa and Brazil, in economy and defense. We will be consumed by the power struggle between Russia, China and India.
- Bi-lateral is the preferred option, can be more balanced i.e. in size (Brazil) or strategic importance. Our technology base determines our strategic value."

With these statements, Kruger (2019) also highlights the issue of asymmetry and its significance in the choice of bilateral partner. Strengthening the argument made by Kruger (2019), Mathieson (2019) states – "In my personal experience, the Russians and the Chinese having much more advanced defence technology and industrial bases, viewed Brazil, India and South Africa merely as markets for their products whereas there were/are more areas for genuine co-operation on development on an individual basis between Brazil and RSA (A-darter [missile]) and India and RSA (Communications and EW). I am not aware of any development co-operation agreements between RSA and either Russia or China on a national level. (Mathieson, 2019).

AP01 (2019) and Martin (2019) qualified their preference for bilateral relations by stating the bilateral collaboration is less complex to achieve, areas of mutual interest are easier to identify, communication and planning are less complex. AP01 (2019) does, however, state the caveat of a requirement for (at least some) common interests – which Kruger (2019) state the requirement for "mutual interest" between partners. Myers (2019) states the requirement for risk mitigation when engaging in bilateral partnerships in terms of secure payments.

AP03 (2019) is of the opinion that, from a geopolitical perspective, India and China do not share much common interest. Russia and China do not share – "comparable defence concepts". This would, therefore, complicate the establishment of a multilateral DTIS collaboration in any form. Wyatt (2019) is of the view that – "… sharing IP, technology and co-production on any advanced systems like robotics, artificial intelligence, remotely piloted vehicles or human-cyber connectivity with Russia or China would garner the wrath of Western states and likely close off all future opportunities there for trade, cooperation, tech sharing or defense offsets. Given this reality, I would recommend only limited cooperation on a bilateral basis with China or Russia. Given any trilateral pact with Brazil and India [IBSA] would likely offend Moscow or Beijing, the best approach, therefore, is bilateral with India and Brazil."

The South African Defence requirement, in terms of volume, for the Rooivalk attack helicopter is to low and thus the further development of the capability is not sustainable without investment and interest from foreign partner States. Thus, the obvious bi- or multilateral partner States would be China and/or India. Given the geopolitical antagonism between China and India, a bilateral partnership would be more suited. Brazil, on the other hand, is already in a bilateral missile technology (air-to-air) development and production partnership with the SA DTIS. Bringing the discussion back to foreign

policy and trade risk – missile and other military technology development collaboration between the RSA and Russia or China will in all probability antagonise the USA and European market segments. (Minnies, 2019). AP03 (2019) amplify this predicament stating the due to the USA imposed sanctions on Russia the SA DTIS will not be able to trade/collaborate with the Russian DTIS. The only avenue might be Government-to-Government contracting through Armscor.

Wyatt (2019) is of the opinion that the Brazilian DTIS's proven performance record and customer base have an inherent potential for JVs and/or M&A with the SA DTIS. "It makes strategic sense for smaller players in states like India, Brazil and South Africa to cooperate [JVs] or, in many cases to consolidate [M&A] […] Immense capital costs for research and development make it very difficult to small players to compete in the aviation design and manufacturing industry. Constant consolidation in the aviation industry has also reduced the number of actors in the West, but conversely has made it easier for those remaining to raise necessary R&D capital." (Wyatt, 2019). These factors are of specific importance to South African companies such as Denel, Paramount, and Armscor. Bilateral cooperation could assist the SA DTIS with market penetration in developing markets with niche technologies such mine-protected vehicles and/or the AHRLAC multipurpose aircraft from Paramount Group, or to license technology development in order to raise export revenue from the leveraging of the IPR. (Wyatt, 2019).

India is the second choice amongst the BRIC partner States. India is still heavily dependent on foreign imports, and mostly Russian. "Cooperation with New Delhi represents a potentially lucrative market for South Africa and a healthy alternative for India, which seeks closer ties to the US. Reducing its dependence on Russian arms would be a positive step for India and benefit South Africa's companies." (Wyatt, 2019).

Minnies (2019 states that the balancing of national self-interest is achieved much easier within bilateral partnerships. Consensus building is better facilitated by bilateral partnerships. Minnies (2019). "Ideally, bilaterals would include technology transfers leading to foreign direct investment through acquisitions, joint ventures and partnerships." (Barker, 2019).

AP01 (2019) describes multilateral collaboration as administratively and politically complex and intensive with the potential to deliver substantial gains through large collaborative projects. Multilateralism also provides access to multiple funding sources, technology and industrial capabilities and more complementarity. As such, with a strategic time horison in mind, multilateral collaboration could provide very substantive results. However, where asymmetry is present, fairness and transparency may suffer.

Minnie (2019) is of the opinion that multilateralism is best suited where possible partner States share the same threats and interests. This is obviously not the case for BRICS considering the discussion earlier in the thesis about asymmetry. Minnies (2019) summaries this asymmetry as follows – "The countries are geographically diverse and mostly do not share the same military threats. The various military sizes are also diverse as SA has a relatively small market compare to Brazil, Russian,

China and India. The wide extent of [the SA] technical military capability is impressive compared to China, India and Brazil."

Barker (2019) is of the view that - "If there were to be any form of strategic cooperation extended to the RSA, multilateral cooperation would be mutually beneficial in accordance with the aims of BRICS' goal of impacting global issues, economic growth and development, expansion of markets and promotion of international trade and investment. This, however, would not preclude multilateral cooperation in specific niche areas e.g. Russian and China's joint development of a fifth-generation fighter or the upgrade to the [Russian-Indian] Brahmos missile." Minnie (2019) is of the opinion that multilateral partnerships also fit situations where funding needs to be pooled. However, where technology development is concerned, bilateralism is more suited.

Du Toit (2019) states concisely that - "… if strategic co-operation is to be pursued at any level within the BRICS construct, that this should be on a bilateral basis for all the reasons discussed under question 1. Moreover, as further discussed in question 1, this co-operation should probably be limited to bilateral cooperation with Brazil and India. The danger with bilateral co-operation with Russia, and in particular China, is that they might see cooperation with South Africa as a means to tap into Western technology which they might not otherwise be able to access. And of course, this would have negative consequences for South Africa."

Heitman (2019), based on some of his views already stated above, strictly favours bilateral relations with India and Brazil. AP03 (2019) also favour India. However, from an IBSA perspective - "Brazil and India where there does seem to be room and potential for some three-way projects as our technologies to some extent complement each other." Heitman (2019) clearly states his scepticism about any future bilateral and or multilateral relation that would provide – "China insight into its defence technology and industry. Nor do I expect the present apparent friendship between Russia and China to last, they have too many differences, too many conflicting interests (particularly in Central Asia) and too much negative history.

5.2.4. Which strategic business levers (e.g. technology transfer, mergers and acquisitions, foreign direct investments, joint ventures, partnerships, etc.) would be prudent for consideration to establish future bilateral defence technology and industrial partnerships between South Africa and the BRIC States – and possible reasons for this?

Mathieson (2019), Kruger (2019), Martin (2019), Myers (2019) and Goosen (2019) are of the view that the strategic business levers mentioned above are all prudent. Goosen (2019) reiterates that the choice of the business levers used should be on a case-by-case basis. Mathieson (2019) confirms his preference for bilateralism with the statement - "Each BRICS partner should be dealt with individually." Mathieson (2019) qualifies this preference with an individualised prognosis of each BRIC State –

Table 5.1. Individualised prognosis of each BRIC State by Mathieson (2019)

Country	Strategic Business Lever	Comment by Mathieson (2019)
Russia	JV & FDI	"Russia views South Africa as a possible springboard into the rest of Sub-Saharan Africa and as such, they would prefer to "buy" new distribution channels to get access to these markets. e.g. Russian helicopters signing a deal with Denel to service their helicopters in Africa. In my own experience, Russia is not prepared to share its technology with the RSA because of the links back to European defence suppliers."
China	Technology Transfer & FDI	"China has not indicated any willingness to engage with joint venture or partnerships as they prefer to support their own military hardware in Africa. They have, however, signed co-operation agreements with the CSIR whereby they get access to hi-tech military technology which they do not have e.g. DRFMs (very one-sided). FDI comes in the form of establishing Chinese production facilities in RSA for products which can be used for military applications, e.g. electronic components."
India	Technology Transfer & Partnerships	"There has been very little in common with India w.r.t. real co-operative developments. The Indian model is that they prefer to by the products from South Africa, but they expect production facilities to be established in India and to get design knowledge on the products to enable local (Indian) product changes. Most of the Indian in-country technology is from Russia and lately from Israel so there is in my opinion very little indigenous knowledge that they can share with the RSA, e.g. Brahmos [missile]."
Brazil	Partnerships, FDI & JVs	"Brazil is the one country where tangible results can be seen w.r.t. to defence co-operation. Brazil has most likely based its decision to procure the Gripen because of the local RSA capability to produce EW Systems, comms systems and missiles for the aircraft. RSA is prepared to share this knowledge with Brazil. They have co-funded the A-Darter programme and indications are that if their economy improves, they are most likely going to fund the RF version of the A-Darter. There is also very good co-operation on the operational level, e.g. Naval and Air Force exercises."

Kruger (2019) calibrate his view with – "… depending on the scenario and desired or expected outcome. Joint "equal ownership" should encourage commitment and the will to succeed, it must enforce participation and be based on a contribution and risk sharing [*sic*] model. If one dominates the others it is set-up for failure. Focus should be placed on operational capability requirements. The retention of key technology enablers between partners providing key capability in the world market should get focused attention." This statement again highlights the significance of asymmetry mitigation requirements.

Martin (2019) provide some calibration stating that some will provide a greater chance for success than others. Martin (2019) also provides some examples to substantiate his opinion – "… transfer of technology has worked well for South African defence companies in the Middle East (particularly those transferring technology and skills to Saudi Arabia and the United Arab Emirates),

but the problem with this approach is that it is short term – as soon as the technology and skills have been transferred, South African expertise is no longer needed. Joint ventures and foreign direct investment are far more sustainable, long term solutions that can jointly grow industries now and in the future. A good example is the collaboration between South Africa and Brazil on the A-Darter missile, which has opened the door to a follow-on (the Marlin) and created other new opportunities. Joint ventures and partnerships have worked well for the local industry in many cases, such as [RDM] (a partnership between South Africa's Denel and Germany's Rheinmetall), and Barij Dynamics (a partnership between Denel Dynamics and the UAE's Barij). Saab's investment in South African companies has also been hugely beneficial as it brings Saab's customer base and funding to the South African industry." All of these examples also support the arguments for bilateralism.

Myers (2019) shares the comments made by Martin (2019) on RDM – "[RDM] seems to be a mix of [M&A] and within this corporate vehicle technology transfers and direct investment now takes place into South Africa giving the Denel entity a far greater global reach than if it remained a South African entity. I believe this entity does sell directly into and offer services to at least one BRICS nation (being India) [large calibre ammunition]. For Damen, opening a South African business entity with some local content and ownership seems to have been enough to unlock business in South Africa (BIRO and TNPA), but I do not know if this will translate to success for DAMEN in other BRICS partners though as I am not aware of orders received by the local DAMEN office from any BRICS members to-date. One South African company (XXXXX Systems) does sell to India, with locally-developed and manufactured EOD and demining protective wear being sold repeatedly into India (and other non-BRICS nations) through a local agent – thus no direct investment or similar arrangement, simply a regional agency agreement with a local supplier, a business model it follows in other non-BRICS nations." Myers (2019) add to these examples some strategic perspectives – "I am of the view that each case needs to be examined on its merits and opportunities presented. The key challenge here is that both Russia and China are key armaments exporters and provide training and support to clients, and India is already a client of both, while Brazil is now starting to purchase both arms and services from both (as well as from the US, UK and European suppliers). This doesn't leave much for South Africa, although I do understand South Africa is in talks with Brazil about providing Air-to-Air Missiles to them for use on their Gripen aircraft and is in talks with doing business with India again (notably the sale and support of missile and artillery systems). How these deals will be done and levers to be used seem unclear, but I would expect the Gripen missile deal to be linked through SAAB and South Africa being a SAAB client, and RMD is an existing supplier to India. I doubt we have anything to offer Russia or China that they don't already have or have access to.

Wyatt (2019) is of the view that JVs, technology transfer and partnerships with the Brazilian aviation manufacturing sector could serve as an appropriate market entry point. Jooste (2019) caution against the practice of technology sharing. Jooste (2019) advise commencing with JVs instead.

AP03 (2019) is of the view that the South African DTIS policy prevents the sharing of what is considered sovereign technology. This points to a hybrid SA DTIS policy framework. The SA DTIS

also seem to overvalue their IP portfolios. AP03 (2019) states that these issues terminated several collaborative opportunities in the past which resulted in the potential partners seeking partnerships elsewhere. Examples of such lost partnerships are Israel, Turkey, South-Korea and China. These countries are non-ITAR, non-USA technology-based but have governments (unlike South Africa) that actively play their respective roles in promoting technology transfer, M&A, FDI, JVs and other collaboration. AP03 (2019) stated his scepticism about any remaining opportunities for the SA DTIS under conditions characterised by a non-committed SA Government to provide trade and funding conditions to ensure a sustainable SA DTIS.

Wyatt (2019) stated on the matter of technology transfer – "Technology transfer to Russia or China will not prove beneficial to South Africa. Neither state has [South Africa's] interests anywhere near their own priorities. While teaming with either could lead to some production in Africa and sales, it is not a prudent idea. South African IP and tech would be at grave risk, likely with little return from those partners. Too, Washington and Brussels would probably write Pretoria off and not cooperate in the future."

AP01 (2019) states concisely that JVs is preferable because it can be structured according to objectives, decision-making authority, and resources allocation amongst the venture partners. Barker (2019) is of the view that - "Any business levers, strategic or not, will have to be based on economic development in South Africa through amongst others, job creation, skills transfer and SMME [small, medium and micro enterprises] development, all [of] which would have [to] be negotiated on a country to country basis and it is here where other member countries may not be sympathetic to the South African cause of socio-economic upliftment whereas their efforts are more focussed on cost-effective business practices; they ultimately have to compete with market demand." Haines (2019) states it simply that strategic business levers are dependent on the nature of the projects in terms of feasibility and profitability. The strategic business levers are also dependable on - "…new forms of industrial and defence participation as the levels of incentives has dropped since the 2000s." (Haines, 2019)

Barker (2019) states further about strategic business levers that - "[t]he entire range of business levers will be a function of the strategic aims of any bi-lateral [*sic*] or multi-lateral [*sic*] cooperative projects and each case should be treated on its merits vs the strategic objectives and government guidelines. There is no one optimum solution, each will have to be treated on their individual merits [a select combination of strategic business levers]. The biggest challenges facing the selection of a business lever will be sovereignty issues and IP transfers [issues of control and ownership, making JVs more preferable]. Ideally, bi-laterals would include technology transfers leading to foreign direct investment through acquisitions, joint ventures and partnerships."

Du Toit (2019) states with great certainly that - "… if bilateral opportunities were to be pursued with Brazil and India, I believe the most appropriate and prudent options would be either joint ventures or partnerships, which might result in technology transfers either between countries or to third parties if joint export opportunities were to be pursued."

Heitman (2019) does not exclude any business lever – "the choice of mechanism depending probably mostly on the equipment or system concerned" but prefer JVs between the SA DTIS and those of Brazil and India. Heitman (2019) states – "The main reason for being so positive here is that I see some areas where our industries really can complement each other. In the case, of India, for instance, they could benefit from SA's ability to bring projects to fruition quickly and at surprisingly low cost compared to their often multi-decade struggles. I would exclude the Rooikat and Project Hoefyster from our list of examples, but for the rest, the DoD, Armscor and the industry have done well and indeed much better than all of the major powers. As quid pro quo, Brazil has learned much from their SIVAM project that they are now applying to their border management system. Admittedly most of the key equipment is foreign, but there are a lot of lessons there for us. Both countries are also ahead of us in ship-building and the aircraft industry (Rooivalk excepted). Finally, both countries employ essentially western approaches to business and government, much as do we (not all of the time of course), whereas Russia and China have quite different approaches." This is also the opinion of AP03 (2019) stated earlier. These do not apply to China and Russia, except – "…for SA companies to enter into JVs to westernize or upgrade equipment for clients. I could, for instance well imagine a Russian BTR-90 fitted with Denel's medium, combat turret being a very effective piece of kit. Anything else would most likely be a one-way street. The only example that I can think of where that was not entirely the case has been joint ventures between Russia and India, and the Indians meanwhile seem less than happy with Russia's side of things."

Pelser (2019) express somewhat different views on strategic business approaches. Pelser (2019) is of the opinion that the future of the SA DTIS, within the context of BRICS, is predominantly with the - "…non-aligned countries. Imagine partnering with countries like Turkey, Jordan, Nigeria, Algeria, Mexico, Pakistan, maybe still Brazil/India (admittedly BRICS), etc. The Non-Aligned Defence Industries Corporation! Countries roughly our size, also on the cusp of a defence industrial capability, with strategic challenges and aspirations. Such cooperation should be on the basis of multilateral govt to govt [*sic*] partnership - with a conglomerate that would operate in each country and that each would consider their own, impossible to take away from them. Many countries will be required to make it viable/affordable and compete with the West and East. Would involve sharing of development costs and IP and spreading of capabilities, protected by escrow." This would fall into the category of consortia or JV (but probably more JV because of the strategic focus – i.e. longer time frame), referring back to Figure 2.15 in this thesis.

Minnies (2019) propose that the difficulties experienced in South Africa with regards to the funding of domestic military technology development and production for the local market as well as export-orientated funding could be breached with financing through the BRICS Bank. This could thus also be perceived as a strategic business lever at the disposal of all BRICS partner States. The proposed South African Defence Industry Fund (DIF) - proposed and investigated by the NDIC - could be used to investigate BRICS Bank financing in support of the aims of the DIF. (Minnies, 2019). An example is offered by Minnies (2019) on how bi- or multilateral partnerships using investment pooling,

possibly in the form of a JV, can be used to drive the development and market penetration of the Rooivalk MkII. This reasoning is based on the technology-pull from the BRICS militaries (possibly excluding the Russian military due to the Mi-helicopter technology produced by the Russian DTIS).

5.2.5. What are the market niches/capabilities/products/services/technology/IP that the South African defence technology and industrial sector can contribute to establishing/enhance possible role(s) in the BRICS defence technology and industrial capability?

"The domains in which South Africa was fast becoming a force to be reckoned with, have declined over the years due to inadequate local demand from the SANDF which has stifled the growth of the supplier base.[also stated by Jooste (2019), AP03 (2019), AP01 (2019) and Barker (2019)] Currently, all the BRICS countries are competitors against each other in the defence marketplace. However, there have been pockets of successful collaboration in terms of co-design and co-development in the missile environment. This has, however, been hampered by the liquidity challenges that the relevant SOE partner (Denel) is facing. The reputation of the local defence industry has also taken a serious knock due to Denel's inability to honour its commitments to international clients and local suppliers. It is therefore difficult to secure meaningful capital-intensive bilateral joint ventures because of the mass exodus of top defence specialists who are migrating to the Middle East, thus depleting the local skills base. South Africa has been reputed in domains like command and control, mine-clearing and heavy indirect fire support equipment. It is not clear if South Africa still enjoys any recognition in that space as much as it did in the past." (Khanyile, 2019).

Barker (2019) is of the view that - "If the technology/products/services being introduced are not disruptive and cost-effective, in today's cut-throat defence industry, such interventions will not succeed. If similar products or services are already in the market, entry barriers are high and it is nearly impossible to break through into such markets. In addition, the national approach to IP control (Armscor) could make any multilateral or bilateral agreements, difficult to implement, particularly in the higher security classification programmes in Electronic Warfare, Missiles or Sensor Technologies." [security as an issue with IPR] [autarkic approach to IP leveraging]

Pelser (2019) states that the SA DTIS had excellent opportunities with – … Rooivalk, the armoured/mine-protected vehicles, G5/6, EW, radio technology etc. [The SA DTIS] should have leveraged these immediately after 1994. However, little remains of the industry and it may be too late to do anything. The SCAMP is dead, the budget is too low and HR heavy, there is no money for acquisition or technology, SANDF is in survival mode and must dedicate all funds to that."

Haines (2019) propose a process of review to determine what defence technology and products are exported and to which markets to provide insight into the SA DTIS market segmentation. This should be supplemented with explorative research to discover – "… new forms of collaborative manufacturing set-ups say in SEZs and IDZs." (Haines, 2019). These economic and industrialised zones could be very attractive for tax-free technology and product development collaborations among the BRICS States. They are in the domain of the Department of Trade and Industry and would also

thus require intra-governmental collaboration aimed at creating a sustainable SA DTIS. In the opinion of Haines (2019), the following technologies/products have an export profile –

- Drone and surveillance video technology
- Optics and related avionics.
- Missile technology and long-range armaments.
- Armoured and mine-resistant vehicles.
- Combat suite technology and integration (e.g. C^2I^2 products that are being exported to the USA)

Haines (2019) is of the opinion that the development of cybersecurity and new applications of blockchain technology requires collaborative efforts. Composite materials are another Tier 3 industry that would require commercial/military collaboration as these have distinct dual-use capacities.

Du Toit (2019) is of the opinion that due consideration should be given to the extent of ownership of SA defence technology and industrial capabilities by Western Defence companies. Du Toit (2019) states further that ownership of capabilities is important from the perspective that if - "… a South African subsidiary of a Western Defence Group is considering partnering with either Brazil or India, where the parent group might equally be considering either selling into the same market or seeking to partner with those nations, or on the other hand, might not be comfortable with co-operation. For purely South African owned companies, the question remains one of where they would wish to position their export opportunities and their access to technology."

Heitman (2019) is of the opinion that the SA DTIS still maintain a comparative/competitive advantage in limited aspects of secure communications and Electronic Warfare (EW). The caveat though is that most of the EW capability is owned by foreign companies based in South Africa in order to mitigate governmental export control issues in their home country. Heitman (2019) provides some examples – "But they would not look away if their own interests were in any way threatened. For instance, quite a few NATO countries use SA self-protection (Saab Grintek Defence) and COMINT (Hensoldt GEW) and would not be at all happy to see Russia gaining insight into that technology. Similarly, India would be far from happy to see [South Africa] give the Chinese insight into our secure comms and ESM/ECM equipment that is widely used by their armed forces." Other technology and product system leadership maintained by the SA DTIS is in

- Long-range artillery (105mm and 155mm). This includes the G5 and G6 self-propelled artillery systems, the ammunition and the processes involved in the production. The competitive advantage of the ammunition produced at RDM was discussed in Chapter 2 as a limited case study. Obviously, without continuous development, this competitive advantage will soon deteriorate into a comparative advantage and then disappear. The merger between Denel Dynamics and Rheinmetall Germany thus prove the utility of liberal industrial policy. It is considered liberal by the researcher because the IPR developed and protected at Denel Munitions were considered strategic – but it was recognised that it would be irrelevant if funding and development could not reach sustainable levels. Hence the merger with a 51% equity sale to Germany). If the SA DTIS consider

bilateral relations with for example Russia and China on the development of their 155mm capabilities – the German Government (and for this matter NATO) will terminate this merger and probably relocate the production facility as well as draw all the expertise with such move. This will leave the SA DTIS with no capability in a very short time and dependent on imports.

- Guided weapon capability, located in the Denel Dynamics capability, is a niche which successfully exists on the periphery of the Western DTIS powers. This is also considered to be – "… ahead of Brazil and in some aspects ahead of India, but not necessarily better than what Russia and China can do and in the case of the former we may well be behind."

A critical element to consider for bilateral DTIS partnerships on secure communication- and EW technology with China and Russia is the negative fallout internationally for South Africa foreign policy and within the SA DTIS market segments, says Heitman (2019). This view is also expressed in a broader sense by Wyatt (2019). He is also of the opinion that the favourable South Africa foreign policy stance towards Russia and China are not shared by the international community. As such, the SA DTIS (potential) Asian market segment would be severely affected. Heitman (2019) states – "I would refer here again to the attempt to force a Chinese OPV (built to their export standard, not as for their own navy) on the SAN. A cautionary tale here might be the notion of selling Umkhonto to Iran – not just the US was unhappy, we would have lost our very lucrative defence market on the west bank of the Persian Gulf" [UAE and Oman]. (Heitman, 2019).

Minnies (2019) list the following systems as possible opportunities for the BRIC market (pending an investigation into the requirement and/or interest) and would have to compete with extant Russian, Indian and Chinese systems –

- Armoured Protected Vehicles (e.g. those being produced by Denel Land Systems)
- Missiles (typically those developed by Denel Dynamics).
- Artillery (typically those developed by Denel Land Systems).
- Logistics support capability for Russian and Chinese made military Aircraft and Vehicles in on the African continent. (Denel and possibly Paramount capabilities).
- UAVs (with due consideration of the foreign policy and trade risk when arming these platforms.

Moodley (2019) is of the view that at least the South African missile systems, EW, Vehicle technologies and a single integrated command and control system are viable options for the BRIC market. Wyatt (2019) posits that the SA DTIS still has some technology capabilities and niches in avionics, flight safety, fixed and rotary wing parts, anti-mine tech, artillery and small arms. Jooste (2019) is of the opinion that some niches still exists in command and control, Vehicles, Munitions, missiles, sensors and possibly other soldier systems. AP03 (2019) provides the following tabulated views of niche technology domains with -

Table 5.2. South African Defence Technology Niches by AP03 (2019)

Technology	Industry Champion	Globally Competitive	% Export	BRICS Attraction	RSA government ability to influence and use in geopolitical e.g. BRICS relationships
EW	GEW SAAB	Very High	>90%	High	Almost nil
Electro-optics	Hensoldt	High	>90%	High	
Radar	Reutech	Medium	>60%	Medium	
Large caliber ammunition & rockets	RDM	Very High	>85%	High	
Missiles	Denel	Low **	>70%	Medium**	IP is owned by the RSA government so could be used if there is demand for this technology – but other developing countries have caught up (e.g. Turkey and South Korea)
UAVs	Denel	Low**	>70%	Low**	
Combat vehicles	Denel	Low**	>80%	Low**	
Artillery systems	Denel	Low**	>70%	Low**	
Radios & communication	Reutech	Medium	>50%	Medium	
MRAP vehicles	Denel, LMT, Paramount, others	Medium	>90%	Medium**	This area is rapidly becoming non-competitive globally due to old technology overtaken by new countries
Small-medium calibre ammunition	Denel PMP	Very Low	>50%	Very low**	This area is completely non-competitive globally due to old technology and old facilities

"Note: ** areas marked were on a positive trajectory until 2015, but as a result of the combined impact of (i) state capture, corruption combined with (ii) the ill-considered "Defence Industry Transformation Charter" combined with (iii) the decimation of local MOD/DOD project funding streams, these areas have lost international competitiveness and is simply no longer "needed' by BRICS and other partners who attracted better technology partners e.g. from Turkey & South Korea, developing countries who fanatically focused on building their industry". (AP03, 2019) South Africa and Brazil do not share this development focus. (AP03, 2019)

Kruger (2019) again places emphasis on niche technology domains. Over and above the technology roles stated in question 1 above

- Engineering solutions for systems, software and logistics where complexity is a primary hurdle.
- "Interpreting customer and operational requirements and translate it into system solutions – from development to production, to commissioning to through life support.
- Interoperability and integration of level 4 systems into level 5 systems."

Martin (2019), continuing a more protagonist outlook, is of the opinion that - "South Africa was a world leader in long-range artillery, helmet-mounted sights, electronic warfare, mine-protected armoured vehicles, guided weapons, unmanned aerial vehicles and small arms. It also developed nuclear weapons, an attack helicopter and space launch vehicles and satellites. Whilst it is lagging in some areas and is being overtaken in others, it still has a lot to offer in terms of technology and skills. For instance South African companies offer armed unmanned aerial vehicles (Denel Dynamics and Milkor) which is a niche in the world market; PMP has created the unique Inkunzi 20 mm weapon which has no equivalent in the world; Desert Wolf developed the unique Skunk crowd control drone;

Denel Land Systems only needs funding to complete its G7/LEO artillery piece that is lighter and has a longer range than competitors; and Rheinmetall and Denel are developing an active protection missile. South Africa pioneered the V-hull mine-resistant vehicle technology and has many different companies manufacturing armoured vehicles. It has successfully helped other countries, especially in the Middle East, develop their armoured vehicle industries and could do the same with BRICS states. Areas of competence which South Africa is still strong in include unmanned aerial vehicles, armoured vehicles, artillery, guided weapons and electronic warfare systems." (Martin, 2019). These views correspond with several of the others above.

Mathieson (2019) provides a short list of niche technologies that could be leveraged within the BRICS DTIS ecosystem –

Table 5.3: Niche Technologies Categorised according to Service Domains by Mathieson (2019)

Naval Technology	Air Force Technology	Ground Forces Technology	Other
• Tracking & FC Radar • Electro-optical trackers • Underwater Autonomous Vehicles	• Electro-optical Sensors, including IR cameras & Helmet Mounted Sights • Air to Air Missile technology • DRFM & ELINT technology • EW Simulation & Analysis (SEWES)	• IED Jammers • HF Radio technology • Mine-resistant vehicles • Long Range Artillery	Test Facilities – Gerotek, Alkantpan, OTB, IMT

Myers (2019) provides a list of possible services and products – "Specialist services (training, mentoring and advisory services), equipment provision and technical support (vehicles, tactical apparel, some demining/EOD/IEDD equipment, munitions stockpile management and reduction, repair/maintenance/upgrade of old weapons/vehicles/aircraft)."

5.3 FINDINGS AND CONCLUSIONS

The findings for Chapter 5 of the thesis are clustered around the questionnaire questions of the thesis. The findings of this section also incorporate the findings of Chapters 2 and 3 to provide a synopsis of both secondary and primary data analysis and synthesis. The primary motive for international DTIS collaboration is to climb the "Ladder of Production" at a faster pace than would be possible within an autarkic approach to DTIS development. The motive is also directed at moving from import dependence to achieving self-sufficiency and ultimately dominance of all or certain technology and//or production capabilities. Conceptually, it is thus to shift the curve of development to have competitive/comparative advantage soonest.

The role of the SA DTIS in the BRICS DTIS ecosystem could be described as a collaboration partner for the development of niche technologies, a supply chain partner for niche product systems and integration services and a gateway to the African market place. There are facets of the BRICS

DTIS ecosystem that provide fertile ground for the establishment of bilateral DTIS partnerships. Such fertility is incubated by similarities within the context of this thesis between the various BRICS States are as follows -

- Evidence of an idealistic DTIS policy.
- Evidence of liberalisation/hybridisation of DTIS policy.
- Recognition by most States that these policies are required to shift the development curve or climb the “Ladder of Production”.
- Aspirations to be self-sufficient and reach Tier 1 capabilities soonest.
- Shared market segments.

This similarity and any potential bilateral DTIS collaboration between the SA DTIS and other BRIC DTISs stemming from them are calibrated by asymmetry. An asymmetric relationship exists at least between South Africa and China, Russia as well as India. This predicament should steer the SA DTIS to carefully consider the practicality and prudence of such bilateral relations (even against the favourable developmental background framed in Chapter 2 and 3) and which strategic business levers will best facilitate the development of the SA DTIS as a strategic partner to the BRIC States.

Cetirus paribus, there seems to be a distinct preference for bilateral partnerships. There is also a predisposition towards Government playing a distinctive role(s) in the formation of such relations, mostly from an investor, customer, regulator and supporter of the SA DTIS perspective. A limited need for multilateralism was also expressed. However, bilateralism will in all probability be the preferred vehicle for collaboration because of the security and discretionary requirements attached to defence contracting. This supports the thesis of this study.

Based on the initial indications of good to exceptional defence and DTIS growth, Chapters 2 and 3 positions Russia, China and India as possibly the best DTIS partner States. Yet, with more discussion on other facets of the DTISs, it becomes clear that both Russia and China are not the best candidates for bilateral collaboration. The primary data support this finding. Brazil and India are positioned by the secondary and primary data as much better options for bilateral collaboration. This is probably based on the extended bilateral relations the SA DTIS has with Brazil on the development of missile systems as part of a JV based in Brazil. There is also less asymmetry between the SA DTIS and that of Brazil. In the case of India, the asymmetry is much higher but mitigated by some of the technology niches still maintained within the SA DTIS. Then also, in the case of both Brazil and India, there are traditional and more recent linkages between the SA DTIS markets situated in NATO countries and those of Brazil and India.

Bilateral relations with China and Russia are less desirable because of their traditional antagonism towards the Western States and their DTISs from a supply chain perspective. The strategic business lever of choice is JVs as pointed out by several of the participants.

Considering the WPDRI 1999 defined list of sovereign capabilities, labelling them “Strategically essential defence technologies and capabilities” (1) Logistic support, repair, and maintenance, (2)

Systems integration; (3) Command, control, and communication systems; (4) Sensors, signal processing, and data processing; (5) Software and software support for combat systems; and (6) Simulation systems and war gaming" (South Africa, 1999, 38-39 and FAS, *circa* 2001) and "… logistic support and the design, development, systems, integration and testing capabilities of the military electronics, guided missiles, artillery, and armored vehicles sectors" were considered strategically important and critical to export markets (FAS, *circa* 2001) stated in Chapter 3 of the thesis – not much has changed in terms of what is perceived to be strategically important and viable niches. A synoptic overview of the findings from 5 is tabulated below –

Table 5.4. South African Market Niches/Capabilities/Products/Services/ Technology/IP Matrix presenting possible opportunities for bilateral partnerships

Niches/Capabilities/Products/Services/Technology/IP	SA Companies	Primary and Secondary Support
EW (e.g. IED Jammers, DRFM and ELINT technology, EW Simulation & Analysis (SEWES))	CSIR	AP03 (2019), Pelser (2019), Heitman (2019), Moodley (2019), Martin (2019), Mathieson (2019), Goosen (2019)
Electro-optics (sensors) (e.g. IR cameras & Helmet Mounted Sights & Electro-optical trackers)		AP03 (2019), Haines (2019), Jooste (2019), Martin (2019), Mathieson (2019)
Radar (e.g. Tracking & fire control radar, R&D)		AP03 (2019), Mathieson (2019), Goosen (2019)
Missiles (guided weapons) (e.g. air-to-air missiles, surface-to-air missiles)	Denel Dynamics, RDM	AP03 (2019), Haines (2019), Heitman (2019), Minnies (2019), Moodley (2019), Jooste (2019), Martin (2019), Mathieson (2019), Khanyile (2019)
Vehicles (MRAP, Armoured/mine protected vehicles)	Denel Land Systems, Paramount	AP03 (2019), Pelser (2019), Haines (2019), Minnies (2019), Moodley (2019), Wyatt (2019), Jooste (2019), Martin (2019), Mathieson (2019), Myers (2019)
Demining/EOD/IEDD equipment		Khanyile (2019), Myers (2019)
Artillery systems (e.g. G5/6 self-propelled artillery systems and G7 under development) & Large calibre ammunition & rockets	Denel Land Systems	AP03 (2019), Haines (2019), Pelser (2019), Heitman (2019), Minnies (2019), Wyatt (2019), Martin (2019), Mathieson (2019), Khanyile (2019)
Radios & communication (e.g. HF systems)		AP03 (2019), Pelser (2019), Mathieson (2019)
Small-medium calibre ammunition		AP03 (2019), Jooste (2019)
Software engineering and integration (i.e. combat suites, cyber		Kruger (2019), Haines (2019)
Systems engineering and integration		Kruger (2019), Haines (2019), Heitman (2019),
Logistics engineering and integration	Denel, Paramount	Kruger (2019), Minnies (2019)

Attack Helicopters (e.g.) Rooivalk		Pelser (2019), Martin (2019),
Command and Control Systems		Moodley (2019), Jooste (2019), Khanyile (2019)
UAVs/Drone (e.g. Skunk crowd control drone)	Denel Dynamics, Milkor, Dessert Wolf	AP03 (2019), Martin (2019),Haines (2019), Minnies (2019)
Underwater Autonomous Vehicles	IMT	Mathieson (2019)
Surveillance video technology		Haines (2019),
Cyber security		Haines (2019),
Blockchain technologies and solutions		Haines (2019),
Composite materials		Haines (2019),
Secure communication systems		Heitman (2019),
Avionics		Wyatt (2019),
Flight safety		Wyatt (2019),
Fixed and rotary wing parts	Paramount, Denel	Wyatt (2019),
Small arms	Denel, PMP	Wyatt (2019), Martin (2019),
Satellites, Satellite launch vehicles	Denel Spaceteq	Martin (2019),
Nuclear weapons		Martin (2019),
Test Facilities	Gerotek, Alkantpan, OTR, Institute of Maritime Technology	(Mathieson, 2019)
Services (munitions stockpile management and reduction, repair/maintenance/upgrade of old weapons/vehicles/aircraft)		Myers (2019)

"Note: As pointed out by AP03 (2019) earlier, these are possibilities that could attract very low interest to very high levels of interest by the BRIC DTIS. The interest levels will be determined by the country-specific national interest, geopolitical stability, DTIS policy approach, etc.

Specific (possible) opportunities identified through secondary and primary data are –

- SA/Russia JV for the servicing of Russian helicopters operating in Africa.
- Possibilities exist for technology development JVs with China in areas where China is lagging behind. There is, however, no guarantee of any reciprocal dividend for the SA DTIS.
- China seems to be prepared to commit to FDI in production facilities (typically dual-use) in SA. With careful management, these could provide access to international supply chains, economic opportunities and employment creation.
- India is still trapped in import dependence on the one end of the scale and on the other, they are motivated by the "made and buy India" self-reliance DTIS policies. The risk in these endeavours is that India expects technology transfer for export contracts. This provides the SA DTIS with some export opportunities up to point where India has shifted its development curve far enough up the "Ladder of Production" to be entirely self-reliant.
- Opportunity to provide Brazil with EW, communications and missiles for their Gripen fighter aircraft still exist – economic conditions of both SA and Brazil depending.

Specific (real) barriers identified through secondary and primary data are –

- The asymmetry between the SA DTIS and especially those of Russia, China and India is not a favourable condition for mutually beneficial technology sharing and developing. The phrase “technology colony” was used by Pelser (2019) to describe a possible result if the asymmetry cannot be effectively mitigated.
- The liquidity of the SA DTIS (specifically Denel SOC) remains a primary barrier to effective development to move up the ‘Ladder of Production” or remain at a Tier 1 level in certain instances. The longer the liquidity deficit remains the further a large part of the SA DTIS will lose its grip on traditional niches and competitive/comparative advantages. This goes hand-in-glove with reputational damage to specifically Denel SOC stemming from difficulties to deliver against contracted milestones. This (amongst others) makes the SA DTIS unattractive as a possible bilateral DTIS partner (e.g. a strategic link in a supply chain and/or technology developer).
- There has been over the past (at least 5 years) been extensive churn of engineering and technical skills to other industries in South Africa as well as migration to regions such as the Middle East. This is eroding the innovation capacity of the SA DTIS to the point of becoming import dependent again (compounded by the current economic realities).
- Joint ventures with Russia and/or China in technology development will in all probability lock the SA DTIS out of the USA and EU defence markets.
- Both China and Russia are perceived as exploiters and not true development partners.
- Chinese JV with the SA DTIS for repair and maintenance of Chinese equipment in Africa is highly unlikely because the Chinese DTIS prefer to do this themselves.
- Russia is reticent to technology transfer, technology sharing and/or JV for technology development with the SA DTIS based on the risk that such technology development could reach the USA and EU.
- The India DTIS has very little indigenous technology knowledge to share with the SA DTIS. This less than positive relationship is fouled up by the India/Israel relations for defence matériel. This might be a foreign policy issue for the South African Government.
- The precarious Brazilian economic condition, compounded by the recent downturn in SA economic conditions, could pose a barrier for further joint SA/Brazil technology development.

5.4 EXPECTATION FOR THE NEXT CHAPTER

Chapter 6 conclude the thesis with a synopsis of the research findings per chapter and highlighting contributions to theory and practice as well as making recommendations for further study.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 OVERVIEW OF CHAPTERS

The first Chapter introduced the context for the thesis, the problem statement, research objectives, research questions and ethical considerations. Answering the research questions posed by the thesis was contingent on understanding what the BRICS DTISs consist of (context), what is the preference for inclusive relations (i.e. bi- and/or multilateral), is there a need for relationship building (motive), what strategic levers are preferred and what does the portfolio of products/services consist of that can be levered? The four secondary research questions, supported with another four related open-ended questions to the participants in the research, culminated in a rich mix of primary and secondary data that supports the findings of this thesis. These questions are directly linked to a possible limitation in the ability of the SA DTIS's capacity to contribute to SA national security as an instrument for economic growth and military requirements due to an awareness deficit, evident from the limited amount of published material, on strategic business levers preferred by the BRICS States for the purpose of DTIS cooperation. As such, the NDP 2030 expressed the urgent requirement for research on matters concerning BRICS partnership building (South Africa, 2012: 241) Thus, there have been an existing national policy requirement (since 2012) for research on matters concerning BRICS partnerships.

The second Chapter provided a theoretical and conceptual framework for the thesis as well as a general literature study on the international facets shaping the defence technology and industrial eco-system. The Chapter is closed with a limited case study on Rheinmetall Denel Munitions (RDM) illustrating the successful application of some of these facets. The Chapter successfully contributes to understanding the different approaches to DTIS policy (idealist vs. realist), why asymmetry is a factor in BRICS, the three predominant DTIS policies (liberal, autarky and hybrid) as well as a fair understanding of how a DTIS develop in the national quest for self-sufficiency/self-reliance. The Chapter also provides a conceptual framework that captures this development in terms of capacity and capability over time. The conceptual framework postulates that bilateral partnerships and strategic levers could be used in the national quest of countries (i.e. South Africa) to be able to shift the development curve positively and thus be able to contribute more significantly to economic growth. Chapter 2 provided the theoretical foundation for the development of Chapters 3 and contributes to the formulation of the questions used for the collection of primary data (processed in Chapter 5).

The third Chapter provided a focussed literature study in the form of an embedded case study about the BRICS DTISs. Starting the analysis with the SA DTIS allowed the researcher to directly and succinctly link any similarities or dissimilarities (with regards to policy approaches to the development of the DTIS, preferences for types of partnerships/relations, markets, technologies, and strategic business levers), opportunities and barriers for the SA DTIS with those of BRIC DTISs discussed thereafter. Chapter 3 successfully contributed to answering SRQ 1-4 from a secondary data

perspective. Chapter 2 and 3 provided the foundation for the questions used for the collection of primary data by means of a questionnaire (addressed in Chapter 5 of the thesis).

The fourth Chapter described the research philosophy, unity of analysis and research methodology employed in this thesis. The thesis relied on the collection, analysis and synthesis of secondary data from public domain sources as well as primary data. A similar type of study conducted by Zhang (2012) successfully used 7 experts for the research about the relative innovation capacities of South Africa and China. This research used qualitative responses from 18 experts (retired Senior Management Service Level (General/Admirals) Defence officials from South Africa, the USA, and Australia; CEOs of Defence Industries; Defence Analysists and Academics). Some of the participants have served in the SANDF as well as Defence Industry in senior portfolios for a number of years. The primary data provide a significant amount of rigour to the findings.

Chapter 5 presented analysis and discussion on the data collected by means of semi-structured questionnaires. The Chapter aimed at broadening the perspectives on which strategic business levers are prudent to establish bilateral defence technology and industrial partnerships between South Africa and the BRIC States? The findings successfully amplified the findings of Chapters 2 and 3 of the thesis. Chapter 5 successfully contribute to the research findings on all the research questions to varying degrees and corroborate in some instances the findings of the secondary data and in other cases expand on the understanding gained.

Chapter 6 (Findings, Recommendations and Conclusion) conclude the thesis with a synthesized view of the findings of the research findings of the thesis and some recommendations. Implications for theory and practice are also provided.

6.2 CONCLUSIONS

The protagonist disposition of the researcher initially (i.e. that the SA DTIS has a role to play in the BRICS), assumed at the onset of the research was quickly challenged by both the secondary and primary data. The SA DTIS is privileged to be in the same alliance as the top projected defence consumers and spenders. However, it does not guarantee the SA DTIS a significant role in the BRICS DTIS ecosystem. Although the secondary data (Chapters 2 and 3 of the thesis) sketch a positive outlook for the emerging markets such as the BRICS States, asymmetry quickly becomes a calibrating factor. Pessimism aside, there are some opportunities still in play for the SA DTIS, at least in the short- to medium-term. However, without a significant South African economic recovery that will provide the financial liquidity required in the SA DTIS – the medium-term could well be the last term.

Throughout the thesis, the researcher employed a relativist worldview (ontological assumption perspective), calibrated with a social constructivist paradigm (epistemological assumption perspective). A qualitative research methodology and case study research approach/design were used which rendered rich description of the BRICS DTISs and the relevant strategic levers in play, whilst using techniques such as document analysis and questionnaires.

The aim of this research was to identify and recommend possible strategic business levers which could assist in establishing SA DTIS bilateral defence technology and industrial partnerships with BRIC countries. This was successfully achieved through four research objectives that provided some international DTIS context, the theoretical background for bilateralism, the dominant strategic business levers, and how the SA DTIS could possibly contribute or play a role in the BRICS DTIS.

The researcher posited that the SA DTIS should adopt a liberal (or at the very least a hybrid) DTIS policy as an entry level requirement to remain relevant within the defence technology and industrial ecosystem. Furthermore, the SA DTIS should be progressive and growing (ascended the 'Ladder of Production") in order to attract and sustain possible bilateral and/or multilateral DTIS relationships with the BRIC States. Such potential collaboration will require a portfolio of strategic business levers to facilitate mutually beneficial growth. If there is a misalignment of DTIS policy approached and the choice of strategic business levers it will be difficult for the bilateral partners to shift their DTIS development curves in order to gain a first-mover advantage (i.e. comparative and/or competitive advantage). The strategic business levers are highly dependent on access to and control of niche technology, products and services – without which, the application of any strategic business lever is rendered superfluous. This thesis stems from the PRQ and is supported by the findings of this thesis.

The research found that the preferred level of inclusion to DTIS-related collaboration is probably bilateral in nature. This support the assumption in the PRQ of the requirement for bilateral relations building. Although the BRICS States do not share borders or even geographic regions, care should be taken by the SA DTIS when cooperating bilaterally with the BRIC States about getting drawn into regional conflicts (e.g. China-Taiwan, Russia-Syria, India-Pakistan) based on the bilateral DTIS cooperation. As such, Brazil is not embroiled in any regional or other conflicts. The complexity of geopolitics and international trade supports the involvement of the South Africa Government (i.e. departments such as DIRCO, DST and DTI) in facilitating the bilateral collaboration, highlighting the importance of the SA Inc. approach. Several of the BRIC States have similar approaches.

The SA DTIS is only active in a limited market segment based on the limited research into BRICS markets in this thesis. The research found that the BRICs States do not have much in common from a market share perspective. The SA DTIS is better positioned for DTIS collaboration in a wide variety of countries outside the traditional SA DTIS market segments. Bilateral strategic business levers are probably the most suited for such collaboration to ensure flexibility, discretion, IPR protection, and mutual beneficiation. Another reason for bilateralism as a preference is that there is existing bilateralism between some of the BRICS States already (i.e. SA-Brazil; China-Russia, India-Russia, SA-India). This, in turn, complicates the establishment of multilateral BRICS DTIS collaboration with substance. Corresponding to the limited market share amongst the BRICS States, there is very limited overlap in bilateral collaboration between the BRICS DTISs and the rest of the world. There seem to be significant involvement of UK/European DTISs in the SA-, Brazil- and India DTISs and to a lesser extent the USA and Scandinavia, as a commonality for future bilateralism. The presence of the

Western DTISs in these countries possibly significantly affect the establishment of bilateral collaborations between the various BRICS States because of their crowding-out effects.

6.3.1 *What is the theoretical strategic motive(s) that inform (bilateral) defence technology and industrial partnerships?*

The strategic motive for DTIS-related collaboration is linked to the achievement of self-sufficiency as quickly as possible. The choice of inclusiveness (bi- or multilateral), the portfolio of strategic business levers, and the portfolio of market niches (technologies and capabilities) are influenced by the national approach to DTIS development – i.e. an idealist or realist approach. Within these two broad approaches, nations will set a fitting DTIS policy conforming to one of three dominant DTIS policy choices – liberal, autarky and hybrid policy. The choice of DTIS policy is driven by national ambition to develop DTIS capabilities in order to be self-sufficient and possibly dominant as soon as possible. These ambitions are, in turn, a product of requirements for foreign policy flexibility and autonomy in decision-making about military technology, capabilities, supply-chain security and quality.

The requirement for self-sufficiency could be linked to idealism (economic growth ambitions, economic alliance requirements and/or foreign policy) and both idealism or realism (foreign policy objectives, military ambitions, military alliance requirements). A common element to all three policy approaches is the objective to gain comparative and/or competitive advantage and to possibly become a dominant player in the international defence technology and industrial market place. The application and impact of the theories have important consequences for the ability of the SA DTIS to be an attractive bilateral DTIS partner to the BRIC States. This is particularly relevant within the context of the asymmetric nature of the BRICS alliance. Asymmetry also provides a motive for the establishment of bilateral DTIS developmental partnerships on a case-by-case basis rather than based on broad multilateral arrangements.

The asymmetry between the possible bilateral partners places a large burden on the SA DTIS to develop and nurture DTIS product, material and knowledge niches that could be leveraged against the negative aspects of asymmetry. Such niches, combined with a clear understanding of strategic business levers such as JVs, FDI and M&A, could lower the barriers to entry for new markets and mitigate some of the crowding-out effects. Continuous SA DTIS development based on strategies to optimise supply chains, cost structures, IPR protection, transparency, adequate funding and good intelligence will bolster the attractiveness of the SA DTIS as a bilateral DTIS partner to the BRIC DTISs. Within this context, South Africa should also be critically aware of the barriers that hamper market entry. This will require a thorough understanding of individual BRIC partner state geopolitical defence and security situations and requirements; offset requirements and their impact on South African budgets and threats to IPR. Thus, the strategic motive for bilateral DTIS collaboration is to attain competitive/comparative advantage (shifting the development curve relative to the “Ladder of

Production") in the least possible time in the quest for self-sufficiency and/or domination. Conceptually, it is thus to shift the curve of development to have competitive/comparative advantage soonest.

6.3.2 *What international DTIS facets are shaping the defence technology and industrial strategic business landscape that can be conceptualised as drivers (or barriers) to possible bilateral partnerships?*

The research found that the SA DTIS finds itself amidst a small group of very strong DTIS growth States, i.e. the BRIC States. The role of the SA DTIS in the BRICS DTIS ecosystem could be described as a collaboration partner for the development of niche technologies, a supply chain partner for niche product systems and integration services and a gateway to the African market place.

Realistically, opportunities can only be exploited if the BRICS partner States share certain characteristics and interests. There are common facets of the BRICS DTIS ecosystem that are drivers for the establishment of bilateral DTIS partnerships and the use of strategic business levers such as JVs, FDI and technology transfers. Commonalities are -

- The adoption of an idealist approach to DTIS policy, i.e. DTIS sustainability is linked to economic development without alienating the DTIS position as an adjunct for national militaries;
- Significant efforts are afoot to modernise and keep national DTISs relevant in the 21st century by India, Russia, China and to a much lesser extent, South Africa. These modernisation ambitions and programmes are forcing traditional autarkic DTISs (e.g. Russia, China and South Africa) to adopt more hybrid approaches in support of DTIS development and growth. The hybridisation (and liberalising) of DTISs is very favourable for DTIS collaboration, especially if a particular DTIS has niche technology, processes or products to offer. Most DTISs still protect their niche technologies as 'crown jewels, supporting the notion of hybridisation. As such, all the BRICS States promote the use of JVs, technology transfer, FDI and M&A increasingly on the back of the understanding that they require access to new technologies and knowledge to be able to climb the "Ladder of Production" in leaps and bounds. The quest for self-sufficiency/dominance probably limits the use of M&A.
- A common view that the DTIS is an integral part of their national defence capability and thus a primary instrument in foreign policy and national security. Therefore, the strong focus on modernising the national militaries directly affect the development of the DTIS. This creates favourable conditions for possible collaboration between the SA DTIS and BRICS DTIS.
- A similarity that results in crowding-out effects is the self-sufficiency programmes of various BRICS State – South Africa (SA Inc.), India (Make in India) and China (Made in China). These programmes focus distinctly on internal (domestic) collaboration and development as a first priority. All DTISs share the ambition to be self-sufficient. Some are ambitious to be dominant also. This provides short- to medium-term opportunities for the SA DTIS capabilities that can provide such niche technology and knowledge in support of the self-sufficiency ambitions.

- All DTISs have some or several Tier 1 technology and/or industrial capabilities complemented by (in some case) a plethora of Tier 2 and 3 capabilities. Again, the Tier 1 SA DTIS technology, knowledge and products provide opportunities for the SA DTIS to lever those into the international supply chains of the BRIC States that seeks them.
- A strong reliance on Government as an investor, planner, customer, industry supporter and regulator. This positions G-to-G collaboration probably as the favoured channel with which to initiate bilateral collaboration.
- The use of bilateral collaboration is promoted through the use of strategic business levers. The preference for bilateralism is probably based on the discretionary and securitised nature of defence business relations.
- Mergers and acquisition are used as a strategic business lever where States allows such activities.

Based on the initial indications of good to exceptional defence and DTIS growth, Chapters 2 and 3 positions Russia, China and India as possibly the best DTIS partner States. Yet, with more discussion on other facets of the DTISs, it becomes clear that both Russia and China are not the best candidates for bilateral collaboration. The primary data (Chapter 5) supports this finding. Brazil and India are positioned by the secondary and primary data as much better options for bilateral collaboration. This could be based on existing bilateral collaboration between the SA DTIS and that of Brazil, as well as less asymmetry between the SA DTIS and that of Brazil. In the case of India, the asymmetry is much higher but mitigated by some of the technology niches still maintained within the SA DTIS. Also, there are traditional and more recent linkages between the SA DTIS markets situated in NATO countries and those of Brazil and India. Drivers that might result in selective collaboration between the BRICS States are -

- There are at least two groups of markets – those that have traditional linkages with European and USA markets (SA, India and Brazil) and those that do not/extremely little (China and Russia).
- There are two groups that support arms control as an international rule-based mechanism with which to govern unwanted proliferation. From a dual-use arms control perspective, the Wassenaar Arrangement – SA, India and Russia ratified that prescripts; China and Brazil are not signatories to the agreement. The researcher acknowledges the fact that there are several other arms control regimes. However, because there is such a large movement towards military/dual-use technology integration the Wassenaar Arrangement is of particular relevance.
- Respect for IPR will probably affect the decision to collaborate significantly. As such, the Chinese record regarding the abuse of IPR does not make China a favourable bilateral partner.

These commonalities; combined with strategic business levers such as JVs, FDI and M&A; probably position the entire BRICS group in a hybrid DTIS policy approach – setting the foundation for possible bilateral DTIS collaboration between the SA DTIS and other BRIC DTISs. Let us consider some of the disparities.

A vast disparity that exists between at least South Africa and India, China and Russia is in terms of relative strength as per Womack's (2004 & 2006) theory of asymmetry which raises the barriers to successful, mutually beneficial, collaboration. The technology niches once maintained by the SA DTIS have been surpassed by newer technology and thus provide very limited buffer capacity against the negative effects of asymmetry on competitive/comparative advantage within the BRICS alliance. The asymmetry is perpetually getting worse due to the poor funding for the SA military and DTIS and hence gradually erodes South Africa's ability to contribute meaningfully to bilateral defence technology and industrial collaboration with the BRIC States.

Another disparity that exists between at least South Africa and India, China and Russia is in terms of the development path (ascending/descending the "Ladder of Production") in the quest for self-sufficiency and possibly domination. India, China and to a lesser extent Russia is rapidly ascending the "Ladder of Production" with targets to reach self-sufficiency ranging from 2025 onwards. Conversely, the SA DTIS is currently facing prospects of reversed development cycles as was conceptually proposed in Chapter 2 of the thesis in the Conceptual Framework. This regression is the result of (amongst issues of corruption, poor management, State capture) the financial decline illustrated in Figure 1.3.; resulting in diminished capacities to invest in R&D, intellectual capital retention, DTIS infrastructure renewal and expansion. These negative market conditions drive the erosion of the national security defence capability and gradually increases national security risk because of the increased exposure to reliance on foreign defence matériel suppliers of technology, equipment, software, logistics, and maintenance and repair capabilities. Combined with the market conditions set by the 4th IR the SA DTIS are hyper-exposed to continuous job losses and highly skilled engineering and technical labour churn - both within the South African industrial labour market, but more concerning, into the international market). These dynamics severely hamper the development of the SA DITS as a possible preferred bilateral partner to the BRIC DTISs. The risk currently is being relegated to being a defence matériel client State rather than an integral and important part of the international (at least the BRICS) defence technology and industrial supply chains.

Another barrier to possible collaboration between the SA DTIS and those of BRIC are international travel regulations between the different countries. Geographically, the BRICS economic alliance is not geographically co-located (such as e.g. the SADC economic alliance and region). This makes free travel across borders a little bit more complex. Without Government intervention to de-bureaucratise travel and trade-related regulations for the DTIS (within the parameters of arms control) the development of successful JVs could be severely hampered or not viable at all. For South Africa, these bureaucratic barriers are compounded by B-BBEE requirements that is a strong barrier for small Indian companies to enter the South African market who cannot surrender a share of their company to a South African counterpart.

When considering the various policy documents mentioned and their target dates there seem to be a small window of opportunities identified in the discussion above for role establishment in the DTIS supply chains of China (2025 self-sufficiency target) and India (2027 the target for 70% self-

sufficiency). This leaves the SA DTIS with only short- to medium-term windows, which is problematic considering the current state of the South African economy and its DTIS.

6.3.3 *Which strategic business levers are used by the DTIS of BRICS States and to what end?*

As stated earlier, the strategic motive for bilateral DTIS collaboration is to attain competitive/comparative advantage (shifting the development curve relative to the "Ladder of Production") in the least possible time in the quest for self-sufficiency and/or domination. Complimenting this motive is the use of JVs (as the preferred strategic business lever), FDI, technology transfer and/or M&A as strategic business levers within the context of a liberal/hybrid DTIS policy approach strive to initiate and facilitate advanced and accelerated levels of development (discussed in Chapter 2 of the thesis) to unlock competitive/comparative advantage sooner than would be possible without international collaboration. At the same time, strategic business levers also lock collaborators into an interdependent supply chain relationship that restrict the level of self-sufficiency attainable. Therefore, their use is calibrated on a case-by-case basis (context driven) and asymmetry levels between the collaborators. Context is calibrated by the national DTIS policy approach.

That said, the use of strategic business levers are prevalent amongst the BRICS States. They are used to reduce entry barriers to collaboration and development, encouraging industrial participation, investment and technology transfer stimulation, providing control and access guarantees for IPR and capabilities coupled to sovereign military and industrial capabilities. There is, however, limited evidence of a preference for M&A as a DTIS strategy amongst the BRICs countries – probably calibrated by the strong desire of the BRICS States for self-sufficiency and even dominance in defence technology and industrialisation. These seem to be the primary vehicles (other than direct import and export) to acquire innovation renewal, to establishing new DTIS capabilities with and to support the foreign policy and military objectives and agility.

Other facets that could be perceived as strategic business levers are being protectionist over market segments and the use of Government to secure defence business. The thesis provides strong evidence suggesting that the BRICS countries guard their traditional DTIS markets as a matter of national interest (from an idealist and realist perspective). There is also strong evidence that the BRICS countries use their Governments to a lesser (SA and Brazil) or significant (China, Russia and India) extent in the quest for DTIS self-sufficiency. This probably makes G-to-G bilateral collaboration the most preferable channel for DTIS development initiatives. From a theoretical perspective, Table 3.6 provides an approximation of which strategic business levers fit which role of government within the DTIS.

6.3.4 *How and what can the SA DTIS contribute to the achievement of bilateral strategic objectives, using bilateral defence technology and industrial partnerships with the BRIC States?*

Over and above the enablers and barriers mentioned above, at least two groupings emerged from the case study – Brazil and India; and Russia and China. A possible SA DTIS role in the DTIS-related supply chains of Brazil and India seem to be the most plausible for the following reasons –

- The least amount of asymmetry present, specifically Brazil.
- Have a certain level of DTIS collaboration between the SA DTIS and Brazil and India, even if it is just as an export client.
- An overlap of DTIS market-related linkages with at least the USA, UK, France, Sweden and Italy (See Table 3.4 and 3.5 below).
- There does not seem to be an excessive risk of IPR abuses.
- Overlaps in Western military technologies and products
- The existence of the IBSA tri-lateral defence forum which facilitates defence cooperation, exercises and possibly technology exchanges.

A possible SA DTIS role in the DTIS-related supply chains of Russia and China seem to be less favourable for the following reasons –

- High levels of asymmetry between the SA DTIS and those of Russia and China.
- Very little (possibly none) historical DTIS collaboration.
- Very little (possibly none) historical DTIS export/import activity – driven by the fact that the SA military has a traditional Western-based technology ORBAT.
- Only limited overlap of traditional UK, European, Scandinavian and/or USA market-related linkages.
- Strong drive to become self-sufficient and dominate combined with strong negative records of IPR abuses makes at least the Chinese DTIS predatory.
- Strong drive to become self-sufficient and dominate combined with a strong focus on exporting Russian defence matériel make Russia less than ideal as a bilateral DTIS partner.
- Within BRICS - both China and Russia dominate in several Tier 1 defence technology and industrial capabilities already and produce virtually the entire portfolio of defence matériel and services for their militaries and several of their clients. This has a significant crowding-out effect for any inward FDI and JVs. Initial JVs between the SA DTIS and Russia/China will render some short- to medium-term supply chain engagements but will in the long term probably lead to the SA DTIS becoming just another customer or entirely crowded out of the defence market.

So, the SA DTIS could possibly play a role as a technology and/or production partner within the DTIS-related supply chains of Brazil (short- to long-term) and India (short-to-medium-term). There is

possibly more scope to a more dominant SA DTIS role within any SA/Brazil DTIS collaboration. The SA DTIS still have (at least in the short- to medium term) competitive/comparative advantage in a number of technologies and products – e.g. combat vehicles, mine-protection technology, long-range artillery, ammunition, UAVs, a select portfolio of missiles, attack helicopter, etc. Brazil, on the other hand, has a strong focus on aerostructures and has strong linkages with Sweden in this regard. This linkage is shared by South Africa through at least the Gripen fighter aircraft club. The SA DTIS can play a significant role in India (in the short- to medium term) as a development partner for artillery systems, vehicles, mine protection, a very select portfolio of missiles, UAVs, etc. However, it will be very difficult to penetrate market segments already established by foreign DTIS such as those of France, the UK and the USA. India, however, seeks more independence from Russia, which might provide short-term opportunities for the SA DTIS to collaborate with India. In the same vein, the UK/European and USA DTISs are monitoring the same Indian DTIS opportunities for exploitation. With the SA DTIS in its current state of disrepair competing with European and USA DTISs for these opportunities is almost unrealistic. The Western economies are also in a much stronger position to accommodate the offset requirements of India. Also, geopolitically, the NATO countries are motivated to penetrate the India market in order to crowd the Russian and Chinese initiatives out of the region. South Africa has no such ambition. The SA DTIS will also lose any ability to be a plausible/valuable DTIS partner (medium- to long-term) if the current erosionary funding conditions for the SA military and DTIS is continued. Last, and very importantly, several key South African policy documents express a preference for collaboration with the African States – not with the BRIC States. This might be based on the asymmetry in the South African-BRIC relationship and/or the complexity of managing such relationships with countries known to be devious industrial empire builders, such as China. It could also simply be that the SA DTIS has slipped too far down the proverbial “Ladder of Production” that the BRIC States are no longer interested in cooperation. This would be a strong position to take as the SA DTIS still owns and develops niche technologies, at Tier 1 and 2 level, in a small number of companies.

The broad SA DTIS capability focus areas identified by the research that could possibly be attractive for the short- to medium-term are: Command & control; Information warfare & cyber defence; Secure communications; IT (including data fusion); intelligence-gathering sensor, analysis & evaluation; target acquisition & identification; Radar (synthetic aperture radar); Unmanned systems (aerial, ground, surface and under-water); Missile & wider guided munitions; Night & poor visibility observation & engagement; EW; Tactical vehicles optimised for operations in the African theatre; Mine & IED detection & protection; Long-range artillery, precision bombardment & point target engagement systems; CBR defence, including the manufacture of military carbons and canisters; Battlefield medical care optimised for the African theatre; Modelling, simulation & stimulation; Test facilities & ranges; Additive manufacturing (e.g. 3D printing) and advanced materials.

The SA DTIS technology and product development for the African market are probably based on unrealistic expectations. This opinion is from the perspective that the SA DTIS’s ambition to

penetrate a traditional and more-and-more Russian and Chinese markets is possibly misplaced considering the current South African economic and related DTIS disposition. Even the role for the SA DTIS to become an MRO agent for Russian and Chinese defence systems in Africa is probably a bridge too far. The Russians and Chinese DTISs generally do MRO (when required) themselves or provide just more of their surplus to keep their client-base locked in.

The opportunity could be locked up in dual-use products design, develop and manufacturing industries**.** These might be particularly attractive within a SA DTIS bilateral context because of less government control and regulation but with the added benefit that they are sometimes reasonably integrated with MOTS industries.

Dual-use infrastructure (such as test ranges and port facilities and infrastructure) is another primary resource that could be leveraged by South Africa. However, South Africa will probably be on the receiving end of development because of the strategic nature of some of its seaports (e.g. Richardsbay, Cape Town and Saldanha harbours). This could also prove advantageous to the South African shipbuilding industry such as Paramount Maritime (mostly dual-use in nature as this juncture). South Africa has some uniques test ranges (e.g. Alkantpan for artillery and the OTR for missiles) that could prove useful to missile developers such as Russia, China and India (risking significant negative foreign policy sanction from the West in the case of Russia and China).

The SA DTIS will thus have to employ a select combination of political-, investment-, trade-, administrative- and capability strategic business levers for each of the BRIC States. The selection will be calibrated by foreign- and trade policy, arms control requirements and the levels of risk attached to issues of IPR protection. From the embedded case study, it is evident that the establishment of bilateral DTIS cooperation would be the preferred relationships, probably based on the security and discretion required for national security concerns. The strategic business levers of choice would seem to be the establishment of JVs within which technology transfer can take place as well as joint design, development and manufacture of product systems. Under the current economic conditions, South Africa would be hard pressed to promote FDI. However, the SA DTIS might attract FDI which could assist with the development of the SA DTIS but will increase dependency on foreign DTISs. Although not entirely excluded, there seems to be a lesser preference for M&A because of its influence on control, ownership and decision-making. Mergers and acquisitions of DTIS capabilities will typically favour the State that has control and/or ownership and thus also that State's quest for domination. It also strips the other State from DTIS capability that may be a requirement to become self-sufficient – self-sufficiency being distinctly linked to foreign policy leverage and national security objectives. The SA DTIS still has some competitive/comparative advantage (at least the short- to medium term) in long-range artillery systems and ammunition, a select portfolio of missiles and UAVs, combat vehicles systems and mine protection, some unique test ranges.

This similarity and any potential bilateral DTIS collaboration between the SA DTIS and other BRIC DTISs stemming from them are calibrated by asymmetry. An asymmetric relationship exists at least between South Africa and China, Russia as well as India. This predicament should steer the SA

DTIS to carefully consider the practicality and prudence of such bilateral relations (even against the favourable developmental background framed in Chapter 2 and 3) and which strategic business levers will best facilitate the development of the SA DTIS as a strategic partner to the BRIC States.

The primary data indicate the following as strategically important and viable technology/product niches supporting the use of strategic business levers within bilateral collaboration opportunities: EW (e.g. IED Jammers, DRFM and ELINT technology, EW Simulation & Analysis (SEWES)); Electro-optics (sensors) (e.g. IR cameras & Helmet Mounted Sights & Electro-optical trackers); Radar (e.g. Tracking & fire control radar); Missiles (guided weapons) (e.g. air-to-air missiles, surface-to-air missiles); Vehicles (MRAP, Armoured/mine protected vehicles); Demining/EOD/IEDD equipment; Artillery systems (e.g. G5/6 self-propelled artillery systems and G7 under development) & Large caliber ammunition & rockets ; Radios & communication (e.g. HF systems); Small-medium caliber ammunition Software engineering and integration (i.e. combat suites, cyber; Systems engineering and integration Logistics engineering and integration; Attack Helicopters (e.g.) Rooivalk; Command and Control Systems; UAVs/Drone (e.g. Skunk crowd control drone); Underwater Autonomous Vehicles; Surveillance video technology; Cybersecurity; Block chain technologies and solutions; Composite materials; Secure communication systems; Avionics; Flight safety; Fixed and rotary wing parts; Small arms; Satellites, Satellite launch vehicles; Nuclear weapons and technology; Test Facilities and Services associated with munitions stockpile management and reduction, repair/maintenance/upgrade of old weapons/vehicles/aircraft. Specific (possible) opportunities identified through secondary and primary data are –

- SA/Russia JV for the servicing of Russian helicopters operating in Africa.
- Possibilities exist for technology development JVs with China in areas where China is lagging behind. There is, however, no guarantee of any reciprocal dividend for the SA DTIS.
- China seems to be prepared to commit to FDI in production facilities (typically dual-use) in SA. With careful management, these could provide access to international supply chains, economic opportunities and employment creation.
- India is still trapped in import dependence on the one end of the scale and on the other, they are motivated by the “made and buy India” self-reliance DTIS policies. The risk in these endeavours is that India expects technology transfer for export contracts. This provides the SA DTIS with some export opportunities up to point where India has shifted its development curve far enough up the “Ladder of Production” to be entirely self-reliant.
- Opportunity to provide Brazil with EW, communications and missiles for their Gripen fighter aircraft still exist – economic conditions of both SA and Brazil depending.

Specific (real) barriers identified through secondary and primary data are –

- The asymmetry between the SA DTIS and especially those of Russia, China and India is not a favourable condition for mutually beneficial technology sharing and developing. The phrase

"technology colony" was used by Pelser (2019) to describe a possible result if the asymmetry cannot be effectively mitigated.

- The liquidity of the SA DTIS (specifically Denel SOC) remains a primary barrier to effective development to move up the 'Ladder of Production" or remain at a Tier 1 level in certain instances. The longer the liquidity deficit remains the further a large part of the SA DTIS will lose its grip on traditional niches and competitive/comparative advantages. This goes hand-in-glove with reputational damage to specifically Denel SOC stemming from difficulties to deliver against contracted milestones. This (amongst others) makes the SA DTIS unattractive as a possible bilateral DTIS partner (e.g. a strategic link in a supply chain and/or technology developer).
- There has been over the past (at least 5 years) been extensive churn of engineering and technical skills to other industries in South Africa as well as migration to regions such as the Middle East. This is eroding the innovation capacity of the SA DTIS to the point of becoming import dependent again (compounded by the current economic realities).
- Joint ventures with Russia and/or China in technology development will in all probability lock the SA DTIS out of the USA and EU defence markets.
- Both China and Russia are perceived as exploiters and not true development partners.
- Chinese JV with the SA DTIS for repair and maintenance of Chinese equipment in Africa is highly unlikely because the Chinese DTIS prefer to do this themselves.
- Russia is reticent to technology transfer, technology sharing and/or JV for technology development with the SA DTIS based on the risk that such technology development could reach the USA and EU.
- The India DTIS has very little indigenous technology knowledge to share with the SA DTIS. This less than positive relationship is fouled up by the India/Israel relations for defence matériel. This might be a foreign policy issue for the South African Government.
- The precarious Brazilian economic condition, compounded by the recent downturn in SA economic conditions, could pose a barrier for further joint SA/Brazil technology development.

6.3 IMPLICATIONS FOR THEORY

The theory around liberal and autarkic DTIS policy for the construction and maintenance of national DTISs is well known and applied within the BRICS DTIS landscape. There seem to be a shift away from autarky towards a more liberal approach to defence business in support of economic development and keeping pace with the levels of innovation achieved in the West. Although States typically commence with an autarkic DTIS policy to build capacity and capabilities; they soon realise that the approach has its limits. However, these States do not just cross the divide between autarky and liberal approaches instantly and totally. These States introduce an almost phased approached to breach the divide between the approaches in order to access the benefits of both approaches and

minimising the negative impact of each. This is what the researcher termed a hybrid approach. Not much is written from a theoretical perspective about the hybridisation of the liberal and autarky approaches. Yet, a hybrid DTIS policy seems to be applied by the nations discussed in this thesis in the quest to become self-sufficient/reliant in their DTIS without being limited in their ability to access new technology and/or innovation through the application of strategic business levers such as JV and M&A. This hybrid approach to DTIS policy allows States to gradually shift their development curve to shorten the time period it would take to build Tier 1 technology and industrial capacities.

6.4 IMPLICATIONS FOR PRACTICE

Foreign policy and international relations are critical to the BRICS DTISs, due to the trans-national nature of DTIS cooperation. It would then be prudent for national research institutes and similar academic organisations to initiate critically focus research projects that investigate the nature of these symbiotic relations and their influences (positive and/or negative) on foreign policy development and/or execution. Such research should also focus on formulating practical solutions to eliminate bilateral cooperation barriers. Included in this foreign policy dimension of the South African DTIS is arms control. Arms control is one of the specific calibrators for success within the defence business. More research should focus on its impact on not only international and national security from a threat perspective, but also its impact on economic development from an idealist perspective and how South Africa can tailor its approach to arms control in support of economic development objectives and ultimately economic, defence and security-related national interests.

6.4 RECOMMENDATIONS FOR FUTURE RESEARCH

The thesis explored and described strategic business levers that could be used in bilateral DTIS cooperative settings Between South Africa and the BRIC States. The levers that were identified can be researched individually in great detail to establish their significance empirically. Individual levers could then be combined with other potential levers to determine their cross-impact within bilateral BRICS settings.

This thesis focussed specifically on bilateral DTIS cooperative arrangements for BRICS. The research could be repeated to find the niches that could exist for DTIS cooperative arrangements within a multilateral BRICS setting.

A similar, very detailed study could be attempted for the IBSA arrangement, based on the findings of this thesis that the role of the SA DTIS has a greater chance of success, bilaterally, within Brazil and India rather than with China and Russia.

Similar research could be attempted for the South African Development Community because of the policy-driven, African focus of South Africa. Such research will probably be more focussed on how the SA DTIS could be positioned to be the premier defence matériel and services provider for the SADC region. Such research should take note of this thesis findings around the crowding-out effect of the traditional defence matériel providers to Africa.

Special attention could be given to G-to-G DTIS development initiatives and why certain countries prefer this type of bilateral interaction rather than direct I-to-I collaboration.

The research could also be narrowed down significantly to the various components of the defence technology and industrial eco-system. As such, similar research could focus on the role of the South African defence matériel T&E ranges and facilities as a front-runner initiative for further DTIS-related collaboration. Another facet that requires detailed research is on how to assure IPR protection in order to mitigate the risk of IPR abuses when developing DTIS collaborative initiatives with China.

6.5 CLOSURE

There might be an expectation from multilateral partnerships such as the BRICS economic alliance to have all-encompassing and multi-directional beneficiation. This can only be achieved in the absence of asymmetry. Bilateral collaboration should be a naturally occurring product of multilateral partnership. Although all the countries in BRICS have at least quasi-idealist approaches to the role of the DTIS in the national economy and have accepted that a liberal or at least a hybrid DTIS policy will be beneficial to achieve self-sufficiency with – asymmetry and national interest seem to skew or prevent mutually beneficial bilateral DTIS collaboration between South Africa and at least Russia, China and India. It should not be assumed that a multilateral partnership will benefit every partner equally and lead to bilateral collaboration on defence innovation (technology) and production (industry) as a consequence. The crystallisation of bilateral DTIS partnerships from multilateral alliances greatly depends on the level of asymmetry, national interest, the quest for foreign policy flexibility and military autonomy, national DTIS policy objectives, technology and products niches, and preference for strategic business levers. It should not be assumed that bilateral DTIS partnerships between South Africa and the individual BRIC States will be mutually beneficial, no matter the strategic business levers employed. The choice of strategic business levers should always be calibrated by the levels of asymmetry and quest for self-sufficiency without getting entrenched in autarky.

APPENDIX 1: LIST OF PARTICIPANTS

Name	Position and Relevant Experience	Expertise	Country
Brig Gen (Ret) Des Barker	CSIR Defence, Peace, Safety and Security division involved in R&D and technology development. Previously – Experimental Test Pilot and CSIR Manager Aeronautics Research	Defence & R&D expert	South Africa
Mr Ralph Mills	Chief Executive Officer, Paramount Advanced Technologies. Previously – Executive Manager Integrated Systems, Denel Integrated Systems & Maritime GM, Denel Integrated Systems Solutions Manager Strategy, African Defence Systems	Defence, defence technology & industry expert	South Africa
Prof Richard Haines	Academic Director South African Cultural Observatory & Professor of Development Studies Nelson Mandela University	Academic	South Africa
R Adm (Ret) Allan Du Toit	Chairperson of James Fisher Defence Global Previously – Retired Chief of the Australian Defence Acquisition department	Defence, defence technology & industry expert	Australia
Mr Helmoed Heitman	Defence Analysist for Previously - Janes Defence Writer of the SA DTIS (Chapter 15) in the DR 2015	Defence, defence technology & industry expert	South Africa
Maj Gen (Ret) Johan Pelser	Entrepreneur (power electronics development) Previously – Chief of Air Staff Logistics	Retired defence, defence technology & industry expert	South Africa
Mr Mark Minnies	Senior Executive Business Development, Denel Group Previously – Group Executive Marketing/Business Development Africa, Saab Senior Manager, Department of Trade and Industry, South Africa	Defence technology & industry expert	South Africa
Maj Gen (Ret) Johan Jooste	Head of Special Projects, SANParks Previously – Director of International Business Development Company BAE Systems Land Systems South Africa	Defence, defence technology & industry expert	South Africa
Col William M. Wyatt	Director of African Studies, US Army War College Previously – Advisor, Africa Business Portal Colonel (US Army), Senior Military Advisor U.S. Mission to the African Union	Defence, business and academic expert	USA
Mr Frik Kruger	COO Dynateq, CEO Reutech Rogue International, COO Reutech (Pty) Ltd Previously – CEO Reutech Solutions	Defence technology & industry expert	South Africa

Mr Guy Martin	Editor of defenceWeb. Defence Analyst	Defence, defence technology & industry expert	South Africa
Dr Moses Khanyile	Armscor Board Member Previously - Committee Member Company Ministerial Defence Review Committee	Defence, defence technology & industry expert	South Africa
Mr Lewis Mathieson	Managing Director, Schauenburg Systems (Pty) Ltd – Previously - Armscor General Manager: R&D & Senior Manager Radar & Electronic Warfare	Defence technology & industry expert	South Africa
Mr Chris Myers	Defence and Security Contractor Previous ROV Superintendent, Various companies in South Africa, UK, Middle East, West Africa, China, Thailand Vessel Master, SA National Ports Authority Naval Officer, SA Navy	Defence, Security, Maritime, Oil and Gas industry expert	South Africa
Mr Pieter Goosen	Senior Business Development, CSIR	Defence, Security and Science & Technology expert	South Africa
AP01	Executive Manager Strategy and Offset, Saab Grintek Defence Previously – CSIR Operations and R&D Outcomes Manager DPSS	Defence technology & industry expert	South Africa
AP02	Group Executive, Paramount Group Previously – SAAF Pilot and Chief of the SA Air Force	Defence technology & industry expert	South Africa
AP03	Executive Vice President of Defence Electronics - SAMI (Kingdom of Saudi Arabia) Board Member Tawazun Dynamics Previously – CEO Denel Dynamics CEO, Hensoldt Optronics Board Member, Turbomeca Africa	Defence, defence technology & industry expert	South Africa UAE Saudi Arabia

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