

# **Mapping: a visual business strategy**

**by**

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## **Declaration**

**I, the undersigned, hereby declare that the work contained in this assignment is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.**

## **Abstract**

Key factors that drive the global information society include knowledge, networking, the Internet and virtualisation. Therefore it is important that the knowledge and information situated within a business or company must be effectively managed to gain a competitive edge. Knowledge and information mapping is a visual management tool that can assist companies and organisations in this quest.

The primary objective of this study was to explore mapping as a visualisation tool that enables an organisation to manage and benefit from information and to visualise explicit knowledge that exists within the organisation. An additional objective was to study mapping as part of a visual business strategy.

The first part of the study consisted of a literature review that focused on the many facets and interpretations of mapping. Related concepts were identified and defined. In order to understand the characteristics of mapping better, an analysis of the concepts information and knowledge mapping was done. Emphasis was placed on various techniques and their applications, as well as an interpretation of the relationship between the different concepts. To reveal these relationships, the applications of different mapping methods and the associations between them were evaluated.

The study also focused on the use of information and knowledge mapping as part of a business strategy in organisations. To demonstrate the value of mapping as a business strategy, it was emphasized that mapping is truly a business opportunity enabler that can be used e.g. for concept mapping of business processes, core competencies, as an aid for gap analysis along with timelines, and as a tool for competitiveness.

Finally, recommendations based on the results of the study are proposed in order to enhance the understanding of mapping as a concept, as well as the use thereof in the business environment.

## Opsomming

Kernaspekte soos kennis, netwerke, die Internet en virtualisering beïnvloed die globale inligtingsgemeenskap. Om kompetend te kan wees, moet bestuur plaasvind van die kennis en inligting wat in die organisasie of besigheid geleë is. Kennis- en inligtingskartering is 'n visuele bestuursmeganisme wat organisasies en besighede ondersteun met die bestuur van hierdie bronne.

Die hoofdoel van die studie was om kartering as a visuele metode te evalueer wat organisasies in staat kan stel om inligting tot hulle voordeel te bestuur. Kartering kan benut word om spesifieke kennis wat binne die organisasie bestaan, te visualiseer. 'n Bykomende doel was om kartering as deel van 'n visuele besigheidstrategie te bestudeer.

Die eerste gedeelte van die studie bestaan uit 'n literatuuroorsig wat gefokus is op die verskeie fasette en interpretasies van kartering. Verwante konsepte is geïdentifiseer en gedefinieer. Om die eienskappe van kartering beter te begryp, is 'n analise van die begrippe inligting- en kenniskartering gedoen. Klem is geplaas op die verskeie tegnieke en hulle toepassings, sowel as op die interpretasie van die verwantskap tussen die verskillende konsepte. Om die verwantskappe tussen die konsepte beter te begryp, is die toepassings van die verskillende karteringsmetodes sowel as die verwantskappe tussen die metodes geëvalueer.

Vervolgens is die gebruik van kartering as 'n besigheidstrategie in organisasies ondersoek. Deur klem te plaas op kartering, word die strategie geïllustreer dat kartering as 'n besigheidsgedeelteskepper gebruik kan word om bv. besigheidsprosesse en kernbevoegdhede te visualiseer, om tesame met die visualisering van effektiewe tydlyne

as 'n hulpmiddel te dien om gapings te analiseer, en om bystand te verleen om kompetierend te kan wees.

Ten laaste is aanbevelings en voorstelle wat gebaseer is op die studie gemaak, nie net om die begrip van die konsep kartering uit te lig nie, maar ook om die gebruik daarvan in die besigheidsomgewing te beklemtoon.

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and

God, for providing me with the opportunity.

## Dedication

This thesis is dedicated to my late parents, Tielman and Jennie Botha.

Hierdie tesis word aan my ontslape ouers, Tielman en Jennie Botha, opgedra.



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# Chapter 1 Introduction

**“All human beings desire to know”**

**Aristotle**

## 1.1 Background to the study

The new information age offers opportunities that business leaders and public sector administrators must acknowledge. Key trends and influences that are impacting businesses, organisations, individuals and society as a whole include knowledge, networking, globalisation, the Internet and virtualisation. Within this context of a learning society, businesses recognise that a competitive advantage depends largely on what a company knows, not what it owns. Among the major trends in a knowledge-driven economy is the use of knowledge as strategic productive resource. It has become clear that knowledge as a resource is a valuable organisational asset which, when managed well, enables organisations to become more competitive.

This phenomenon has an impact on the way managers assess the relative importance of knowledge in the corporate world. Recent developments that have an influence on the way managers do business are the rapid changes in technology (Coombs, 1996), as well as the emphasis on competitiveness as a business strategy (Callon, 1996).

Inventions help to perceive old things in new ways. Therefore the advances in technology and specifically computers enable a new visual representation. This has resulted in a new field of information visualisation (Card et al. 1999). Visualisation is a tool for discovery, understanding, communication and teaching that is globally applied. Rapid advances in

the development of processes such as computer graphics continuously lead to new and improved tools for visualisation.

Visualisation can be defined as adjustable mapping from data to an illustrated form that helps the user to perceive this data (Card et al. 1999). Therefore mapping could act as an aid to manage information and to visualise knowledge. Furthermore, mapping relates directly to the key trends of contemporary knowledge - networking and virtualisation. Recent literature suggests that the mapping of knowledge and information resources is a helpful technique for companies to illustrate how knowledge and information flows through an organisation. This knowledge leads to several physical products that managers can use for the protection and development of their organisational resources. It is therefore a means of creating added business value. However, the link between visualisation and the organisation's information and knowledge resources has not been fully recognized. Nevertheless, it is clear that organisations with a business strategy which is focused on the relationships between information and knowledge mapping will be ahead of the competition.

### ***1.1.1 Objective of the study***

The aim of the study is to evaluate the potential of mapping as part of a business strategy that can be used as a visual tool that allows organisations to utilise their inherent information and knowledge optimally, and to assess how this strategy can be used to describe the flow of knowledge and information in an organisation better.

### **1.1.2 Scope of the study**

Because there are numerous interpretations of the term mapping, it is important to define the basic concepts relevant to the term, and more generally this field of study. An extensive literature review was therefore conducted and used as a guide in developing working definitions of the concepts information mapping and knowledge mapping. This was done on the assumption that, because mapping can assist to visualise relevant data, information and knowledge, this visualisation can create value if the methods, applications and techniques of information and/or knowledge mapping are clearly understood.

In order to determine the advantage offered by mapping, the technique was evaluated in terms of the degree to which it could be applied to make data, information or knowledge more accessible to users. This included evaluation of mapping as a tool that 1) functions as an enabler of communication and 2) can improve an organisation or business processes. A fundamental step in developing an understanding of mapping as a tool was to grasp the various interpretations and the relationships between the different concepts. This required consideration of the different mapping methods as well as associations between mapping methods. Different mapping methods that were applied include: 1) concept mapping, 2) content mapping, 3) object mapping, 4) process mapping, 5) visual mapping, and 6) geographic and geospatial mapping. The subsequent evaluation of the associations between mapping methods was based on the characteristics of mapping methods.

An additional area that needed to be emphasized was mapping as a business strategy. This was done in view of mapping as an enabler to support business opportunities through the visualisation of core competencies, its potential role as an aid to perform gap analyses

and to produce visual timelines, and more generally, as a device that supports competitiveness.

## **1.2 Research problem**

The use of information and knowledge (galvanized information) has a potentially huge impact on organisations so that some observers refer to it as the "knowledge revolution" (Badaracco, 1991). This increasing importance calls for tools and mechanisms like mapping to enable an organisation to utilise the information and knowledge that exist within the company to its full potential.

However, various meanings of the term "mapping" exist. Consequently clarification of the terms mapping, information mapping, knowledge mapping and related concepts was needed. In addition to the need for definitions of these terms, there was a need to analyse the various mapping methods and techniques which organisations can use to consolidate, exchange and share information and knowledge. More generally, an illustration of how knowledge and information flow through an organisation was needed.

An interpretation of the relationships between pertinent concepts is central in understanding the idea of mapping. These relationships between concepts must assist in the quest to manage information and to visualise knowledge. From a practical perspective however, proof is needed that mapping can be a tool in developing a business strategy that allows for informed decision making in order to gain competitiveness.

In a rapidly expanding, relatively young field such as information and/or knowledge



mapping there is a diverse array of applicable methods to collect information and strategies to apply the information. These need to be analysed in order to optimise application.

### **1.3 Research design and methodology**

The overall objective was to contribute to an improved understanding of the concept of mapping, especially with regard to the role that knowledge and information mapping can play in an organisation as a conceptual aid to visualise knowledge and information. For this purpose an extensive literature search of recently printed material, including books, articles and research works, as well as the World Wide Web was conducted to indicate the way in which mapping can assist an organisation in visualizing a competitive advantage. During the research process selected elements of mapping were used as a guiding framework to evaluate the literature. This strategy enabled a comparison of the research material to reveal variations, different interpretations and nuances in the meaning of the concepts.

In addition to the study of concepts related to mapping, including relationships between the concepts, the methods and techniques for mapping were analysed, and finally the potential of mapping as a business strategy was evaluated.

### **1.4 Summary**

From the background information presented in this chapter, it is clear that knowledge and information mapping offers a unique, contemporary approach that organisations can apply

to improve their competitiveness. As it is a relatively new field, however, efforts are needed to define and consolidate the available concepts and methods. A logical approach to achieve this would be to analyse the rapidly expanding body of literature on the topic critically.

## **Chapter 2 Literature review and definition of related concepts**

### **2.1 Introduction**

The foundation for a new business management strategy is often a set of preliminary ideas. This review is an investigation of the ideas surrounding the concept that mapping is an enabler to manage information and to visualise the flow of knowledge. The understanding of mapping and related concepts is necessary in this research, since “the way you conceive of knowledge influences the way you manage it” (von Krogh and Roos, 1996). Therefore, a discussion of the literature on the properties of mapping is a vital first step for this study. The primary objective of this discussion is therefore to provide clarification of the different meanings of mapping and its purpose. It is important to point out here that, because of their wide application in numerous disciplines, information and knowledge mapping are complicated concepts. For the purpose of this study it was therefore essential to define all relevant concepts. Once the concepts are understood, further analysis of the methods and techniques are possible.

### **2.2 A review of the literature on the properties of mapping**

Maps conventionally represent geographical or physical space. However, according to Fisher (1982) they can also communicate information that varies in abstract spaces. For instance, the term mapping could relate to spatial, quantitative and symbolic aspects that are used as a communication tool that provides writers with an approach to get their message across in a way that meets their users' needs (Mapping and its principles, 2003).

The process of mapping consists of various elements that can be used in various applications. For example, mapping software assists the user by interpreting spatial data to create maps (Tombarge, 1999). But mapping can also be utilised for purposes such as the enhancement of information retrieval, visualisation, or navigation. A study of the properties of mapping is therefore essential to assist in the selection of an appropriate procedure. To understand these properties better, elements of mapping such as graphics, spatial characteristics, symbolic qualities, and visual features should be considered. The framework of such a study should also include the use and the value of mapping as success factors of the technique.

### ***2.2.1 Graphic aspects***

Various mapping methods such as information and knowledge mapping share common characteristics such as graphing. For instance, integrated graphic designs are used when the information mapping technique is used to map documents. Additionally, the information map can be used as a graph for the development of a web-based subject expert bank. Therefore information maps are presented on the World Wide Web as graphics and text interfaces.

A goal of knowledge mapping is to develop a network structure in a graphical format. Liebowitz (2002) argued that knowledge graphs are networks of concepts. Furthermore, a number of graphic displays can be used in the cognitive mapping technique to reflect the information through the capturing lines of reasoning in the forms of ideas (concepts) and relationships (links) (Ackermann, 1994). Concept mapping is a good example of graphical illustration, which is an administrative tool that consists of a series of words laid out in a graphical representation (Liebowitz, 2002). Thus it can be seen as a method that

represents knowledge in graphs. In essence, together with related concepts such as querying and reporting techniques (Tsai, 2003), graphical illustrations are integrated during the process of information landscaping in such a way that the information is conveyed in a more visual format.

### **2.2.2 Spatial characteristics**

All maps have a spatial aspect, therefore a key feature is that maps can present a large amount of information in a limited space. Recent advances in the field of software development has had a notable impact on the field, and a variety of mapping software packages is available to transform the information into a format applicable to the creation of maps. For instance, a geographic map typically reveals a large amount of information, or spatially reference data (Tombarge, 1999). Information systems are required to perform spatial analysis to present the information in a meaningful way. Similar to geographic information systems, other forms of mapping require information systems that can transform information in such a way that it gains a spatial dimension.

### **2.2.3 Symbolic qualities**

All maps have symbolic components that represent specific concepts, ideas or facts. These symbols may differ depending on the mapping method that is used. In general, the information mapping method provides guidelines for symbolic representation of information. There is, however, a wide range of possible symbols ranging from the well-known examples on a road map to those with meaning to only workers in a specialized field. For instance, procedural knowledge maps deal with knowledge and knowledge sources mapped to spell out a business process symbolically (Plumley, 2003). These symbolic knowledge maps are usually process-based. On the other hand conceptual

knowledge maps symbolize the hierarchical organizing and classifying of content (Lanzing, 1997). Despite this variety, there is core function applicable to all forms of symbolic representation of knowledge, namely to assist with the repackaging of knowledge in such a way that it can be presented in a clearer manner. There is a large degree of choice in this regard, although a dominant factor will be the client's needs (Horn, 1998).

Technically, in order to create a concept map to represent knowledge in the symbolic format of a graph or illustration, these concepts should be converted into a series of networks, nodes (symbols of the concepts) and links of concepts (Liebowitz, 2002). As indicated above, this is greatly facilitated by contemporary software packages.

#### **2.2.4 Visual features**

When considering the nature of mapping it is clear that visualisation plays an important role. For instance, visual displays of information retrieval can be used to convey a large amount of information in a limited space (Lin, 1997). Besides, visualisation of information enables the fusion of graphics, scientific visualisation, databases and human-computer interaction.

Data, information and knowledge can be visualised through mapping. For instance, data visualisation can be used to clarify processes within the organisation, while process maps can be used to visualise the transformation of information and processes within organisations. In addition, the visualisation of the relevant knowledge of an organisation can be displayed through knowledge mapping. An important element of knowledge mapping is the means it offers for the visualisation within an organisation to determine ownership and the use of knowledge. Also, visual cognitive maps can provide patterned

abstractions of policies that allow the managers to consider policy implementation.

### **2.2.5 Communication tool**

According to Horn (1976) information mapping is a method that can improve the technical communication of the users of the information. A knowledge map also communicates multiple relationships between concepts via nodes, links and spatial configurations (Leibowitz, 2002).

In essence, the purpose of mapping is to communicate information. The need to communicate information is not a new phenomenon. However, where applicable, mapping is of benefit in instances such as corporate communication, where information design is applied to integrate content selection, writing, visual graphs and communication into a coherent whole.

### **2.2.6 Simplified model of complex issues**

Maps are simplified models of complex issues. For instance, information mapping can assist a business to get insight into the needs of customers where data that was gathered during the sale of goods was transformed into information through the use of mapping techniques. These simplified models of visual information can then be used in a pro-active manner to ensure that buyer trends are taken into account, thereby giving the business a competitive advantage. Therefore, despite the potentially complex nature of the process to generate the map, the end result is a simplified graphical representation that can reveal important trends that would otherwise have been obscured by volumes of raw data.

### ***2.2.7 The use and value of mapping***

Information retrieval and access systems, including mapping methods, must engage with the requirements of intended users, and the users must understand the relevance of the information provided by the system (Seidel, 1982). It is clear that, in order for mapping to be of value, the goals must be well defined, and similarly, workers with appropriate expertise are required to design and implement the process.

#### *2.2.7.1 Enhancement of information retrieval*

Data, information and knowledge are important resources for an organisation. Optimal utilization of these resources depends on the availability of effective mechanisms for their retrieval. Mapping offers a promising possibility in this regard. Furthermore, data mining is a method that can assist mapping. This involves extracting "hidden" information from a database that the user had been unaware of. Once this data is extracted it can be mapped to make it more accessible to the user. Information mapping can therefore be seen as an information retrieval system and a potentially valuable element in the information processes of an organisation.

Knowledge mapping can be described as an ongoing search within an organisation to determine the ownership, location and use of knowledge as such and to learn the expertise of workers. Thus, knowledge mapping helps to identify existing knowledge in the organisation. The identification of this existing knowledge is useful for the optimization of resource allocation (Gbaguidi, 1998).

#### *2.2.7.2 Location of knowledge*

There is no universal methodology available to organisations to trace data, information and



knowledge when needed. In fact, organisations may use any one, or combinations of a variety of techniques for this purpose, including frequently asked questions, heuristic procedures, best practices, lessons learned, and solutions to common problems, product knowledge, as well as market and process knowledge. After knowledge has been located, mapping can assist in the visualisation of these resources, as indicated above.

Mapping can also assist in the quest to trace information. Indeed, an aim of structural knowledge mapping is to inform managers about the explicit knowledge resources of an organisation (Applied knowledge research institute, 2003). In the case of cognitive mapping, the main goal is to detect and capture the knowledge of individual group members in a natural and transparent manner without losing the complexity of the material (Ackermann, 1994).

#### *2.2.7.3 Improved workflow*

Mapping offers an illustration of the flow of knowledge through an organisation. For this, process maps are required to prepare the work (documents) that flows through that process (Jones and Lancaster, 2001). Information mapping techniques can therefore help organisations to streamline their information through the improvement of information workflows. All these enhancements ultimately assist in adding business value to the organisation.

#### *2.2.7.4 Superior navigation*

Mapping can be seen as a navigational tool for informational space. According to Horn (1998), the goal of information mapping in this regard is to deliver well-structured documents that are easy to navigate. It is evident that for organisations such as libraries,

information mapping can be of much value as it helps their users to gain access to and navigate through the available resources. Liebowitz (2002) describes concept mapping as a navigational tool that assists the user by clarifying concepts. In other words, concept mapping uses words to navigate the information space.

#### *2.2.7.5 Identification of constraints*

Mapping can identify the constraints of data, information and knowledge in an organisation. Identification of constraints through techniques like gap analysis can assist management to see new opportunities. Gap analysis is the comparison of existing documents with existing document record requirements (Paradis, 1996) and can be performed by the application of mapping.

#### *2.2.7.6 Better use of information*

As it is a prerequisite for the better use of data, information and knowledge through mapping, it is essential to know the important role that information and knowledge plays in recent literature.

Because of the demonstrated emphasis on the use of information and knowledge as basic resources, there is an increased interest in its management, as is clearly reflected in recent articles, books, and conferences. In parallel streams of research, concepts like intellectual capital (Sveiby, 1997), organisational learning (Levitt and March, 1988; Huber, 1991; Brown and Duguid, 1998), organisational knowledge creation (Nonaka and Konno, 1998), the knowledge worker (Drucker, 1999), and knowledge management (Alee, 1997; Badaracco, 1991) helped to form an understanding of the significance of information and knowledge. These studies indicated the value of information when it is to transfigure into

knowledge.

Once the importance of information and knowledge is understood it becomes clear that mapping can add quality to the use of these resources in organisations. Therefore mapping could be seen as a tool that is available to management to visualise these resources.

As an example, information mapping may help to gain an understanding of clients' needs, limitations, opportunities and competitive leverage at a very basic level. Therefore using information mapping may add value to organisational documentation (Horn, 1998). Other objectives of information mapping are the assistance to companies to improve the quality of products or services, and the use of the mapping technique to assist management in the selection of teams. Mapping can also be used to clarify the matching of technology needs and processes (Grey, 1999).

Finally it is clear that an information perspective focusing on the use of information and knowledge mapping in organisations will be advantageous in many respects. It is important that the organisation's goals are known since mapping is a tool that enables and supports the achievement of goals. This visualisation method would assist an organisation in taking informed decisions and should therefore be a strategic instrument.

## **2.3 Definition of related concepts**

To guide the objectives of this study, some clarification of terminology is needed. Such clarification can not be restricted to the term information mapping only, but should include some related terminology such as information, knowledge, maps, knowledge mapping, information auditing, data mining, information landscaping, information architecture, visualisation and competitive advantage.

### **2.3.1 What is information?**

Data in context (not fixed) becomes information. In other words, when data has been compiled into meaningful and useful patterns to human beings, it becomes information. In turn, information can be a resource (data or facts not yet turned into knowledge), or a commodity that can be bought and sold. Information is also relative, because of the context imposed by the existing knowledge base of the user of the information in the process of interpretation. In other words, information could be seen as perception. Information is a power in its own right; it has the power to change context. We can therefore say that information is a constituent force in society. According to Bateson, as quoted by Choo (1998), it is any information that makes a difference. It typically reduces uncertainty and ambiguity. Choo (1998) further stated a key requirement for information to become strategic: that it must be galvanized into knowledge that can guide action.

Furthermore, for the purpose of this study it is important to acknowledge that information is

part of the organisation's information systems. Information systems are interrelated components working together to retrieve, process, store and disseminate information to support decision making in the organisation. Therefore organisational learning depends to a large degree on the management of the information systems which in turn requires an understanding of the organisation, management and information technology shaping the systems.

Besides, information technology (IT) within organisations is of a changing nature. Its infrastructure, which includes computer hardware, software, data, storage technology and networks, provides opportunities through the use of new technology (e.g. mapping) but it also increases its strategic vulnerability. Therefore it must be viewed from a strategic perspective. The organisation's management must search for profitable IT applications. Such an application can be the use of the mapping technique to make information more accessible and usable. Therefore the codification of information through mapping hangs together with information strategy. Because an organisation's information is a valuable resource once it is processed into knowledge to guide action, it is important to define knowledge.

### **2.3.2 What is knowledge?**

According to Choo (1998) we need to understand the nature of knowledge in organisations in order to manage it. Three categories of organisational knowledge were identified: explicit (articulated) knowledge, tacit (unarticulated) knowledge and cultural knowledge, which is based on shared beliefs. Explicit knowledge can also be regarded as information.

Therefore it is possible to indicate that tacit knowledge can be shared through socialisation, and made explicit through externalisation. In an organisation, tacit knowledge is made up of the collective mindsets of everyone in the organisation. Tacit knowledge is the entry points through which information is transmitted and processed into knowledge. Furthermore, the application of existing knowledge is the factor that changes data into information and information into knowledge.

Davenport and Prusak (1998) presented a working definition of knowledge as a “fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the mind of knowers. In organisations, it often becomes embedded not only in documents or repositories but also in organisational routines, processes, and norms.” Therefore in a company or business it is important to define whether the actual knowledge “owner” is the company or the employee. This definition makes it clear that knowledge in organisations is in people’s minds (tacit) and it exists in formal products and procedures (explicit). The know-how that exists within an organisation enables data to be used effectively so that that it can be seen as information. Through the use of knowledge as an intellectual resource, information can be turned into knowledge.

Knowledge can be seen as an important strategic resource because it is linked to intellectual resources and capabilities. Therefore knowledge can be regarded as part of the intellectual capital of an organisation, which can be defined as human capital, customer capital and structural capital (market needs). According to Skyrme (1999), knowledge development and sharing have a strategic impact on the organisation’s structure, culture and environment. Furthermore tacit knowledge has an influence on the

elements, strategy, systems, structure and culture of structural capital. Companies with superior knowledge (intellectual resources) can coordinate and combine their resources and abilities better. Mapping can assist the organisation in accessing this organisational knowledge. Mapping strategic knowledge implies the ability to support the competitive position.

### **2.3.3 What is a map?**

“A Map is a spatial analogue: its purpose is the understanding, portrayal, and communication of information that varies in space” (Fisher, 1982). Maps are visual representations of interpreted evidence. Traditionally, it can be seen as an abstract image of the physical features of a section of the earth’s surface graphically presented on a flat surface. Perspectives on a map’s appearance are directly influenced by the available knowledge and information within reach. For example, perspectives on a globe are influenced by existing ideas. Europe is usually positioned on the upper part of a globe and Antarctica on the bottom part. Is this the truth or just a perception? Therefore it is clear that knowledge and information play a pivotal role in the constructions of maps.

Maps usually represent geographical or physical space, but it can also communicate information that varies in conceptual space. Nevertheless, any useful measurable scale may define imaginary space. Mapping engages in varied aspects suggested by the words spatial, quantitative and symbolic. Elements of maps include signs, symbols and spatial relationships. A map shows the spatial relationship between points (or objects) on the map in terms of their geographic or conceptual positions in relation to each other such as geographical or conceptual proximity. Typically maps highlight, generalise and leave out

certain characteristics from the map to meet specific aims (e.g. railroads may be omitted on a highway map).

### **2.3.4 What is information mapping?**

According to Horn (1976), information mapping is a method of bringing together current learning research and instructional technology into comprehensive materials development and presentation technology to improve technical communication.

Mapping involves a system of principles and procedures required for learning and reference including 1) identifying, 2) categorizing, 3) interrelating and sequencing, 4) presenting graphically and 5) information (Horn, 1976). As indicated below, mapping offers a powerful tool to convey information. Its commercial value is also recognised, as is shown by the formation of companies such as Information Resources, Inc., Lexington, Mass, USA, which has been developed by American educator Robert Horn. This definition of information mapping focuses on the instructional approach to designing instructional material.

The essence of mapping is well defined in the following quote "Mapping is a communication tool that provides writers with an approach to getting their message across in a way that meets their users' needs. This approach also provides users with ways of scanning, skipping and retrieving information they need quickly and easily. Mapping is not a format; it is a way of thinking. It is the up front analysis and organisation of the information being presented that make mapped documents so effective." (Mapping and its principles, 2003). It is an approach which explores information use and the need(s) of the



information under study.

Information mapping can also be used to display information graphically through e.g. charts or literally maps. The technology used is the interdisciplinary tool Geographic Information Systems (GIS). Information mapping assist users with the ability to analyse and resolve issues by means of visual thinking. Information mapping is a powerful tool that is easy to use with infinite applications for recording and communicating information.

Information mapping can also extract themes and topics from massive amounts of unstructured text. With this information in hand an interactive map can be created for the organisation. Information mapping also relates to information resources mapping (sometimes described as information auditing) that deals with information flows between information resources. Therefore the next definition that will be discussed is information auditing.

### ***2.3.5 What is an information audit?***

An information audit supports a repeatable process to drive ongoing improvement in information management across the enterprise. The process includes 1) specific audit techniques, 2) reporting guidelines, as well as 3) the evaluation of information (Information auditing process details, 2003). Orna (1999) defined an information audit as "a systematic examination of information use, resources and flows, with verification by reference to both people and existing documents, in order to establish the extent to which they are contributing to an organisation's objectives". Buchanan and Gibb (1998) explained that the main purpose of an information audit is to identify an organisation's information resources

and requirements. It is evident that there are various definitions of the term. There are also various methods of conducting an information audit. The main objective of an information audit is to map the information flow and to identify the key information gaps. When conducting an information audit a qualitative approach rather than a quantitative one is preferable, since the aim of an information audit is to visualise the meaning of information as well as patterns of behaviour.

### ***2.3.6 What is knowledge mapping?***

Knowledge mapping is a dynamic technique for making contextual knowledge representable, explicit and transferable to others (Liebowitz, 2002). Additionally, a knowledge map is an interactive, open system for the exchange of ideas that defines, organises and builds on the intuitive, structured and procedural knowledge used to deal with, and resolve problems (Wright, 1993). Recent research by Liebowitz (2002) supported the idea that the terms knowledge maps and knowledge mapping in the knowledge management field can be parallel to the use of concept maps and concept mapping. Lanzig, as quoted by Liebowitz, argues that concept mapping is a technique for representing knowledge in graphs (2002).

Knowledge mapping is dependent on an ongoing search within an organisation to 1) determine the ownership, location and use of knowledge as such, 2) to assess the expertise of personnel, 3) to identify the constraints of knowledge and to 4) stress opportunities to support existing knowledge. The process consists of surveying, auditing and synthesising the acquisition and loss of information and knowledge in groups and individuals. Mapping illustrates the flow of knowledge through an organisation and it helps

an organisation to evaluate the influence of the loss of personal knowledge on intellectual capital.

A further application of knowledge mapping is to assist in selecting teams and to match specific technology needs and processes (Grey, 1999). Examples relevant to knowledge mapping include frequently asked questions, heuristic procedures, best practices, lessons learned, solutions to common problems, and product, market, and process knowledge. Knowledge mapping therefore helps to determine where knowledge resides in an organisation through the use of a social network analysis. Specifically, the goal of knowledge mapping is to develop a network structure that represents concepts to identify existing knowledge in organisations (Liebowitz, 2002). In conclusion it is a valuable tool assisting in 1) identifying key knowledge agents, 2) leverage of the knowledge agents networks, and 3) detecting gaps in the organisation's knowledge base as it develops into a learning organisation.

Knowledge maps are visual representations that help us create, store, modify, recall, and share information. Knowledge mapping tools assist users to form pictorial networks (maps) that tap and expand our individual and group creativity.

### ***2.3.7 What is a knowledge structural map (KSM)?***

Knowledge structural mapping provides structural information about the knowledge that relates directly to the way the knowledge can be developed and used (Applied knowledge research institute, 2003). In order to comprehend structural knowledge mapping the objectives of KSM were examined. These objectives are to 1) inform managers about explicit knowledge resources of an organisation, and 2) assist managers in their decisions

aimed at protecting and developing these resources.

With KSM a map of the knowledge structure of a particular area of the business is produced, which provides a common frame of reference for discussion. It also provides structural information about the knowledge that relates directly to the development and utilisation of that knowledge. It therefore enables explicit knowledge management.

### ***2.3.8 What is data mining?***

Data mining is the automated extraction of hidden, predictive information from databases (Thearling, 2001). According to Laudon and Laudon (2002), data mining is the analysis of large pools of data to find patterns and rules that can be used to guide decision-making and predict future behaviour. Furthermore, as stated by Garofalakis and Rastogi (2002), massive collections of network-management data grow vigorously every year, and hide "knowledge" that is essential for effectively managing a communication network. Although data mining is not a business solution, it helps to extract this information and therefore to solve business decision problems. It is fair to suggest that data mining is almost like an extension of statistics, and for that reason it could be seen as statistics with an artificial intelligence.

### ***2.3.9 What is information landscaping?***

According to Tsai (2003), information landscaping is an integration of information mapping, charting, querying and reporting techniques. Information landscaping has been developed

to provide a means for the construction of a total quality knowledge management system. Besides, this management system must focus on a particular subject information field. The information map is used as a graph for the development of a web-based subject expert bank, which is part of the information landscape.

### **2.3.10 What is information architecture?**

According to Rosenfeld and Morville (2002), information architecture is a combination of organisation, labelling, and navigation systems within an information system. Furthermore, it is the structural design of an information space to facilitate task completion and intuitive access to content. Information architecture is also the science of structuring and classifying web sites and intranets. Information architecture assists people in accessing and managing information and it also brings the principles of design and architecture to the digital landscape.

As with any concept, it is difficult to define absolute boundaries for information architecture. For instance, activities such as graphic design, software development and usability engineering are not information architecture (Rosenfeld and Morville, 2002).

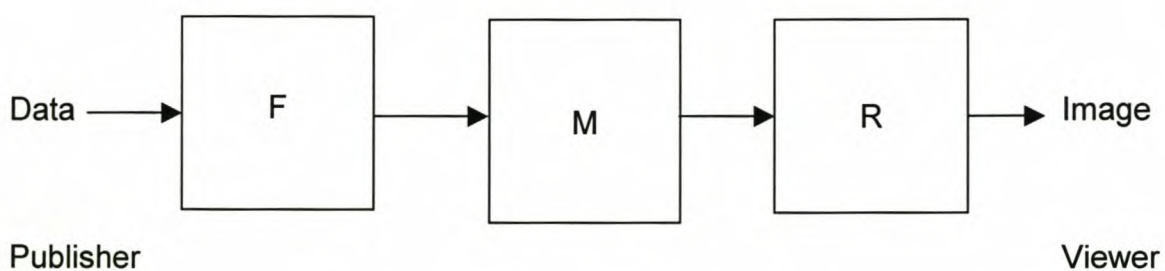
### **2.3.11 What is visualisation?**

Document visualisation is not simply the retrieval of information. Card et al. (1999) defined visualisation as "the use of computer-supported, interactive, visual representations of data to amplify cognition." He also indicated that the purpose of visualisation is insight and not

pictures. The goals of this visualisation insight are discovery, decision-making, and clarification. Furthermore, non-physical information such as business information or documents can also benefit from a visual format.

Scientific visualisation is the representation of data in a graphical format. This format helps to gain understanding and insight into the data through e.g. data browsing. It helps to view data selectively and interactively in "real time". It is only part of the greater field of visualisation and is sometimes referred to as visual data analysis.

The reference model for visualisation that has underpinned much of modern scientific visualisation was proposed by Upson (Wood, 1996). This model (figure 2.1) describes visualisation as a pipeline, in which a source of data is fed in and consecutively filtered, mapped and rendered to create a final image that emerges at the other end.



*Figure 2.1: Visualisation pipeline (Adapted from Wood, 1996: 81)*

### **2.3.12 What is information visualisation?**

According to Scheinerman (1999), information visualisation is a compact graphical presentation and interface for manipulating large numbers of items possibly extracted from

large datasets. It enables the user to make discoveries, decisions or explanations about patterns (including correlations, clusters, gaps, and outliers), groups of items, or individual items. Furthermore Card et al. (1999) defined information visualisation as the use of computer-supported, interactive, visual representations of abstract data to amplify cognition (Table 2.1). Information visualisation deals with portraying concepts and data in a significant way. In addition, information can be visualised in either static or dynamic forms depending on the medium used. Information visualisation is also emerging as an important fusion of graphics, scientific visualisation and database and human-computer interaction. Haber, quoted by Duclos and Grave (1993), proposed a classification of the processes and kinds of data involved in a visualisation system.

**Table 2.1. Definitions related to information visualisation (Adapted from Card et al., 1999)**

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**Definitions**

<b>External cognition</b>	Use of the external world to accomplish cognition.
<b><i>Informal design</i></b>	<i>Design of external representations to amplify cognition.</i>
<b>Data graphics</b>	Use of abstract, non-representational visualisation of data to amplify cognition.
<b><i>Visualisation</i></b>	<i>Use of computer-based, interactive visual representations of data to amplify cognition.</i>
<b>Scientific visualisation</b>	Use of interactive visual representations of scientific data, typically physically based, to amplify cognition.
<b><i>Information visualisation</i></b>	<i>Use of interactive visual representations of abstract non-physically based data to amplify cognition.</i>

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### **2.3.13 What is an Internet based information system?**

An Internet based information system is a collaborative form of information that contains structured multidimensional space for information objects. Furthermore, through the use of intranet technologies the information system handles the contextualisation of the information supply as well as the visualisation of information objects (Sternemann and Zelm, 1999). For instance, the North American Presentation-Level-Protocol Syntax (NAPLPS) is a standard encoding method for visual information that can be applied to a variety of computer systems. Furthermore, NAPLPS was developed from the Telidon Videotext system. The Telidon Videotext system was developed in Canada and is AT & T's PLP system that was presented in 1981 (Fleming and Frezza, 1983). It is a good example of graphical interfaces that are used to reveal structure and meaning.

More examples of interactive graphics are Lucid Mapping and Codex Transformations in the Z-Buffer. According to Kirschenbaum (1999), Lucid Mapping uses the virtual reality modelling language to explore textual and narrative possibilities within three-dimensional (3D) electronic environments. Finally, it also considers the implications of 3D textual environments on visual language and communication.

### **2.3.14 What is competitive advantage?**

Callon (1996) argued that a company gains a competitive advantage by providing value to customers. He also suggested that this value could be real or perceived as long as the customer was provided with added value. This vision implies that an organisation must continually work in order to stay ahead of the average organisation. In other words,



although per definition this appears to describe a relatively simple concept, the implications can be far reaching because such a competitive advantage is often important and can be the deciding factor in the survival of an organisation. At this stage it should again be emphasised that mapping can enable a company to be competitive.

## **2.4 Relationships between pertinent concepts**

### ***2.4.1 Associations between concepts***

All organisations have data. When this data has been compiled into meaningful and useful patterns, it becomes information. For information to become strategic, it must be galvanised into knowledge that can guide action. Organisational knowledge can be explicit (articulated) knowledge, tacit (unarticulated) knowledge and cultural knowledge. An organisation's tacit knowledge is made up of the collective mindsets of everyone in the organisation and is therefore the entry point through which information is transmitted and processed into knowledge. Furthermore, according to Sveiby (1997), information is facts, but knowledge is skills, know-how, value judgements and social networks. In this regard Liebowitz (2002) maintained that knowledge graphs are networks of concepts. Knowledge graphs can also be portrayed as knowledge maps; therefore it can be said that knowledge maps represent networks of concepts.

### ***2.4.2 Strategic perspective***

Data can also be seen as a strategic resource because data mining assists the organisation in the analysis of large pools of data to find patterns and rules that can be used to guide decision-making and to predict future behaviour. Although data mining is not a business solution in itself, it supports management to solve business decision problems.

Information is also part of the organisation's information systems which consist of interrelated components working together to retrieve, process, store and disseminate information to support decision making in the organisation. Information architecture, which helps people to access and manage information, is a combination of organisation, labelling, and navigation systems within an information system. Information landscaping has been developed to provide strategic guidance to organisations for the construction of a total quality knowledge management system. The Internet is now an integral part of organisations' information systems. The Internet-based information system can be seen as a collaborative form of information that is structured in multidimensional space. It is therefore clear that it is of strategic importance for an organisation to be connected.

On the other hand, knowledge can be seen as a very important strategic resource because it is linked to intellectual resources and capabilities e.g. human capital, customer capital and structural capital (market needs). This exemplifies the fact that data, information and knowledge have strategic value for an organisation. Consequently it is important to make these commodities accessible to all the stakeholders of an organisation. A means to achieve this goal is the use of IT solutions like mapping.

#### ***2.4.3 Mapping as a visual enabler***

The discussion so far argued that mapping can be used to make data, information and knowledge more strategic within an organisation. A related concept is visualisation, which is the representation of data in a graphic format. This can also be regarded as visual data analysis, and a typical sequence of events during such analysis includes loading the data, followed by filtering, mapping and rendering to create a final image or visualisation.

Because the visualisation of information involves a compact graphical presentation and interface for manipulating large amounts of information, it requires appropriate hardware and software. Similarly, an Internet-based information system is a collaborative form of information objects that is visualised through the use of intranet technologies, consisting of graphical interfaces that are used to reveal structure and meaning. It can therefore be argued that information landscaping is an integration of information mapping, charting, querying and reporting techniques. Information visualisation and information landscaping are both visual aids to an organisation and both deals with access to information.

As indicated previously, maps are visual representations of the interpreted spatial relationship between points in terms of their geographic or conceptual positions. It is thus obvious that information mapping involves the mapping of information in documents. It may also involve mapping of documents or resources, so that is sometimes referred to as information auditing.

In essence, it can be said that knowledge mapping strives to develop a network structure that represents concepts to identify existing knowledge in the organisation. In an organisational context, structural knowledge mapping provides a suitable mechanism to inform managers about explicit knowledge resources of an organisation. It may also assist managers in their decisions aimed at protecting and developing these resources.

## **2.5 Summary**

The concepts discussed here either involve the need or use of data, information and

knowledge within an organisation, or deal with the way in which information technology supports an organisation through retrieval and use of data, information and knowledge. It is argued here that the mapping technique, which facilitates spatial orientation in a graphical format, provides a suitable approach for this purpose. Therefore mapping can be seen as an enabler that supports an organisation's efforts to become more competitive.

Considering the variety of related concepts, including information, knowledge, various aspects of maps and mapping, visualisation, auditing, data mining, as well as landscaping and information architecture, it is clear that mapping and related concepts constitute a complex issue. This, together with the fact that mapping has many facets and interpretations, necessitates a thorough understanding of this technique before it can be applied successfully as a resource enabler.

## Chapter 3 An analysis of mapping methods and techniques

### 3.1 Introduction

The concept of mapping was introduced in the previous chapter as a potentially effective tool for the visualisation of information and knowledge. The objective of this chapter is to expand on this topic, especially in terms of the relevant methods that can be applied during the implementation of mapping as a tool for a business strategy.

As indicated in the previous chapter, information must become part of people's knowledge if its utility is to be enhanced. Organisations need to consider various factors to utilise this ability, namely tenacity (beliefs and traditions), intuition (reason), authority (knowledge from authoritative source) and science (theory). Information mapping can assist the organisation in locating their core or distinctive competencies, alliances as well as methods of knowing. It is clear that in the current information age, and subsequent competitive environment, innovative techniques are required for companies to remain competitive. One such example is Porter's five forces framework, which can be used by companies to map an environment that is constantly changing and becoming more uncertain in an effort to comprehend the way competition is being transformed (1979).

It is increasingly challenging to sustain a pool of relevant information that is accessible through networks. Causes of these difficulties are the information overload of network-available information and the increasing complexity, diversity and a lack of uniform terminology of different information sources. To assist companies in managing these

challenges, a thorough understanding and analysis of mapping methods and techniques are required. Research has shown that the concept of information mapping not only differs in the literature, but that the interpretation of the concept also varies. In addition there are many other uses for the term mapping.

The term information mapping has been around since the 1960s. According to Horn (1976) the need for information mapping increases as technology gets more advanced. In 1977 Horn therefore developed an information-mapping course that included developing procedures, policies and documentation. The growing awareness of the importance of information management was accompanied by a growing tendency to use information systems to add quality to organisational documentation. In response Horn founded the company Information Mapping, Inc. in 1991 that aims to improve the quality of documentation systems and information systems through the use of ISO 9000 standards. Despite these and similar efforts by others, the use of information mapping and its various interpretations have not been well documented.

An important characteristic of knowledge mapping is the capability it offers for the visualisation within an organisation to determine ownership and the use of knowledge. In addition to visualising the expertise of employees, knowledge mapping also identifies the constraints of knowledge. The method typically consists of surveying, auditing and synthesising the acquisition and loss of knowledge in groups as well as individuals.

### 3.2 Information mapping method

Horn's (1976) interpretation of the information mapping methods largely dominates this field. Information mapping is seen by Horn as an extension of the principles of programmed teaching as developed by Skinner, Crowder, Gilbert and other workers in this field (Fields, 1982). An information map embodies all the information pertaining to a particular issue. The essence of information mapped context contains summaries in e.g. blocked format on pages, each of which describes a topic of the main subject. The topics are placed in a linear sequence developed from a hierarchy of the subject matter to form a logical instructional outcome.

Horn (1976) defined information mapping as a set of rules and guidelines for organising and displaying information. There are six basic types of maps: 1) structure, 2) procedure, 3) process, 4) classification, 5) concepts and 6) fact maps. A main objective of Horn's company mentioned above (Information Mapping, Inc.) is to offer a professional service and apply these different map types to assist organisations to leverage their information and knowledge to improve performance. While focusing on strategy to improve contents, the research-based methodology produces client-focused, structured content that is easy to find, use and reuse. The company has also launched an information mapping starter kit that includes an e-learning programme and tools that clients can use to master the information mapping technique. Their goal is to deliver well-structured documents that are easy to publish, manage and navigate. Knowledge and a careful selection of methods are therefore necessary to apply this technique successfully.

### **3.2.1 Overview of methodology**

Methods for information mapping can be found in the published literature for public use, as well as commercial outfits. For instance, Horn's information mapping method (IMAP) used by the IMAP Company is a systematic approach for analysing, organising and presenting information based on the client's needs and the purpose of the information (The Information Mapping Method, 2003). The analysis phase includes a project plan that determines the 1) client's needs, 2) purpose, 3) accuracy and 4) structure of the information. The technology that is used to deliver the information is also reviewed. IMAP provides six principles for structuring information. These principles are chunking, labelling, relevance, consistency, integrated graphics and accessible detail. The IMAP method also provides guidelines for visually representing information in the format of choice based on the client's needs. Furthermore, when information mapping is coupled with XML technologies it becomes dynamic and more accessible.

The IMAP company provides various seminars on topics including mapping operation procedures, e-learning, software tools such as Formatting Solutions Pro and XML, as well as conversions from paper to online format. As part of their products and services they have also published various publications such as Mapping Hypertext (The Information Mapping Method, 2003).

For more general use, Horn (1976) suggested a number of design principles and map features that can be used in information mapping. For example, to support teaching the following features may be considered:



- 1) Feedback questions, review questions, answers, topic treatments;
- 2) Using examples or not;
- 3) Introductory paragraphs to alert the learner;
- 4) Underlining important words in definitions;
- 5) Using marginal labels and informative map titles;
- 6) Using diagrams and drawings;
- 7) Using tables and verbal matrices to display concept relations; and
- 8) Using active voice and simple sentences.

### ***3.2.2 Goals of information mapping***

Companies need to have a thorough grasp of the goals of information mapping if they want to use the methodology. According to Horn the purpose of information mapping is to 1) assist with learning and referencing, 2) help with preparation and 3) maintain the learning and referencing materials. It is obvious that information mapping can be used for a variety of other aims, such as improving the quality of products, services, or internal operations in a business environment, or to increase the marketability of a company. Here mapping will ultimately assist in adding business value. Although the aims of information mapping are similar, its elements may vary depending on the field in which the mapping is applied. Nevertheless, the elements of information mapping, as suggested by Horn, provide a good general scheme. These include: 1) a set of classification categories, 2) rules for writing information maps, 3) procedures for preparing maps, 4) formats for the presentation of different kinds of maps and 5) comprehensible rationales and research on which the technology is based.

### 3.3 Knowledge mapping method

Knowledge mapping helps to determine where knowledge exists in an organisation. It also identifies key knowledge representatives and visualises their knowledge through mapping. Therefore mapping helps to illustrate the flow of knowledge through an organisation. To assist a company in the development of a knowledge map, they should include current knowledge as well as knowledge that will be needed in future - thus it is both present and strategic.

According to Plumley (2003) knowledge maps can be classified into three types, namely: 1) procedural knowledge maps, 2) conceptual knowledge maps and 3) competency knowledge maps. Procedural knowledge maps deal with knowledge and knowledge sources mapped to spell out a business process. Besides being process-based, knowledge mapping is definite and tactical. To confirm this notion, the analysis and application of process-based knowledge mapping are orientated towards the planning and implementation of a pragmatic project, programme or strategy.

Conceptual knowledge maps makes possible hierarchically organising and classifying content. Recent research by Lanzing (1997) focused on concept mapping as a technique for representing knowledge in graphs. In response, Liebowitz (2002) argued that knowledge graphs are networks of concepts, and thus consist of nodes (concepts) and links (relations between concepts). An example is social network mapping, which entails networks of knowledge and patterns of interaction among group members, organisations, etc. In a similar fashion, Leibowitz (2002), viewed a knowledge map as a two-dimensional diagram, which communicates multiple relationships between concepts via nodes, links and spatial configurations. Competency knowledge maps can therefore be seen as the

yellow pages of an organisation because they document the skills, positions and even career paths of individuals in the organisation.

Knowledge mapping is often conducted in phases, each of which can potentially reveal new information. Therefore, to benefit optimally from this approach, there should be constant awareness in place to identify and uncover information opportunities if and when they arise.

### ***3.3.1 Goals of knowledge mapping***

An important aim of using knowledge mapping is to help companies to evolve into learning organisations (Liebowitz, 2002). Specific objectives of knowledge mapping to achieve this goal include 1) developing a network structure, 2) identifying existing knowledge in the organisation and 3) determining where the gaps are in the organisation's knowledge base. It is important for the organisation that the developed network structure should represent concepts and their associated relationships in order to identify knowledge agents.

### **3.4 Analysis of mapping by comparing characteristics and goals of methods**

When data is compiled into meaningful patterns, information is formed, and this information becomes part of the organisation's system. In turn, the latter directs the way in which the organisation's processes and outputs proceed. As discussed earlier, information mapping is a graphic way to support organisations with organisational learning, which depends to a large degree on information management. The mapping method that will be followed is dependent on the nature of the organisation, as well as the type of information

that needs to be mapped. To demonstrate how the nature of the information type has an influence on the mapping method, examples of two types of information that can be mapped are shown below, namely the contents of documents, and information resources.

When document content is mapped, information mapping can be seen as:

- a set of rules and guidelines for organising and displaying information;
- a tool to enable the strategy to improve contents to structured contents;
- useful in the field of teaching (where the document provides the learning material) and to enhance teaching aids.

In the case of teaching, obvious goals for the interpretation of information mapping include assisting educators with learning and referencing, and helping with preparation and maintenance of documents.

When information resources are mapped, information mapping can be seen as:

- a repeatable process to drive ongoing improvement in information management in the organisation;
- a process that uses auditing techniques to enable a systematic examination of information use, resources and flows within existing documents, reporting guidelines, as well as the valuation of information;
- as a way to identify an organisation's information gaps and requirements;
- useful in organisations such as libraries to enhance the use of information to support organisational learning.

An example of where this may be applicable is companies, where the goals of information

mapping include assisting the company in order to improve the quality of products or services, internal operations, and to increase its marketability.

Following this processing of information, the information becomes knowledge, and so in a form that can guide action. This, and the fact that knowledge management deals with intellectual capital, are reasons why knowledge can be seen as the organisation's most valuable resource. It is obvious that co-operation and interpersonal skills are needed to manage intellectual capital (human, customer and structural). Tacit knowledge (Choo, 1998) is an important aspect in this regard as it is seen as part of the human capital (collective mindset) of an organisation. Similarly, tacit knowledge also has an influence on the four elements of structural capital, namely strategy, systems, structure and culture. Therefore companies with superior knowledge can coordinate and combine their resources and abilities better, and therefore knowledge can be seen as a strategic resource. Ultimately, organisations require means to support their management of this strategic resource - knowledge mapping shows much promise to fulfil this requirement.

Important characteristics of knowledge mapping are:

- the capability knowledge mapping offers within an organisation to determine ownership (key representatives) and the use of knowledge through the eyeing, auditing and synthesis of the acquisition and loss of knowledge in groups as well as individuals;
- the capacity to identify constraints of knowledge;
- the means to determine the flow of knowledge;
- that it can be defined as procedural knowledge maps, conceptual knowledge maps and competency knowledge maps;
- that it can be conducted in phases – to add new knowledge;

- to stress opportunities to support existing knowledge;
- that it can assist in selection of teams and to match specific technology needs and processes;
- that because it deals with the visualisation of a resource it is of importance to businesses.

In this context, the aims of knowledge mapping include the identification of key knowledge agents (intellectual capital), leveraging the knowledge agent networks, and detecting gaps in the organisation's knowledge base.

It can therefore be argued that knowledge and information mapping can play important roles in organisational learning. In order to perform this mapping, a sound understanding of the existing knowledge, information and data, within as well as outside the confines of the organisation, is necessary. The reason for the latter is because organisations need to position themselves in a competitive environment, and as a result, these mapping strategies cannot be formulated in isolation.

### **3.5 Benefits of mapping**

There are many benefits for a company when resources like information and knowledge are utilised properly. Therefore an understanding of the benefits of mapping is essential to enhance a company's position in the new knowledge-driven business environment. These benefits include risk determination, increased knowledge and information, manipulation of information, functionality of information, innovation, quality control of information, and being part of a new technology.

### **3.5.1 Mapping solutions and risk determination**

The application of mapping can be of great benefit during risk determination. Examples of companies that need a visual display of the geographic concentration of risk are the insurance companies, where the value of mapping is evident (O'Donnell, 2003). For instance, in the wake of September 11, 2001, man-made catastrophes became a major issue for these companies. The greater New York insurance companies dealing with commercial multi-peril and workers' compensation products needed a mapping solution to guide its employees to determine risk. An example of such a mapping programme is MapInfo. With this programme a browser can be used to search any geographic area to view coverage by product and exposure.

### **3.5.2 Gaining information on competitors**

Mapping skills can also be used to gain information on competitors to help an organisation to position itself. For example, the gap analysis technique combined with the visual representation of mapping could help an organisation to gain this type of information. Gap analysis also facilitates quality control. By identifying the company's own constraints within its own knowledge base, the company can obtain a better view of its own advantages and constraints.

### **3.5.3 Manipulation of mapped information**

The ease with which mapped information can be manipulated holds advantages for organisations. Since mapped information is easy to manipulate, it is possible to present a large amount of information in a limited space. A further advantage is the manipulation of

data and information into an easy-to-understand visual format. Further examples of the technological manipulation of information include the integration or merging of information, repackaging information and altering information by electronic means.

### ***3.5.4 Functionality or purpose of mapping***

There are many examples to demonstrate the functionality of information and knowledge mapping, including 1) advanced access, 2) enhanced retrieval, 3) better visualisation, 4) good navigation, 5) improved workflow, 6) an easy-to-use method and 7) a method that can determine ownership.

Information and knowledge maps are represented in a format that is accessible. Research by Horn (1976) suggested that the information was more accessible because of the reduced volume which improved the reading speed of employees.

An additional benefit offered by information mapping is that it assists in information retrieval, improved information recall, and finding information. The fast and accurate retrieval of information leads to the notion that mapping can be seen as a factor in enhanced information retrieval. The improved visualisation of information and knowledge through mapping is evident, and usually it should not be too difficult for management to convince employees of the benefits of this method.

In addition to the value of mapping for the internal functioning of an organisation, it is also a useful support in efforts to promote collaborative work within the organisation through the sharing of information and knowledge. A factor that typically limits collaboration is the



volume of information that needs to be transmitted as the volume dictates the communications capacity. Mapping can be used effectively to address this limitation as it enables the improved flow of information and knowledge, its navigation and subsequently an enhanced workflow that leads to reduced writing time for users.

Because information and knowledge mapping is easy to use, the training time of employees is decreased, and the complexity of information and knowledge is reduced. Through this reduction in complexity, mapping simplifies efforts to determine the ownership of information and knowledge. A further important benefit of this visual format is that it facilitates the identification of knowledge areas that are strategic to the organisation.

### ***3.5.5 Mapping stimulates innovation***

It is a fair assumption that information and knowledge are needed if an organisation wants to be innovative. Mapping of information and knowledge provides a sense of direction for new ideas and thus enhances innovation. Plumley (2003) suggests that sharing new ideas through mapping gives employees a sense of freedom. It can therefore be argued that knowledge mapping stimulates those ideas for sharing and for leverage knowledge that are most suited to the organisation and its business context (Plumley, 2003).

It is clear that the improved insight and understanding which is facilitated by visual landscaping will stimulate innovation. It is important for management to recognise these benefits, to stress opportunities that support existing knowledge, and to provide visible support for developing the means to share this knowledge.

### **3.5.6 Mapping as part of new media**

Information mapping is part of a new medium that stemmed from the development of real-time visual computers. Typical advantages of this medium is that it 1) brings increased resources such as perceptual processing to the users, 2) reduces the search-time for information, 3) enhances the recognition of patterns, 4) enables the use of perceptual inference and monitoring, and 5) is manipulative as well as 6) interactive (Card et al. 1999). In fact, it is almost impossible to imagine information mapping in the 21<sup>st</sup> century without modern computing facilities, the latter relating directly to the key trends and influences that have had such a notable impact on businesses, organisations, individuals and society as a whole.

### **3.5.7 Quality control**

The application of technology, including technology used in information mapping, also has an impact on the quality of the mapped information. This is mainly applicable to the reliable gathering and processing of such information.

A clear benefit of modern technology is that it can execute processing activities such as copying information and mechanical editing with absolute accuracy. Subsequently, this technology is ideally suited to assist in human observation. As such, technology is regarded as a reliable and accurate "observer" of information.

## **3.6 Critique on the mapping technique**

Despite the numerous advantages of information and knowledge mapping described so far, these techniques also have some shortcomings. Examples of shortcomings include

(and are not limited to) inadequate research on the method of choice, a company culture which is incompatible with the method of choice, quality control, security, and privacy. If addressed appropriately, some of these disadvantages can be transformed into benefits for the company. To achieve this, an understanding of the critique on the mapping technique is essential for a company's strategic vision on the method. Potential ways to address these shortcomings are described below.

### ***3.6.1 More research is needed on the effectiveness of methods***

According to Fields (1982), there was at the time of his study no published example of the effectiveness of mapping and the theory that it promoted learning. Furthermore Fields was convinced that Horn incorporated proven educational principles in his information mapping technique, which was effective in isolation, but still needed to be proven effective as a combination. Horn used it as a teaching aid and the system was not compared against other teaching systems at the time (1976). Therefore more research was and still is needed on mapping as a teaching aid, but that is just one aspect of the method. To convince organisations of the benefits of mapping more up to date research on the effective use of information and knowledge mapping methods is needed.

### ***3.6.2 Threat to company culture***

The common use of techniques like mapping as well as the use of knowledge itself could lead to the loss of the specific local character of this knowledge (Cohendet, 1999). This is especially true for global firms where information and knowledge mapping can assist in efforts to reduce the threat to local culture.

### **3.6.3 Quality control**

Quality control can be perceived as a benefit as well as a problem. For example, when technology through the use of a computer multiplies a string of factual and other errors in a document it can have serious implications. Measuring the quality of information as an intangible asset is very important for the company's improved performance, but it is difficult to do so.

### **3.6.4 Security and privacy**

Individual as well as organisational privacy can be threatened by the lack of security in the electronic handling of information and knowledge in the mapping process. This issue relates closely to the greater accessibility and security-related concerns of information and knowledge in electronic format.

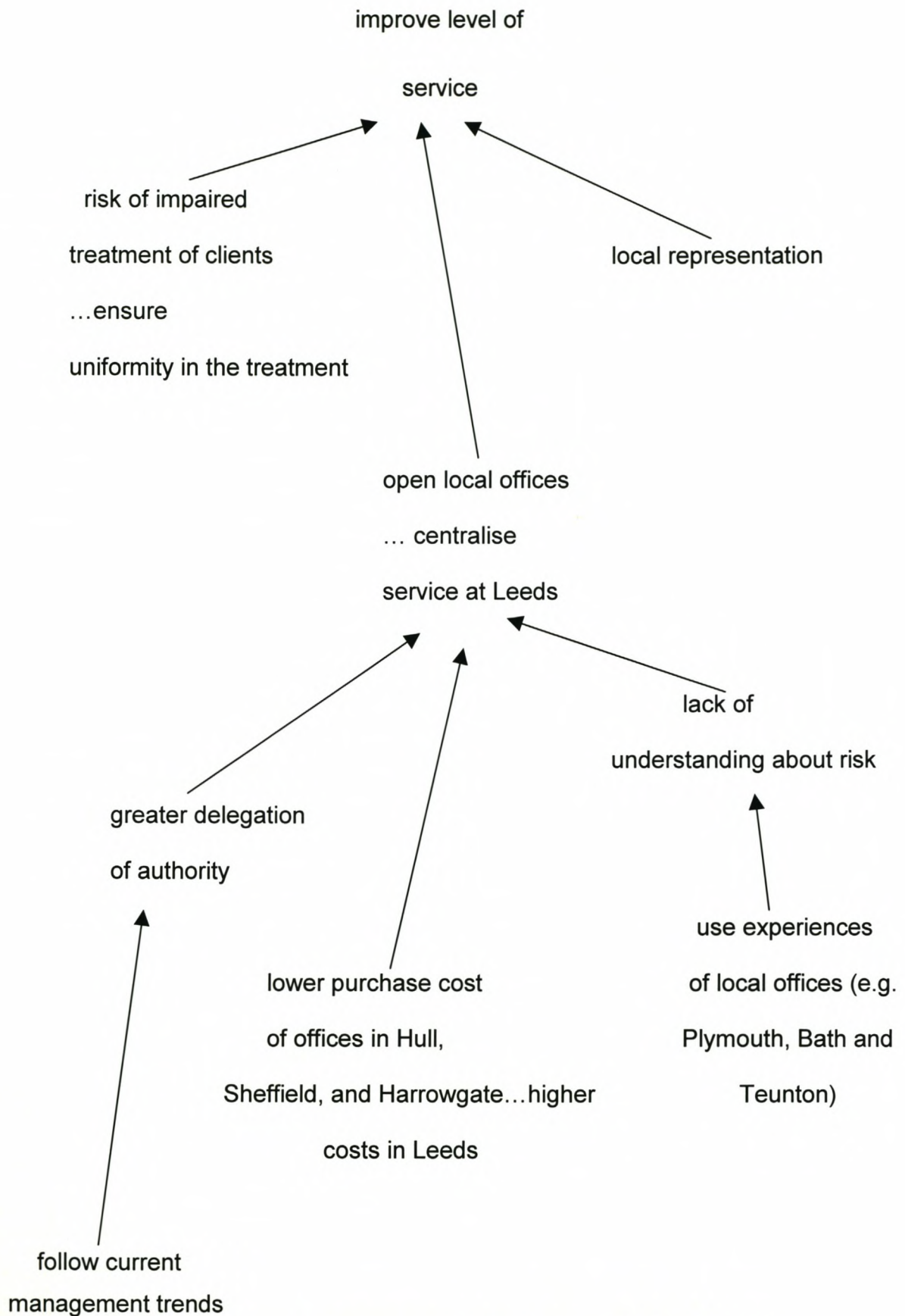
## **3.7 Various mapping techniques**

This discussion of knowledge mapping and related concepts, including benefits and critique, will now be followed by a discussion of some of the mapping techniques that can be used within an organisation. These techniques include the cognitive mapping technique, information visualisation and the end user, citation mapping used in science, and models like data mining that enable mapping.

### **3.7.1 Cognitive mapping technique**

The main goal of the cognitive mapping technique (see Figure 3.1) is to capture the knowledge of individual group members in a natural and transparent manner without losing the complexity of the whole (Ackermann, 1994). Ackermann and Belton argued that these

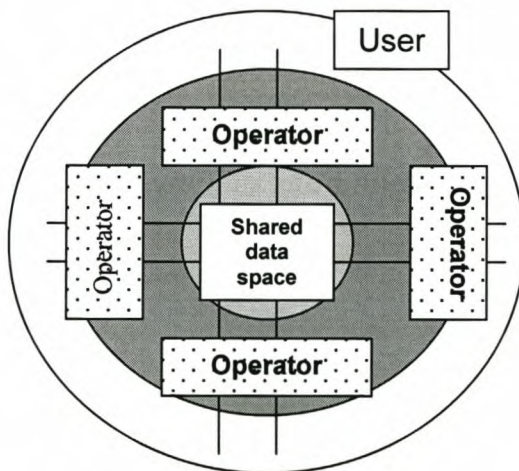
maps can be visualised by entering them into a computer model using COPE software. For instance, cognitive maps can be created during individual interviews with diverse groups of people, and these can then be incorporated into one combined group model. Common subjects are usually identified with which to organise the data. The model combines all knowledge and perspectives, and so reflects the views of all the group members without stating who proposed what (Ackermann, 1994). Furthermore, a number of graphic displays can be used to reflect the information through the capturing lines of reasoning in the forms of ideas (concepts) and relationships (links). The utilisation of this model helps the group to make better informed decisions that can provoke innovation in the organisation.



**Figure 3.1 Part of a cognitive map (adapted from Ackermann, 1994:165)**

### 3.7.2 Information visualisation and the end user

Information visualisation allows direct interaction with the end user. Research has shown that this visualisation system can be considered as a set of visualisation operators acting in a shared data space (Duclos, 1993), for utilisation by the end user (see Figure 3.2). Each user can respond directly to transformation that can occur within the different phases of the visualisation process. Therefore, every user is able to use or produce different kinds of data and information.

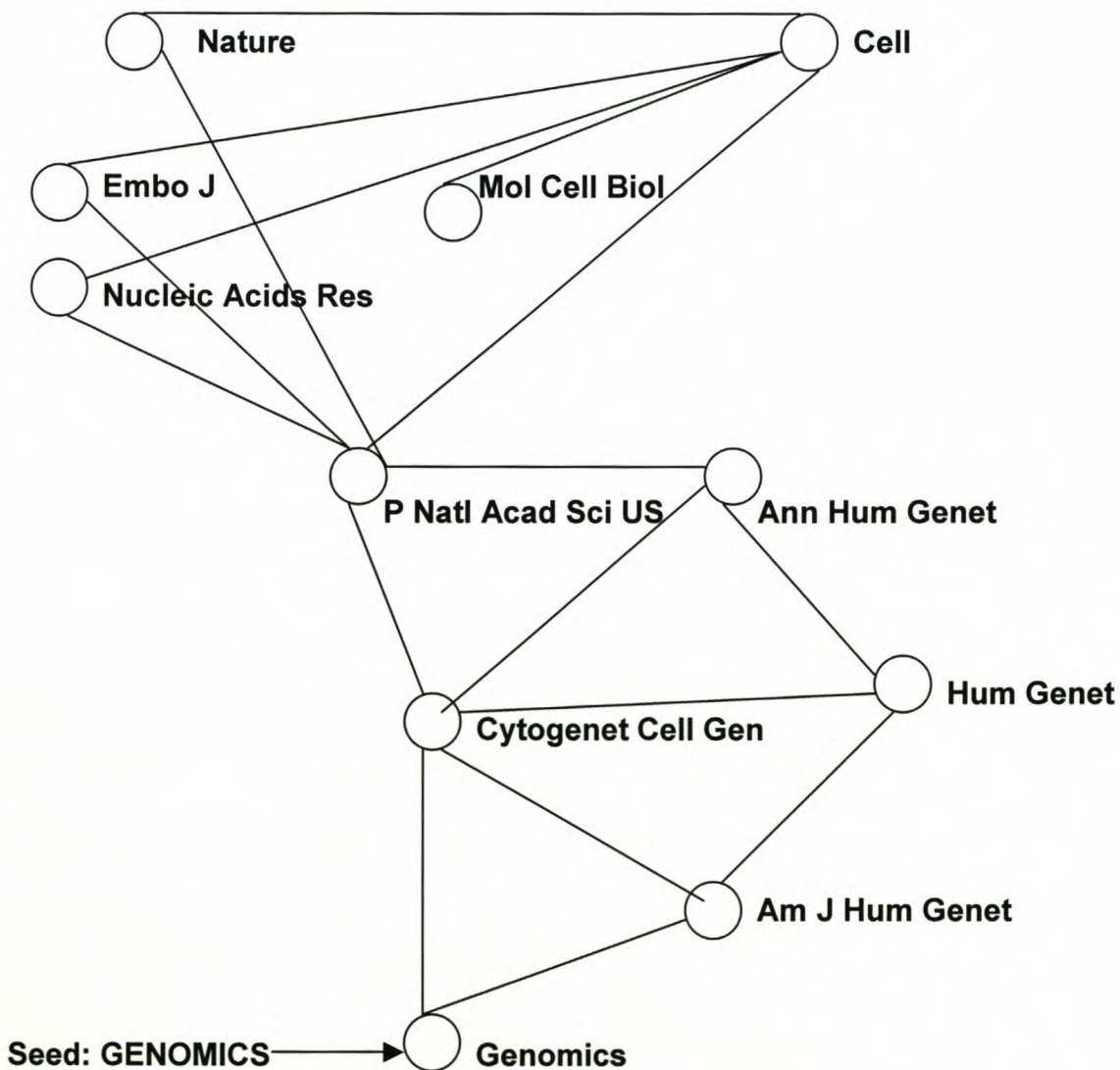


**Figure 3.2 Shared data space (adapted from Duclos, 1993:6)**

In addition, there is an explicit network of operators since the duration of the shared data objects are different from the operators referring to them. This kind of model could be used for data and information operators that work in a domain other than that of scientific visualisation. Research has shown that interaction stimulates innovation. Therefore the visualisation-mapped information in an organisation can give them the edge.

### 3.7.3 Citation mapping used by science

Science can be visualised through citation mapping. Citation mapping gives insight into the state of knowledge, it uses information for making discoveries and helps users to find literature that is indirectly related to a subject (Petras, 2001). There are different types of citation analyses of which co-citation clusters (Fig. 3.3) is probably used most often to identify influential authors or works. Citation data can be used to construct maps of science through focusing on the use of co-citation clusters. Advanced virtual reality software can be used to visualise the data (Small, 1999).



**Figure 3.3** Map of co-citation cluster (adapted from Petras, 2001:5)



### **3.7.4 Data mining models enables mapping**

As stated earlier, data mining involves the extraction of "hidden" information and the location of useful relationships between variables that are non-intuitive. To maximize the value of the information, this graphical data visualisation should be presented with the end-user's needs in mind and it must clarify the process for the user. Obviously the user must understand and trust the data mining model.

According to Thearling (2001), advanced visualisation techniques can greatly expand the range of data mining models that can be understood by domain experts. The process of insight also helps an organisation when they have to make a decision about the accuracy versus understandability trade-off.

Components that are essential for understanding a data mining model include representation (visual form), interaction (use of) and integration (display relationships and provide user context). A possible classification model is a decision tree. Decision trees like SGI's MineSet Tree Visualiser are easy to understand but can be very large. Examples of commercial data mining software applications are Darwin, Xchange Dialogue for modelling and Pilot Software's Discovery Server.

Visualisation by means of data mining helps with the interaction, manipulation and viewing of the results. Therefore data mining can be used as an enabler for information and knowledge mapping.

### **3.8 Mapping applications**

Mapping can be used as an enabler with many purposes. Some of these mapping applications are especially useful for the optimisation of resource allocation, and to communicate large volumes of information in a limited space. Together, these applications allow users to have better control of information. Mapping applications that support these advantages will be explained briefly below.

#### ***3.8.1 Mapping Quality of Service (QoS)***

Mapping the Quality of Service (QoS) from the user's view down to the network infrastructure is addressed with the provision of multimedia services. This mapping is useful for the optimising of resource allocation (Gbaguidi, 1998). The estimated amount of resources is compared with the available resources to determine possible gaps. Therefore mapping assists with quality control.

#### ***3.8.2. Map displays for information retrieval***

Map displays for information retrieval can be used to 1) convey a large amount of information in a limited space 2) reveal semantic relationships between terms and documents, 3) facilitate browsing on retrieval interfaces, 4) detect complex relationships among given documents and 5) provide interactive tools to allow the user to interact with the underlying information. Therefore it can be used as an overview, access, or exploration tool (Lin, 1997).

### **3.8.3 Visualisation of information on the World Wide Web**

Users not only need to view data; they need to have control of the data. This is appropriately described by Schneiderman in his recent book, "Designing the user interface" (OLIVE, 1997), where he suggested a framework which can be used as criteria for the user to have control of a visual environment. The framework consists of the following steps: overview to get a broad idea of the subject matter, zooming-in on the specifics followed by filtering to eliminate elements not required, then details on demand.

A number of approaches for the visualisation of information are available. These approaches are presented on the World Wide Web as 1) graphics and text interfaces, 2) framed interfaces, 3) text only interfaces and 4) WebTOC interfaces. According to Schneiderman (1989) the future of interfaces will be presented in an "information abundant" display, which is overwhelmed with information that can be turned into knowledge. Furthermore visual query formulations and visual display results can be combined in a successful manipulative strategy for the organisation or user.

It is widely believed that human perceptual skills are under-utilised in current information and computing systems. Agreeing to this assumption, Schneiderman (1989) argues that we have to develop tools to manipulate information spaces. Examples of these tools are dynamic queries, starfield displays, treemaps, treebrowsers, a variety of widgets to perform search, browse, and filter functions, as well as compare rich information spaces.

### **3.9 Key issues related to the collection of information for mapping**

Information mapping can be used for various applications, including 1) planning, 2) gap analysis, 3) corrective action, 4) document structure, 5) document and record control, and 6) certification preparation (Paradis and Small, 1996). It is therefore important to clarify the type of information that needs mapping. Once this is established, addressing some key questions can assist management in implementation. Examples of such questions include the location of the information, as well as the method of collection. Finally the selection of the appropriate form of display is of essential importance.

#### **3.9.1 What information needs mapping?**

Various forms of information can be mapped, including documents, files, systems, policies, directories, competencies, relationships, and authorities. It is good policy to define information in terms of its role (e.g. problem solving information), coverage (general or specialised), level (scientific, technical, popularised, etc.) and channel (information systems, mass media, interpersonal communication, etc.) before it is mapped. During the process of mapping, issues such as location, ownership, validity, timeliness, domain, sensitivity, access rights, storage medium, use statistics, medium and channels used should be addressed. Horn (1976) indicated that information mapping can be used in all domains of life, for example in documentation of projects, for reference material, for initial training material, and for computer assisted instruction.

When mapping knowledge, various sources such as artefacts, stories, heuristics, patterns, events, practices, and activities are of importance. Explicit and tacit knowledge, which is linked to strategic drivers, core competencies and market intelligence, also needs to be considered. In essence, the purpose of mapping is to communicate information. Therefore

it is important to have a clear picture of the user, the data, information and knowledge, as well as the visualisation method in mind.

### **3.9.2 Location of information**

Information and knowledge for mapping exist within organisational boundaries and within people that work for that organisation. Considering the almost unlimited range of sources within organisational boundaries, such as the information found at news feeds, contact addresses, network transactions, helpdesks, patent registers, asset and human resource databases, warrantee claims, LAN directory structures, libraries, record archives, process descriptions, push profiles, and meta-data directories (Grey, 1999), it is clear that in addition to knowing where the information is, it is necessary to have strategies to screen the information and to bring it in line with needs. Because of the great variety of possible locations of information, there are usually numerous criteria to consider when selecting locations. For instance, if the objective is to extract information that will reveal the usage of the Internet for non-work related browsing, network traffic logs can be obtained. Information is not only available at extensive locations such as the Web or libraries; research of simple or individual files can also be productive. These may include specific policy documents, organisational charts and process documentation. In most of these instances, it is important to realise that, in addition to the variety of potential locations and sources, information can typically also be at multiple levels (individuals, groups, departments) within the organisation, and linked to external sources including external organisations (Grey, 1999).

### **3.9.3 Collection of information**

Information is often collected through interviews by using targeted questions as well as through observation of work in progress. Information required for knowledge mapping may also include tacit knowledge obtained through formal and informal gatherings.

An example of a widely used approach is the environmental scanning technique, which includes viewing as well as searching for information. For instance, when used for the acquisition of information about trends and relationships in an organisation's external environment, different styles of scanning are applied, including undirected viewing (social gatherings), condition viewing (browsing through newspapers), informal search (market checks) and formal search (systematically gathering information). Environmental scanning is also done at different levels such as high-order levels (broad picture) and low-order levels (specific areas). Most organisations use mixed scanning because the Internet and computer technology are blurring the lines between internal and external knowledge.

### **3.9.4 Key questions**

To assist management in the implementation of information and knowledge mapping methods, some key questions may be seen as criteria for implementation. These questions are helpful when an organisation is considering using the method. Working examples of key questions are the following:

- 1) What type of information and knowledge is needed to do the work?

- 2) Who provides this information and knowledge?
- 3) Where can this information and knowledge be obtained?
- 4) What are the critical issues that need to be covered?
- 5) What are the plans to gather this information or knowledge?
- 6) What problems prevent you from gathering this information or knowledge?
- 7) What can be done to solve these problems?
- 8) In what format is this information or knowledge available?
- 9) How can value be added to the information or knowledge?
- 10) Who should be involved in the process? (Stakeholders)
- 11) What happens after this information or knowledge has been gathered?
- 12) How can the information and knowledge flow be improved?

### ***3.9.5 Utilisation of information***

Information mapping is an element of the information process and it can be seen as an information retrieval system of an organisation. It is important for the organisation that the information retrieved should be useful. Information retrieval systems are not trouble-free answers to access problems. They must interconnect with the requirements of intended users, and the users must understand the relevance of information provided by the system (Seidel, 1982). There is insufficient knowledge about the utilisation of this information by organisational members as information seekers and information users. Nevertheless this

information can be utilised by 1) compiling yellow pages and a register of boundary objects and templates, 2) recording resourceful and best practices, 3) constructing an ontology, 4) seeking re-use opportunities, and 5) anticipating learning opportunities, knowledge and gatekeepers.

For an organisation to be able to utilise the information in the report feedback, the objectives and supporting data, for example interview transcripts, boundary object register, file structure, concept maps and knowledge maps, should be included in the appendices.

### **3.10 Summary**

This chapter gave an overview of information mapping, knowledge mapping as well as various other mapping techniques. A major conclusion from this overview is that mapping is a highly diverse field that can meet a variety of objectives. The variety of objectives suggests that a variety of methods and techniques need to be considered in the process of mapping. Therefore the organisation must carefully select the appropriate mapping technique that complements its aims and objectives.

These methods, applications and techniques can improve organisational processes. Therefore the process of mapping will also be evaluated by management with the objective of improvement. Furthermore, it is important that managers are aware of who is using the information and knowledge that is part of the process. Employees must get the benefit from the shared information and knowledge, which in turn can assist them to become more creative.



## Chapter 4 Relationships among pertinent concepts

### 4.1 Introduction

The primary objective in this chapter is to evaluate the relationships among the different concepts related to mapping. The points of departure used to develop a better understanding of these relationships were the applications of different mapping methods and the specific associations between mapping methods.

### 4.2 Applications of different mapping methods

#### 4.2.1 *Concept mapping*

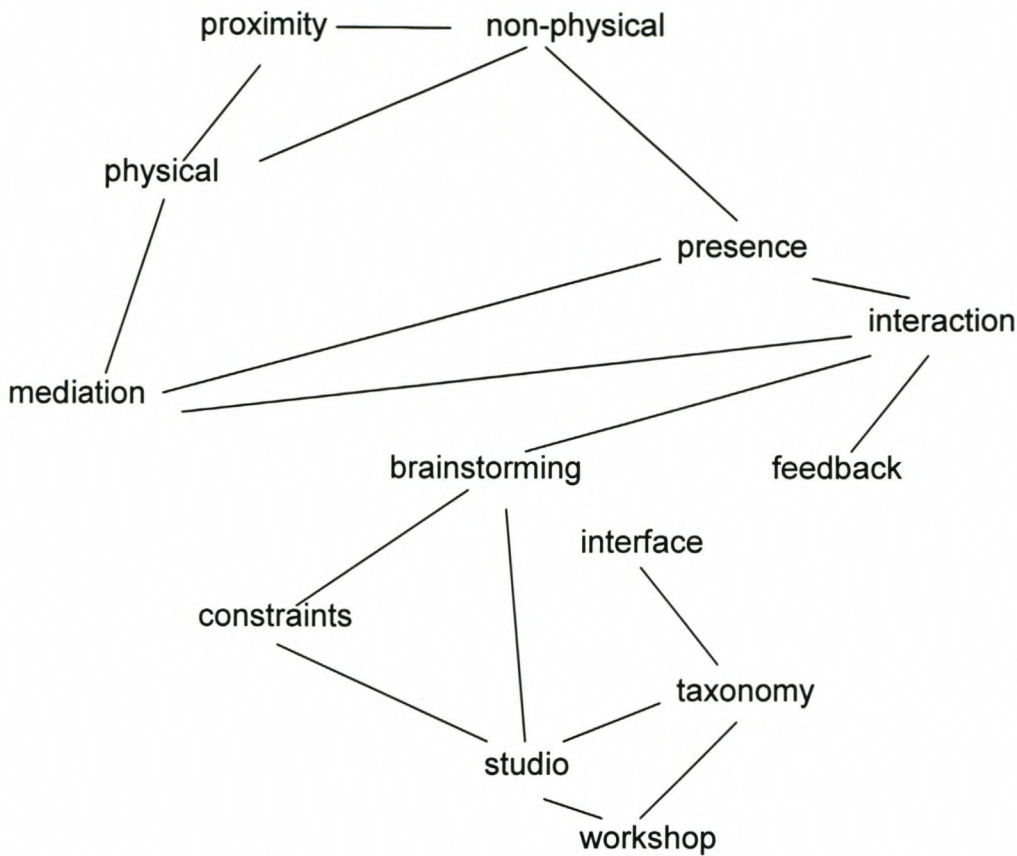
Concept mapping (e.g. see Figure 4.1) can be seen as a navigational tool, an organisational instrument and an administrative tool that consists of a series of words laid out in a graphical representation. According to Liebowitz (2002), concept mapping is extremely useful to map knowledge. His research findings led him to suggest that concept mapping is a method for representing knowledge in graphs. Knowledge graphs are networks, nodes and links of concepts. In addition nodes represent the concepts, while links represent the relations among concepts (Liebowitz, 2002).

Furthermore Liebowitz (2002) argued that spatial maps are better suited for navigation, whereas conceptual maps excel in assisting the learning experience. Concept mapping works well for online learning because it puts the learner at the centre of the educational experience. In the new knowledge-driven economy organisations are now also focusing on life-long learning. Therefore this method can also be used to enhance employees'

information and knowledge skills.

The method of concept mapping uses words to navigate the information space. Words can therefore be seen as the key to navigate informational space. Concept mapping is also a process in which keywords are used to create a map that is representative of a specific concept. It is clear that concept maps can be useful for visual learners and therefore online learners. Java technologies are using interesting metaphors such as geographical maps to assist in online learning (Cicognani, 2000). Through concept mapping the data is visually represented in such a way that the learner can define his educational goals more clearly. Furthermore, according to Horn (1998), concept maps represent semantics and are therefore tools that cognitive scientists often use to lay out conceptual schemes. Concept maps can also be applied to identify misconceptions: a concept map can portray what users know but it also reveals misdirected links or wrong connections.

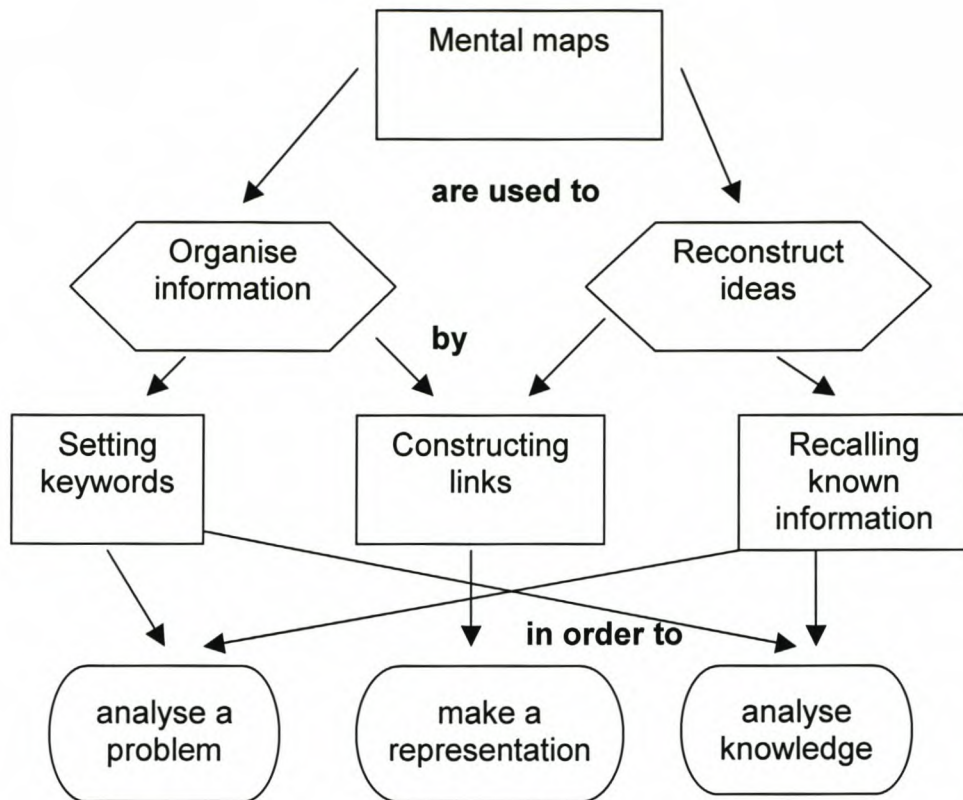
White and Gunstone, as quoted by Liebowitz (2002), used concept maps to 1) explore understanding of a limited aspect of a topic, 2) check whether learners understand the purpose of instruction, 3) see whether learners can make links between concepts, 4) identify changes that learners make in relationships among concepts, 5) find out which concepts are regarded as key ones and 6) promote learner discussion.



**Figure 4.1** An example of a concept map (adapted from Cicognani, 2000:6)

In this map words are linked by the user's understanding of the connections among the concepts. This map illustrates that the purpose of concept mapping is the production of a visual layout that makes a specific issue clearer (Cicognani, 2000).

Several authors portrayed concept maps as flowcharts (see Figure 4.2) with hierarchical levels for each concept and connection. It should be pointed out, though, that a concept map is not necessarily a flowchart.



**Figure 4.2 Concept map as a flowchart (adapted from Cicognani, 2000:7)**

Typically, concept mapping is carried out with several purposes in mind (Liebowitz, 2002). These purposes are 1) to produce ideas, 2) to create a complex structure, 3) to communicate multifaceted ideas, 4) to give support to learning by openly integrating new and old information as well as knowledge, and 5) to assess understanding or diagnose misunderstanding. Liebowitz further argued that it is an active technique for making contextual knowledge representable, explicit and transferable. He also believed that mapping in the knowledge management field can be analogous to the use of concept mapping.

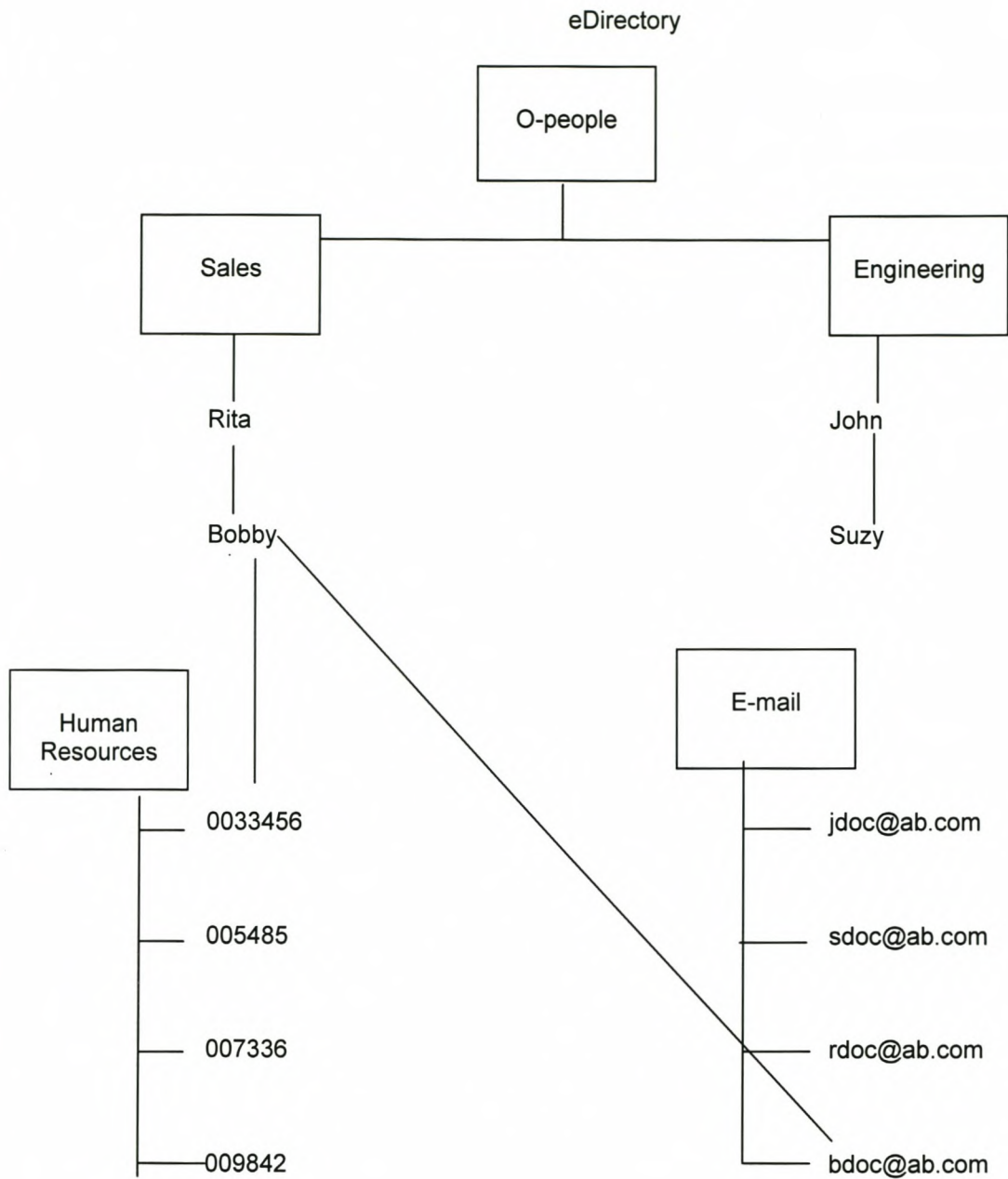
To conclude, concept maps not only visually represent information and knowledge, but also assist users (learners) to understand information better, and to link them to useful material contained in the database.

#### ***4.2.2 Content mapping***

An example of content mapping is the hypertext system used to map data, information and knowledge on the World Wide Web. This hypertext system, which includes data and text mining, holds considerable promise. However, the indexing of concepts by search engines and existing indexes on the World Wide Web are areas that still need considerable research and refinement. Also, due to the absence of peer-review, the accuracy of the retrieved information from the World Wide Web can often be questionable. It is clear that processing World Wide Web content is a requirement in order to provide real support for the purpose of concept accessing (Pichappan, 2003).

#### ***4.2.3 Object mapping***

Similar objects can be identified in several ways by following different approaches. For instance, naming schemes may vary and properties of the same objects may differ. Figure 4.3 illustrates that the same person can be identified as a number and as an e-mail address. Furthermore, objects can be mapped regardless of hierarchy.



**Figure 4.3 Object mapping in eDirectory (adapted from External data conversion, Online: 6 December 2003)**

Object mapping also facilitates the clarification of the cumulative advantageous learning experiences that can be seen as knowledge in an organisation. New technologies such as

machine-readable mapping can assist the process of object mapping by focusing on the essential objects. For example, microcomputer software programmes such as IBM's BASICA LOGO language can assist a company in the mapping of the essential objects. According to Tsai (1993), these objects are pre-definable through citation analysis within a particular subject field. Thus, a machine-readable map is generated to represent a particular subject field. It is obvious that these programmes can be very helpful in the application of knowledge mapping.

#### ***4.2.4 Process mapping***

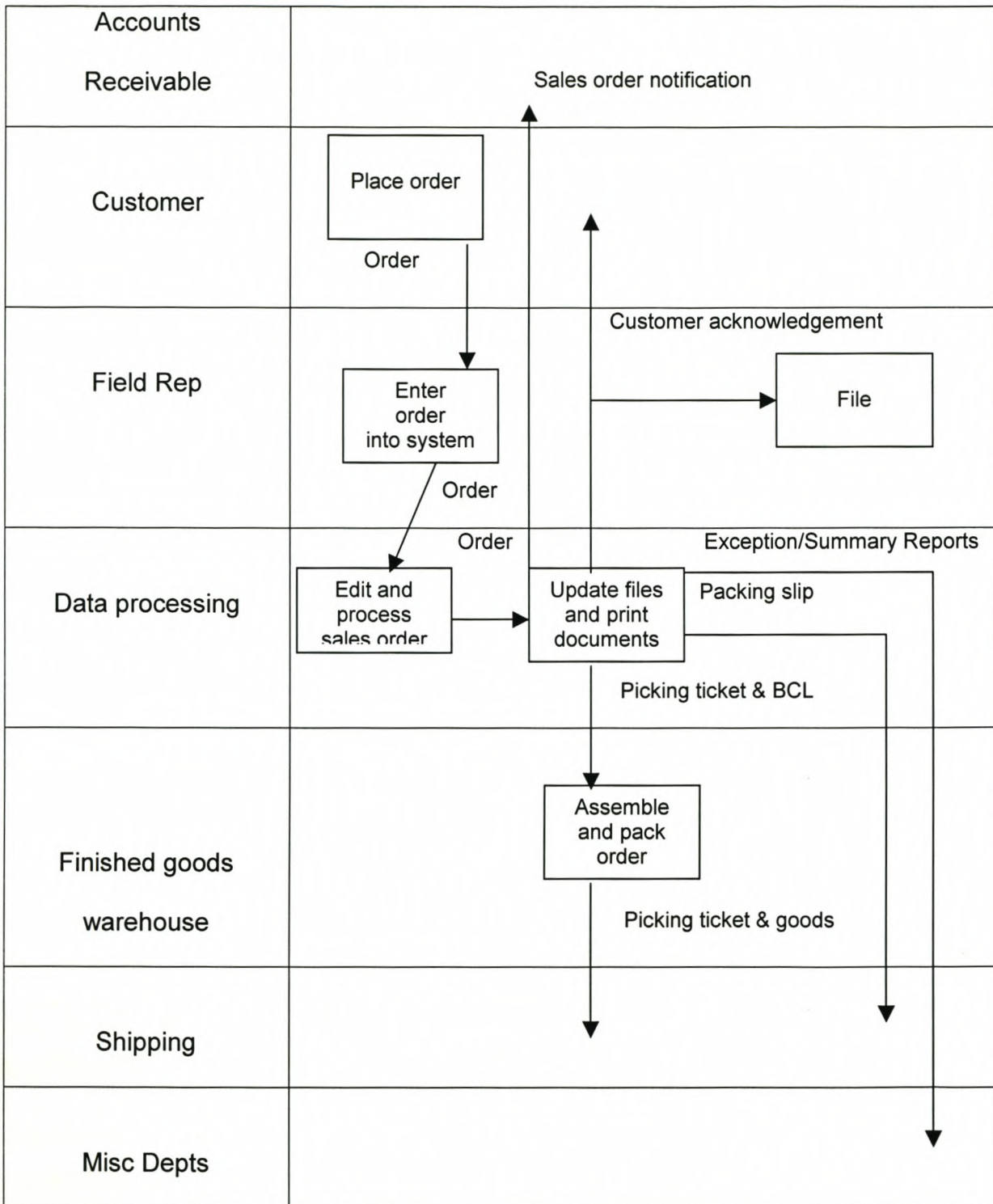
Process maps are usually simple models of complex processes. There are three types of process maps: relationship maps, cross-functional process maps and flowcharts. Relationship maps focus on the customer-supplier relationships or linkages that exist between sections of the organisation. Therefore, it shows organisation functions in context. Cross-functional process maps show how an organisation's major work processes are spread over various functions, e.g. they show functions, steps, sequence of steps, inputs and outputs for a particular work process. The focus here is on the process/people interface.

Flowcharts have been used to define, document and analyse processes. Furthermore, they illustrate tasks and their sequencing, as well as the inputs and outputs for a particular work process. On the other hand, flowcharts focus on the detail of the process (Damelio, 1996).

Process mapping can also be seen as a way to transform information so that it becomes visible. Process maps are typically used for applications such as 1) cost reduction, 2) cycle

time reduction, 3) quality improvement, 4) measurement system design or evaluation, 5) customer satisfaction measurement, 6) horizontal management, 7) benchmarking, and 8) re-engineering. Furthermore, Jones and Lancaster (2001) stated that process maps prepare the documents that flow through that specific process and that they are used to identify areas where improvements are possible. Figure 4.4 illustrates a customer order placed and entered by a sales representative into the system. The functional areas affected are portrayed on the left hand side of the figure.





**Figure 4.4 Process map (adapted from Jones and Lancaster, 2001: 268)**

#### **4.2.5 Visual mapping**

Hutcheson (2002) explained that visual mapping is a “term used to describe a technique that uses off-the-shelf graphics or flowcharting tools to capture knowledge about products, to communicate that knowledge, and to collaborate with other members of the team.” These flowcharting or graphics programmes produce graphical images of a process, function or system architecture through the use of boxes, arrows and standard flowcharting symbols. Furthermore, boxes and arrows represent user interaction with the system, which results in a united view of the system that includes the user.

Visual mapping is a technique that is used in various phases of a product life cycle in a software development environment. This technique can be used as an aid to multidisciplinary teams to understand their product, maintain current and past states of development and to communicate with management and customers. The visual mapping technique is used in a multidisciplinary environment and can therefore be useful for various role players, including technical communicators, management, developers, visual designers and software developers (Hutcheson, 2002).

Visual mapping also helps managers of companies in decision-making and policy-making processes by providing patterned abstractions of policy "landscapes". In other words, visual cognitive maps support the decision-makers and their advisers when they have to decide which policies to implement. These maps provide a valuable information management tool by facilitating management through major public policy issues. In addition, visual maps

have benefits for policy analysts and decision-makers similar to those of geographic maps. There is also an interpretation that believes visual mapping is synonymous with the terms thinking maps or mind maps.

Visual language knowledge mapping has developed because of the complexity of modern life and the capacity of the computer to create maps. A key function is to find information on a product from various sources (e.g. manuals, online media, experts' minds), and capture it in a single format that is useful for product learning, teaching and communicating. Furthermore, new technologies such as the international auxiliary language combine words, visual elements, illustrations and diagram-like features in knowledge mapping efforts. Inspiration software and Visual Net are examples of visual mapping software that can be used for education and by businesses. Visual Net is a visualisation technology which uses mapping software to "act as a front end to the Universal Description, Discovery and Integration (UDDI) Registry. The UDDI is a global, public, online directory that gives businesses a uniform way to describe their services. Visual Net is a superior navigation system that enables users to find information for businesses" (Antarcti.ca systems announces visual mapping software for UDDI, 2001).

#### ***4.2.6 Geographic and geospatial mapping***

##### *4.2.6.1 Geographic information systems (GIS) and mapping*

The concept of information mapping is derived from geographic information systems (GIS). GIS is an organised collection of computer hardware, software, geographic data, and

personnel designed to capture, store, update, control, analyse and present all forms of geographically referenced information effectively. Because a GIS is both a database system and a set of operations working with data, it is an intricate system available for manipulating and mapping spatially referenced data. GIS mapping provides a visual image of available facts and data, and is therefore a tool that presents an opportunity to work with data referenced by spatial or geographic coordinates. This data will help to determine procedures that can be presented as a graphic picture to others (What is GIS mapping?, 2000).

The primary goal of GIS is spatial analysis and not map creation. Clients such as libraries will typically use the GIS system when they are requested to provide information on spatial and geo-referenced data. They will therefore need a specific spatial thematic map to illustrate a point. In order to respond to the demand for such capability and to assist clients with map making, Microsoft has incorporated map-making capabilities into Excel. Lotus 1-2-3 followed the same route.

The changing nature of spatial and geo-referenced data constitutes problems but with the help of mapping software to interpret spatial data it is easier to create relevant and current maps (Tombarge, 1999). Unfortunately the GIS system is not very user friendly in its current format and assistance of an expert is often needed to use it.

An advantage of the GIS system is its pattern visualisation software. The latter enables the analysis and correlation of data in, for instance, an organisation's sale and marketing departments. Another useful characteristic of GIS software is that it can help a business to "see" customer sales patterns. However, this data must have a spatial component and

must be valuable to the company. Examples of software that is used for this purpose are ArcView, MapInfo and MapPoint 2000 (Millan, 1999).

GIS has been used for research in universities and businesses. It is also often linked with environmental concerns. In addition it is used by schools, city planners (to fulfil needs such as urban development), public officials and activists. GIS can be seen as a data assembling tool that enhances our understanding and so enables us to build a better community around us (What is GIS mapping?, 2000).

#### *4.2.6.2 Geospatial data production and mapping science research*

It has been demonstrated that geospatial data is of much benefit to governments, for instance to enable more effective mapping of scientific research (USGS mapping partnership programme, 2003). Consequently, the United States government is in the process of implementing a programme that is specifically related to, and responsible for, geospatial data production. Specific applications of geospatial data that are of interest to the United States government are: assisting in issues such as the formation of conventional as well as innovative partnerships, facilitating the construction of frameworks, and arranging cooperative research and development agreements with various government agencies and industries.

Expected benefits of implementing this programme include cost saving, data standardisation, improved data availability and formation of partnerships to exchange technology between public and private mapping organisations (USGS mapping partnership programme, 2003).

### **4.3 Associations among and characterizations of mapping methods**

It is possible to establish associations among various mapping concepts and methods based on the specific meaning, analysis as well as techniques used in connection with mapping.

Although there are a variety of mapping methods, they share common characteristics such as the fact that they all to some degree 1) visualise information, e.g. graphing, 2) can be seen as a navigational tool for informational space, 3) use new technology, 4) improve workflow, 5) uncover “hidden” information, 6) simplify complex issues 7) identify constraints and, finally, 8) amplify cognition.

Furthermore, the mapping method techniques involve concepts, data, information and knowledge. These techniques either deal with one concept only or with a combination of concepts. They focus on the availability, accessibility, understandability, irretrievability of data, information and/or knowledge through documentation, manipulation, interpretation, comparison and improvement. Mapping also engages in the exchanging and sharing of data, information and/or knowledge.

All the mapping methods have spatial, quantitative and symbolic components that represent specific concepts, ideas or facts. Because of their ease-of-use, mapping methods are helpful to the user when utilised to clarify experience that can be seen as knowledge within an organisation. In this sense these methods also enable communication, and as a result can assist in team building. Since mapping is user orientated it can create a framework for innovation without too much need for assistance. In addition to being used by the individual, mapping techniques can be applied as

organisational mechanisms that support administration with e.g. goal setting and cost effectiveness. It is a managerial aid that backs decision makers with policies, strategies, tactics, audits, decision-making and discovery.

#### **4.4 Summary**

It is argued here that data, information and knowledge are assets that need to be leveraged if a company or organisation is to gain a strategic advantage. Therefore it is important to manage the access, the quality as well as the flow of these resources.

Mapping, through the sharing and exchanging of these resources, can be used to achieve this management objective.

An important building block for the understanding of mapping is a good grasp of the applications of different mapping methods along with associations among these methods. The aim of this chapter was therefore to enhance an understanding of approaches such as 1) concept mapping, 2) content mapping, 3) object mapping, 4) process mapping, 5) visual mapping and 6) geographic and geospatial mapping.

Building on the information presented in chapters 2 and 3, this chapter showed the similarities in the characteristics that are present within the different interpretations of the concept mapping. One of the common characteristics of mapping that stands out is the graphical representation of data (including information and knowledge) that can be used as an administrative and navigational tool to improve availability and to communicate multifaceted ideas (data, information, knowledge). Mapping also supports the organisation in data standardisation, which can lead to cost savings.

The needs of different disciplines vary and therefore various mapping techniques can be appropriate. Some end-users will only need to map the contents of a single document, using keywords to make the contents of the document clear to the user. Other end-users like businesses perhaps need to map multiple documents throughout the organisation to trace the existence of such documents. Businesses may also need to map their processes or existing knowledge.

When comparing concept mapping, content mapping, object mapping, process mapping, visual mapping and geographic information systems, it becomes clear that concept mapping (that consists of word portraits in graphs) can be a useful technique for teaching. It explores the understanding of a limited aspect of a topic and is therefore useful for online learning.

In contrast, content mapping uses a hypertext system to map data, information and knowledge on the World Wide Web. This example of content mapping implies that the method can be used by everyone who is connected to the World Wide Web. In addition, object mapping can be used to map knowledge of an organisation in a machine-readable format. Because knowledge exists in every company and business, object mapping can be used by management as a strategy to enable the flow of knowledge within the organisation or business.

Business and service organisations like libraries can make good use of process mapping. Process maps are usually simple models of complex processes that can be used to show links among departments or sections, to visualise the organisation's major work processes



or to define, document and analyse processes by means of flowcharts.

Businesses and organisations can benefit from visual mapping because it visualises a patterned abstract of policies that helps the decision-makers with policy implementation. Visual mapping is also useful in the multidisciplinary environments in which technical communicators, management, developers, visual designers and software developers operate.

Businesses that sell goods can benefit from geographic information systems (GIS) that are related to the concept of information mapping. For example, GIS can manipulate customer sales patterns through mapping. Other applications of GIS include the use of geospatial data by governments for economic and security reasons, and by universities for research.

With the relationships and applications of the various mapping methods in mind the following chapter will describe how these mapping techniques can be utilised as a business strategy development tool.

## Chapter 5 Mapping: a business strategy development tool

### 5.1 Introduction

Information mapping is a method that visualises information and knowledge. A good communication infrastructure is required as a foundation for the effective use of the mapping technique. On the other hand, modern-day communication technologies need data and information to prove that value can be added to a business. It is clear that together, a good communication infrastructure and a new technology like mapping can enable an organisation to reach the competitive edge.

In the light of the above, part of a business strategy should be to consider a number of criteria to make an assessment of the capabilities of communication networks and in-house information system infrastructure (Callon, 1996). These infrastructures must be in place before the visualisation and mapping applications can be used. Examples of these business criteria for communication infrastructures include connectability, flexibility, phaseability, availability, reliability, manageability and ease of maintenance. These criteria are important to businesses or organisations when their implementation of the mapping method as a visualisation tool relies extensively on on-line work. Within this context, mapping as a business strategy can be considered a business opportunity that is applied in business processes, including process-based knowledge mapping, of core competencies, and as an aid for gap analysis along with timelines. Ultimately, it serves as a tool to achieve and maintain competitiveness.

## 5.2 Mapping as a business opportunity enabler

It is a reasonable assumption that mapping presents business opportunities for entrepreneurs who recognise and pursue it. The question is: How does mapping enable business opportunities within an organisation? To be able to answer the question a summary of some benefits and characteristics of the mapping method, as discussed in previous chapters, is needed.

In general, mapping is aimed at creating a visible framework for information and knowledge to support management. The method is not intended to replace other efforts to manage information and knowledge within the organisation. In fact, it is intended to support efforts to manage these resources.

The techniques relevant to the mapping method involve the resources data - information and knowledge that can be considered as the backbone of any business. Businesses rely on the availability, accessibility, understandability, and stability of data, information and/or knowledge. Mapping can assist businesses to visualise documentation and tacit knowledge through manipulation, interpretation, comparison and improvement. For instance, some government agencies use the information mapping method to acquire information faster.

Some benefits of mapping are 1) improved workflow, 2) transparent information, 3) simplified methodologies of visualisation, 4) identification of constrains, and 5) improved cognition. Therefore, mapping may be useful for an organisation to gain a competitive advantage.

Mapping also facilitates the exchange, trading and sharing of data, information and/or knowledge. As it enables communication within a business, it is a powerful tool for team building. Therefore it can assist the company in driving out the barriers between departments and employees and for that reason mapping is an effective tool that can be used across departments of the same company. As a result it has a direct impact on the culture of sharing in a business. This culture can have a direct influence on innovation and the sharing of new ideas.

Because of the inherent character of mapping as a teaching aid, it has two primary advantages for businesses. Firstly, it can enhance their own employees' skills (better services) and it can also be sold as a product. Information mapping can assist organisations with on-the-job training and can be used as a teaching aid within the organisation to improve workers' skills. Furthermore it can help with the self-improvement of employees through the clarification of knowledge in the organisation. Not only can it be used within the organisation, but it also be marketed as a teaching aid. Research has shown that the method for information mapping has already been sold on the World Wide Web as software for companies and personal computers (The Information Mapping Method, 2003).

A major factor contributing to the usefulness of mapping methods is the fact that they are easy to apply. As it makes information and knowledge readily accessible, it is obvious that mapping helps to put users in control. Since mapping is user orientated, it can create a framework for innovation. The users are empowered through the visualisation of information and knowledge. Empowering the employees helps a company to accomplish transformation. Appropriate transformation can contribute notably to providing a structure

for innovation.

Using the mapping technique greatly improves the chances that businesses applying it will be at the forefront of innovation because it is part of the key trends that include new technology, globalisation, visualisation and the navigation of space. Mapping can lastly be seen as a business opportunity enabler because the related techniques are organisational mechanisms that support leadership with e.g. goal setting. It is a managerial aid that backs decision makers with policies, strategies, tactics, audits, decision-making and discovery.

### **5.3 Process mapping used in business processes**

Process mapping can be used very effectively to visualise business practices because this technique enables a business to understand, document and improve existing processes. Understanding can be gained through the visualisation of the interaction between functional areas. Process mapping can also be utilised in the redesign of space utilisation through the application of linear programming models (Aldowaisan and Gaafar, 1999). This approach allows the process of searching for alternative process maps to proceed in a systematic way. Businesses must strive for efficient business processes because that can assist a business to gain the competitive advantage.

Process mapping can also be applied when organisations or businesses are reengineering. It must be pointed out that process maps typically applied in business processes constitute only a part of the larger scheme of the process reengineering method (Aldowaisan and Gaafar, 1999). Overall, the purpose of business process engineering is either to achieve

exciting improvements, or to measure the performances in the business. To achieve these goals it may be necessary to change the process design completely. To facilitate this visualisation configuration, scripting is often the approach of choice (Jones and Lancaster, 2001).

### ***5.3.1 Process-based knowledge mapping***

Research in this field supports the contention that process based knowledge mapping has a business focal point. A process based knowledge map visually displays knowledge within the context of the business process (Plumley, 2003). The knowledge includes tacit knowledge like know-how, experience, and intuition as well as explicit knowledge (codified knowledge such as documents). Within the business process the knowledge can be mapped, analysed and shared.

Process based mapping can be used to determine intellectual assets or knowledge that is strategic or critical. It can also assist a company in the implementation of a knowledge management strategy, for instance where a series of knowledge maps are used in a knowledge audit. A company's knowledge management strategy should reflect its competitive strategy which can be either codified (people-to-documents) or personalised (person-to-person). Most companies use both approaches. Codification can be seen as the development of an electronic document system that codifies, stores, disseminates and permits the reuse of knowledge. In contrast, personalisation deals with the development of networks for connecting people so that tacit knowledge can be shared (Hansen, 1999). The assumption can therefore be made that information mapping involves codification, while knowledge mapping deals with personalisation.

#### **5.4 Mapping of core competencies**

The circulation of knowledge among all the knowledge workers within a company is essential as it forms part of the core competencies of the business. Core competencies can be seen as the skills that enable an organisation to provide the worker with a fundamental advantage. Therefore the integration of knowledge can be used as a core competence by organisations. Cohendet (1999) indicated that it had previously been established that the performance of learning processes within an organisation depends to a large degree on the types of knowledge and expertise that are created and exploited. However, knowledge integration not only includes the creation of knowledge but also its combining, accessing and application. Mapping can be part of the core knowledge process through the diffusion of knowledge to or among individuals, teams, groups and companies.

However, studying competencies implies analysing the tacit and codified knowledge inherent to the organisation. Emphasis can be placed on existing competencies in the form of knowledge and new competencies that can be created through the development of mapping processes. It is important for this knowledge be prioritised in terms of its relevance to a business if that business is to be competitive.

To enable the circulation and the equal distribution of this core knowledge, transnational companies need new modes of integration and interaction (e.g. mapping). Since many companies are global, this core knowledge can be spread literally across the world. To assist a business in this quest, new information and communication technologies are needed to make it possible to transport information and knowledge in various and exciting

visual ways. Ultimately, the demonstrated need for the circulation, integration and transport of information emphasises the fact that a shared knowledge base of core competencies is needed for organisational learning. Companies can visualise this knowledge base through the utilisation of mapping, when the latter is applied as a visual aid that helps companies to access this core knowledge base.

## **5.5 Mapping as an aid**

A major criterion to judge the value of any method is its usefulness as an aid to assist a business on its journey to success. Mapping may possibly be used as an aid for gap analysis as well as for the development and maintenance of an organisation's timeline.

### ***5.5.1 Mapping and gap analysis***

Mapping enables the organisation to bridge the gap between established views and new perspectives. For instance, in the case of a business, concept mapping can assist in plotting existing market structures, projected needs and opportunities for comparison with its current infrastructure and requirements to address future needs and opportunities. In other words, it enables the business to map and quantify its new visions in a graphical and creative manner.

Furthermore, there is often a gap between the needs of and demands for specific business information. To solve this problem, mapping can be used to perform a gap analysis within an organisation to assist with the evaluation of the company's activities, to compare the customer's requirements to the company's actions, make adjustments where necessary, and to provide a means of organising feedback of information about customers, products



and processes. Therefore mapping can bring clarity to market opportunities as well as transparency to decision making processes.

A divide can also exist between the current use of information and the use of information prior to the implementation of the information mapping technique. Hence a gap analysis can be a comparison of existing documents and existing document record requirements (Paradis, 1996). Furthermore mapping reveals actual quality system operations along with actual records. Corrective action is often needed to close the gaps between the existing quality systems and what is required in the external set of conditions.

### ***5.5.2 Mapping and timelines***

The mapping method can be used as a format to inform employees about timelines within the organisation. A timeline is an important communication device that is maintained by management. Timelines play an important role because information and knowledge value depend on time and context. They also keep employees informed about goals reached or changes that need to be made within a specific timeslot. It is good practice for management to revisit the timeline once the gap analysis has been completed.

### **5.6 Mapping as a tool for competitiveness**

The effective use of mapping can also assist a company in gaining the competitive advantage by satisfying their business needs. To clarify their needs, businesses and organisations must have a vision (long term direction), strategies (long term plans), tactics (short term plans) and a business plan (allocation of resources and funds). Mapping can be introduced as the innovative tool for the management of the organisational plan.

One of the factors enabling competitiveness is the use of communication as a delivery vehicle. Information and knowledge mapping is part of the visualisation of this communication process, and represents a communication link to colleagues and customers. Since communication is so important, leadership within the company can adopt a new philosophy of sharing by using of the mapping technique.

Knowledge and information resources are visually managed through mapping; therefore it can be seen as a visual aid for the improvement of the company's products and services. Additionally, mapping can improve the company's productivity, quality and cost effectiveness - all of which play a role in competitiveness. A major advantage is the fact that it can change the value that is added to the product for the customer.

It is clear that one of the objectives of mapping is to improve the ability of an organisation or business to be more competitive. This objective can be achieved by improving efficiency and accessibility, and by increasing productivity. Information systems are gaining recognition as an enabler for these objectives. As Callon (1996) pointed out, the innovative use of information systems in businesses requires a systematic approach. Therefore new techniques like mapping should be systematically introduced in an organisation. In conclusion, mapping assists the company in its aim of improving competitiveness, and to provide opportunities to use the knowledge gained.

## **5.7 Summary**

In conclusion it should be emphasised that the analysis of the methods and techniques of

mapping, including the related concepts, plays an informative role when management considers mapping as a development tool for a business strategy. It has been shown that information and knowledge mapping techniques are characterised by unique properties that may make it suitable for use in creating business opportunities.

Mapping makes a positive contribution to the technology infrastructure, which is an enabling resource to support the business aspirations of any organisation. Mapping must facilitate the integration of data, information and knowledge from multiple sources if it is to support the business in its decision-making. Therefore mapping can be seen as a catalyst that “makes things happen” in businesses. Nevertheless, it should be emphasised that information mapping is not a business strategy in itself, but an enabler to the strategy.

## **Chapter 6 Summary, conclusions and recommendations**

### **6.1 Summary and conclusions**

The global information society puts forward prospects that managers, leaders and administrators have to be familiar with. Significant tendencies and influences in this regard that are affecting countries, businesses, organisations, individuals and society are knowledge, networking, globalisation, the Internet and virtualisation. As a result, organisations are set today in a world where change is the only constant. It is therefore clear that there must be a system in place that can capture the core competencies of an organisation and leverage these to provide a strategic advantage.

The knowledge and information located within a business or company must therefore be understood and managed within the context of a learning society, in order for the business or organisation to gain a competitive edge. Organisations need to be aware of the location of key information, as well as the identity of the experts who can optimally use such information. It is important to have a clear grasp of the related concepts if mapping and other visualisation methods are to be utilised to the advantage of the organisation. In fact, a key conclusion from the literature review was the need to be familiar with the unique properties of mapping in order to apply this method as an important enabler of information and knowledge resources in an organisation.

The value of mapping for knowledge and information visualisation having been recognised, the objectives of this study were to explore mapping as a visualisation tool that enables an organisation to benefit from the better management of information, to acquire knowledge that exists within the organisation, and to explore means to apply this

knowledge more effectively. These were subsequently evaluated as part of a visual business strategy. This investigation was necessary to gain a better understanding of visualisation techniques such as information and knowledge maps, to discover how mapping as a visualisation tool can enable an organisation to benefit from the information and explicit knowledge that exists within the organisation, and finally to understand how knowledge and information flow in an organisation.

The term 'map' is central in the discussion of information and knowledge visualisation. Maps embody a much richer source of information than the conventional and restrictive view of maps as aids to provide geographic information through spatial, quantitative and symbolic aspects. Indeed, when the relevant literature was examined it became clear that as communication tools, maps are rich and flexible visualisation instruments, ideally suited for use as devices to extract hidden information and knowledge.

This study showed that mapping is a valuable tool to visualise the relationships between data, information and knowledge, to bring the relationships between these valuable organisational resources into perspective, and to manage them in a strategic manner. This resource strategy typically focuses on two aspects:

- 1) the need to increase the access to data, information and knowledge that can lead to new knowledge, and
- 2) opportunities to manage existing data, information and knowledge resources.

Even with the applicable tools, the management of, and access to these resources are often difficult to achieve, resulting in incomplete representation of data, information, knowledge and resources. When the variety of tools to select from is considered, the need

pointed out before, namely that a sound understanding of the various tools is required in order to select and apply the correct approach, becomes evident. These tools include (but are not limited to) information mapping, knowledge mapping, structural knowledge mapping, information auditing, data mining, information landscaping, information architecture, and visualisation. A further complicating factor is that information mapping concepts are interpreted in various ways in the literature, and therefore the understanding and use of these concepts may differ depending on the source that is consulted in this regard.

Using the work by Horn (1976) as point of departure, information mapping was described as an information retrieval system as well as a method to improve and visualise technical communication. This, and work by other authors described the value of information when it is transformed into knowledge.

It is shown in this study that various connotations of the word "mapping" exist. Furthermore, when considering the visualisation of information and knowledge, not only mapping, but also other terms such as information mapping and knowledge mapping should be considered. For instance, an evaluation was done of the concept of mapping as a mechanism by which organisations consolidate, exchange and share knowledge. It is clear from this study that further exploration of the different interpretations of the mapping concept, in view of the characteristics and needs of a specific environment or organisation, is needed for the selection of appropriate concepts, and the development of applicable actions.

The assumption was made that a specific environment or organisation can only choose a

mapping method through awareness of 1) the kind of information and knowledge that needs mapping, 2) the available mapping methods 3) their use or application, 4) benefits and 5) limitations. For instance, information mapping works well as a teaching aid, while process maps can prepare documents that flow through a specific process in a sales business. Therefore the choice of mapping method is influenced directly by the type of organisation, department, etc., as well as their needs and environment. A further observation made in this study was that different mapping methods may be needed to achieve different benefits. Consequently, issues like the critique on the mapping techniques, various mapping techniques (e.g. cognitive mapping technique, information visualisation, science mapping, and data mining), various mapping applications (e.g. mapping quality of service, map displays for information retrieval, visualisation of information on the World Wide Web), methods of collection used in information mapping (e.g. clarifying the kind of information that needs mapping, the location and collection of this information), and utilisation of information were researched to gain a better understanding of the concept.

In essence, this research emphasised that mapping (e.g. information mapping) visualises the relationships (links) between concepts (nodes) of data, information and knowledge. The intricacy of the different mapping method concepts and techniques indicated that mapping is a complex issue.

One of the direct advantages associated with the application of mapping is the manipulation of information (such as enhanced information retrieval, better navigation and improved workflow) for organisations and businesses alike. Research indicated that mapping is an effective visualisation tool that enables an organisation to benefit from the

information and knowledge that exists within the organisation. Furthermore, mapping supports a better understanding of how knowledge and information flow in an organisation.

As stated before, different disciplines may experience different benefits through the use of mapping. For example, claims to benefits in the teaching discipline may be that it supports material development through information mapping, assists individual students in the learning process (cognitive mapping technique), can support the comparison of organisational needs, facilitates individual attainment (gap analysis with assistance of knowledge mapping), and helps to plan more efficient modules of education to support better access.

A further benefit is that mapped information will assist in uncovering hidden knowledge. Together with knowledge development and the sharing of knowledge, such uncovered knowledge will provide a better understanding of the organisation's structure, culture and environment and therefore of organisational behaviour.

These benefits result in fast visual access to internal and external sources of information and knowledge, thereby reducing the time spent in searching for information, and subsequently improving productivity, communication and teamwork. In practical terms it implies that mapping can support an organisation in several ways, such as asset management in identifying areas of knowledge requiring attention, assisting in strategic planning, and improving staff development. Thus the more efficient use of existing information technology supports more efficient decision making and ultimately, because it



strengthens innovation, it is a means to create added business value.

From a business perspective, there is a tendency to value information and knowledge, networking and virtualisation technologies as strategic productive resources that correlate directly to the business performance of an organisation. Recent literature supports the idea that the mapping of knowledge and information resources assists an organisation or business in understanding the flow of information and knowledge within that organisation or business.

This thesis described a business perspective that focuses on the use of information and knowledge mapping in organisations. For implementation, this notion must be sold within the organisation. To demonstrate the value of mapping as a business strategy, it should be emphasised that mapping is truly a business opportunity enabler that can be used e.g. for concept mapping of business processes, for core competencies, as an aid for gap analysis along with timelines, and as a tool for competitiveness. It contributes to a systematic approach that assists management in a variety of enabling factors, including vision, strategy, tactics, business plan, competitive options, definition of roles and relationships, telecommunication as a delivery vehicle, as well as a success factor profile (Callon, 1996). Mapping can therefore be seen as a valuable aid that helps the organisation in achieving its goals and objectives.

This study also showed that using mapping as a competitive playing card presents both technical and marketing challenges. Both business and technical issues must be addressed for the strategy to be successful. Aligning the mapping method as part of the company's information systems with the business strategies is an ongoing process.

People, as well as their knowledge, are essential for the company to be able to establish an information system (which includes the mapping techniques) that can be both competitive and supportive. Mapping brings a positive involvement to the technology infrastructure.

Callon (1996) argued that companies achieve competitive advantage through a new way of doing things or a better way of doing old things. This advantage can only be sustained through continued improvement in business strategies. Therefore mapping can play an important role in the process of innovation and improvement in a business through the sharing of knowledge and information.

This technique can then be seen as an enabler to managerial strategic approach which will set an organisation apart from the rest. The competitive advantage is sustained through resources such as knowledge because it is difficult to imitate (tacit), is not easily purchased, supports the development of a learning organisation, compliments new and existing knowledge, and gives increasing returns to businesses. As in other disciplines, learning is the core process of knowledge transfer. In order to enhance this learning process, organisational knowledge must be shared among organisation members. Mapping is a visual technique that assists organisations in this regard. Therefore it seems realistic to argue that mapping has the ability to stimulate new organisational knowledge and, as a result, to guide innovation.

Another area that was emphasised is the use of mapping as a business strategy. It is clear that organisations and businesses process information and knowledge in order to reduce uncertainty, for example by doing a gap analysis. Its information processing

requirements, including information mapping, are determined by the task, technology, environment, and organisational structure. Information that is acquired and processed through information mapping can be regarded as added value to an organisation or business. Therefore businesses should consider a way to add value when formulating a strategy.

Finally, there has been significant development in the hardware and software for data management and storage in recent years. Considering its use as discussed in this thesis, mapping provides a useful tool to benefit from these developments. It is therefore probable that information mapping will eventually mature into a widely-used tool, embedded in all business intelligence software.

## **6.2 Recommendations**

The following recommendations, based on the results of the study, are proposed in order to enhance the understanding of mapping as concept, as well as its use in the business environment. The recommendations include: 1) enhanced understanding of the concept, 2) further research and theory development, 3) advancement of a business application, 4) organisational culture readiness for change and 5) the future management of the information and knowledge maps.

### ***6.2.1 Enhanced understanding of the concept***

The results of the study clearly indicate that a better understanding is needed not only of the concept mapping but also of the various techniques and methods as well as the

relationships among these concepts. The present understanding of the mapping methods is a preliminary attempt to conceptualise the knowledge regarding the concept.

Therefore is it important to consolidate the different interpretations to produce a manageable format e.g. a comprehensive framework for the future. It should also be understood that mapping as a visualisation method must be seen only as an enabler of enhanced information and knowledge use in an organisation.

The effectiveness of using the mapping method to gain the better utilisation of information and knowledge resources would be dependent on the levels of complexity and the unique properties of the resources they seek to visualise. Once these issues are understood the technique can be applied in organisations as well as businesses to reach their competitive goals.

### ***6.2.2 Further research and theory development***

Once there is an improved description of the concept, and it is more generally understood, further research into theory development is needed. The reasons behind the limited current use of mapping techniques and methods need to be explored in order to make an advantageous theoretical case for the use of the method. This seems to be relevant as the better utilisation of information and knowledge within an organisation is a competitive strategy that is emerging globally. Despite this argument for the application of mapping, it seems that more time and effort must initially go into defining areas that can assist an organisation in the use of their internal as well as external information and knowledge. Only then will it be possible to apply mapping optimally. It is even possible that such a description of key areas may be a prerequisite and that the discussion of the use of

mapping as a method that assists information and knowledge management could be premature without it.

Methodologies for such studies could include more definite examples where the technique is currently used. For the expansion of a definite theory on the mapping technique 1) a compilation of the different interpretations of mapping is essential, 2) the different methods must be understood, and 3) the use of the method by the end user must be taken into account.

Based on these insights, the research programme can then proceed to acknowledge the relative importance of mapping as an enabler to gain the competitive advantage. An alternative and more appropriate use of mapping approaches and techniques for the visualisation of knowledge and information can then be constructed on the platform of the observed validated properties of the method, and the relative merits to existing approaches empirically validated.

Once the recommendations are implemented, the outcomes should be investigated to achieve wider validity as well as applicability. A methodological approach that can be used in this case is action research. In this research process the researcher and the manager will spend time together to develop research questions on the subject of mapping. This method can also contribute to the flow of knowledge between the researcher and the organisation that is using the mapping technique. However, this methodology raise the question of validity because of possible prejudice and this problem should be addressed with the greatest care (Reason and Lincoln, 1996). Because this is a relatively new field, ongoing studies are needed to establish the mapping method, and consequently enable

realisation of the potentially excellent contributions it can make in the field of visualisation.

### **6.2.3 Advancement of business application**

The general importance of knowledge as a resource across industries and businesses are widely acknowledged (Drucker, 1993). Furthermore, research confirmed that the importance of information and knowledge as resources may vary in degree with regard to different industries. An excellent development for the implementation of the mapping method as an enabler of these resources, would be to establish the degree to which these resources are of importance to various industries, organisations and businesses at a given point in time. This process clearly needs to be conducted on an ongoing basis, in order to stay abreast with current industry, organisation and business developments.

Upon establishing the urgency of initiating the mapping efforts in a given industry, organisation or business, a major contribution will be a suggestion of how to implement the method in these organisations. Once the techniques and methods of mapping are understood and the need for the method is established, further research into the different commercial packages that are available for mapping is needed.

Once the method is implemented, examination of the impact of the visualisation of knowledge and information will be a fundamental next step in establishing the added value that was given to the company through implementing the mapping technique. Because knowledge and information are changing on a daily basis this process will be an on-going process for the given industry, organisation or business.

#### **6.2.4 Organisational culture and change**

When any new methods are applied, it is important that companies, businesses and industries should be ready for it. Employees may be reluctant to implement mapping because they may see it as just another “fad”. This reaction is comprehensible when one considers all the new issues that has been offered recently, for example re-engineering. Some authors even went so far as to insinuate that knowledge management is also a management “fad” (Prusak, 1999). An assessment of the culture of acceptance of new ideas and change within the company must be made before implementing. It may even be necessary to devise strategies to convince employees of 1) the important role that mapping has as a visual aid and 2) the positive role it can play in the business environment.

The changes associated with mapping may be unacceptable to employees because of risks involved in implementation. A decision has to be made regarding the degree of risk involved, for instance once knowledge is mapped there is the risk of loss of confidentiality. Furthermore, to deal with the resistance to change, the implementation of the technique needs to be planned and training should be provided where necessary. Change will also be more acceptable if the necessary information systems are in place to use the mapping technique. If the people who need to benefit from the mapping are able to access it, this may have a positive effect on the implementation and use of this new technique.

#### **6.2.5 Management of mapping**

If the strategic context is well understood, management can focus on the utilization of key resources (information and knowledge) to maximize the value of it for their customers, shareholders, employees and stakeholders. With this background information industries,

organisations and businesses can decide how to make this core knowledge and information available. Mapping can be used as an enabler of these resources as well as a communication medium within this “knowledge chain”. This internal process of resource mapping assists industries, organisations and businesses in the creation of a shared knowledge base.

Because mapping can be applied on a range of different levels, management must choose whether they want to use it on a general (global) or specific level (within the boundaries of the organisation). It can also be restricted to specific departments or projects. Typically organisations must also implement the use of mapping on different levels, such as strategic, specific and fundamental, within the organisation.

Once a mapping technique has been put into place it must be evaluated and adapted on an ongoing basis. This will be a big challenge for managers as employees with the essential or applicable knowledge may leave the organisation. Therefore tacit knowledge can be lost to an organisation and/or business. In the current stage of the emerging field of information and knowledge management research, it is clear that further investigation not only into these fields, but also into their enablers is necessary. Further studies into mapping, and especially into information and knowledge mapping, may represent an excellent contribution to the broader field of information and knowledge management.



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