



A Systemic Landscaping of the Software Industry of an Emerging Economy: A case of the Western Cape, South Africa.

A Thesis Presented to the Department of Information Systems, University of Cape Town.

As a fulfilment for a Master's Degree in Information Systems.

**By Gwamaka Mwalemba
(MWLGWA001)**

August 2013

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

Plagiarism Declaration

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.
2. I have used the APA convention for citation and referencing. Each contribution to, and quotation in, this dissertation from the work(s) of other people has been attributed, and has been cited and referenced.
3. This dissertation is my own work.
4. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.
5. I acknowledge that copying someone else's work, or part of it, is wrong, and declare that this is my own work.

Date:

Signature:

Full Name of Student: **Gwamaka Mwalemba**

University of Cape Town

Abstract

As the world is transitioning to the information and knowledge-based economy led by innovation, the functional versatility of new technologies is increasingly becoming dependent on the ability to program and embed them with software that will enable them to undertake a range of tasks. At the same time, developing countries are also increasingly realising the potential impact of the software sector on structural transformation, education, innovation, service delivery, job creation and export revenue. However, research on the software industries in emerging economies points to the need for a systemic understanding of the industry (the whole) if a country is to set strategies that will incorporate a collective effort from all stakeholders in building an innovative, sustainable and competitive software industry. This study is an attempt to address that need focusing on Western Cape Province of the Republic of South Africa. Making use of case study research strategy, the research aimed at identifying the major pressure points in the software industry, their interactions (impact on each other) as well as impact on the overall industry. Data was collected through interviews with industry leaders operating in the province, analysed and synthesised abductively making use of systems thinking techniques to generate key insights for the industry. Research findings reveal an increasing frustration amongst businesses in dealing with a continuous decline of quality and quantity of software related skills, tension from competitors (mostly India) and absence of a nationwide or even regional software strategy which is an outcome of lack of leadership in the sector. The study concluded by highlighting the need for the government to take leadership and systemically organise the collective efforts of industry stakeholders such as business, academia, as well as NGOs into addressing the identified challenges.

Acknowledgements

I would like to express my deepest gratitude to my family: My mom & dad, my sister Suma, my brother Jones and my beloved daughter Mira. Thank you for your constant support, encouragement and reassurance throughout the journey.

I would also like to thank my mentor and supervisor, Prof. Kosheek Sewchurran, for his patience and valuable guidance in seeing this research through. Prof. Kosheek together with my other mentor Dr. Elsje Scott, have been a constant source of inspiration to me and I am forever grateful for their thoughtful advice from when I was doing my undergraduate degree to date.

Thanks to Jenny McKinnel, Director at Cape IT Initiative, as well as Andre de la Harpe, from CPUT, for their contribution and input to the research. Thanks also to the leadership of the Western Cape Provincial Government for supporting this research.

Finally, I would like to thank the Head of the Department of Information Systems, Prof. Lisa Seymour, as well as all other staff members in the department for their continuous support.

Table of Contents

Plagiarism Declaration.....	i
Abstract.....	ii
Acknowledgements.....	iii
Index of Figures and Tables.....	vi
Figures.....	vi
Tables.....	vi
Chapter One: Introduction.....	1
Background.....	1
Research Focus.....	3
Overall Research Aim and Individual Research Objectives.....	4
Chapter Two: Literature Review.....	6
The Classification and Role of the Software Industry.....	6
The Software Industry in Emerging Economies.....	9
Brazil.....	11
China.....	12
Israel.....	13
India.....	14
The South African Software Industry.....	18
The Software Market Orientation.....	18
Skills Sourcing.....	19
Government Support.....	20
Emerging Issues and the Need for a Systemic View of the Industry.....	22
System Thinking as a Methodology to Make Sense of the Complexity.....	24
Chapter Three: Research Methods.....	26
Research Strategy.....	27

Data Collection.....	30
Framework for Data Analysis	32
The Abductive Logic of Research.....	33
Ethical Issues.....	36
Limitations and Potential Problems	36
Chapter Four: Research Findings: Description, Analysis and Synthesis.....	38
Findings.....	38
Theme 1: IT Budget.....	38
Theme 2: Software Costs and Sourcing Pattern:	40
Theme 3: IT Labour Profile and Skills Needs.....	42
Theme 4: Technology Platforms	45
Theme 5: Performance/Productivity Measure	46
Theme 6: Standards, Methodologies and Frameworks	47
A SWOT Analysis of the South African Software Industry	48
Strengths.....	49
Weaknesses.....	50
Threats	50
Opportunities	50
A Systemic View of the Industry	51
Causal Loop Model	51
Discussion on the Model	52
Chapter Five: Conclusion	55
Summary of Research Findings and Conclusions.....	55
Recommendations	58
Chapter Six: References.....	61
Appendices.....	67
Appendix A: Research Questions	67

Index of Figures and Tables

Figures

Figure 1: Classification of the IT industry (Heeks, 2006)	7
Figure 2: Classification of the software industry (UNCTAD, 2012).....	8
Figure 3: Qualitative data analysis process adopted for the study.....	34
Figure 4: A mapping of key strengths, weaknesses, opportunities, as well as threats as highlighted by respondents	49
Figure 5 : A causal loop model highlighting the dynamism factors impacting South Africa's software industry.....	53

Tables

Table 1: A summary of the Brazilian, Chinese, Israeli and Indian software industry	17
Table 2: A list of interviews conducted	31

Abbreviations

Abbreviation	Meaning
BI	Business Intelligence
BRICS	Brazil, Russia, India, China and South Africa
DTI	Department of Trade and Industry
CHEC	Cape Higher Education Consortium
CITI	Cape Information Technology Initiative
CMMI	Capability Maturity Model Integration
COBIT	Control Objectives for Information and Related Technology
CPUT	Cape Peninsula University of Technology
ERP	Enterprise Resource Planner
ICT	Information and Communication Technology
IS	Information Systems
IT	Information Technology
PIMBOK	Project Management Body of Knowledge
R&D	Research and Development
SaaS	Software as a Service
SITA	State Information Technology Authority
SMMEs	Small, Medium and Macro Enterprises
SPI	Software Process Improvement
SU	Stellenbosch University
TQM	Total Quality Management
UCT	University of Cape Town
UWC	University of Western Cape

Chapter One: Introduction

Background

The ICT sector is increasingly becoming a key player in developing countries' economies for both developed as well as emerging markets. According to Parthasarathy (2010), ICT forms an integral part of the third industrial revolution by virtue of its ability to transform pre-existing sectors of the economy to improve efficiency, productivity, as well as the overall standard of living. A further look at the sector reveals a shrinking in the advances in design and manufacturing technologies to enable the inexpensive production of information processing devices, as predicted by Moore's law. Consequently, the function versatility of ICTs is now increasingly dependent on how one programs them to undertake a range of tasks. A mobile phone's worthiness nowadays has less to do with the hardware, but more with its ability to perform a wide range of tasks with ease, something which is mostly a function of the software installed. As put by Parthasarathy (2010, p. 249), "...it is software that increasingly gives contemporary ICTs their revolutionary character". The significance of computer software in the third industrial revolution has positioned the software industry to be one of the fastest growing industries. It is a relatively low investment, environmentally friendly, high growth global industry, and it has formed an integral part of development and innovation in developed countries and as we are witnessing recently, even more so in emerging economies.

Developing countries are increasingly realising the potential impact of the software sector on structural transformation, education, innovation, service delivery, job creation and export revenue. Businesses and the private sector in general are now cognisant of the role of the software industry in terms of its impact on their ability to be effective, innovative and able to compete globally. Governments are also experiencing the need for a strong software sector if they endeavour to effectively provide service delivery in areas such as education, health and job provision, as well as other key social, political and economical issues (UNCTAD, 2012).

The last two decades have seen a significant increase in the share of developing countries in the global software market. A number of developing countries have successfully developed and strengthened their own software industries, India being the most renown, followed by countries such as Brazil as well as China (Carmel, 2003b; Commander, 2005). This growth in the software industries has been partly attributed to strong cost advantages favouring

developing nations, as well as relatively low physical capital requirements, main requirement for the industry being skilled human capital (Commander, 2005) .

A review of literature on software industries in several emerging economies highlights that, in spite of a common engagement in software development, the countries remain very heterogeneous in their characteristics as well as in the local dynamics of the industry. For instance, while India, Ireland and Israeli's software industries have been fuelled by exports, those of China and Brazil have grown largely thanks to their domestic market (Arora & Gambardella, 2006; Carmel, 2003b; Commander, 2005; Heavin, Fitzgerald, & Trauth, 2003).

Emerging markets have also explored different niches within the software industry. For instance, with both countries focusing on mainly software products, Israel is seen to focus more on technologically sophisticated products, whereas China's focus is mostly on financial software packages for the local financial system (Commander, 2005) . China's case could be a result of specifics (language, culture...) in its domestic market, as well as lack of integration between China's market and the rest of the world. India and Brazil on the other hand are considered to concentrate more on providing software services (compared to producing software products).

Currently, the success of software industries in developing countries is more commonly measured based on the ability to master software production techniques and business models that allow them to compete with the global market (Avgerou, 2010). This goes hand in hand with an implicit assumption that success in the software industry will have a direct positive impact on the economic well-being of a country (Carmel, 2003b) . However, research points to several instances where a trade-off existed between efforts to foster a particular (unfit) model of software industry, and innovation in domestic organisations and a country at large (Avgerou, 2008).

Furthermore, while the positive impacts of a successful software industry for a developing country have been well documented, a failure to establish the right framework that will bring about the required domestic capabilities to seize such opportunities may instead severely hinder the prospects of such a country to grow both its private as well as public sector. This may subsequently result in failure; not only to compete globally, but also to deliver its basic services (UNCTAD, 2012).

Finally, this study is being conducted at an interesting time with respect to regional as well as geopolitical relations. Having recently been recognised as an emerging economy, South Africa is under pressure to at least keep up with other emerging economies namely Brazil, Russia, India and China, the other four BRICS countries, which have all made significant progress in the software as well as ICT industry at large. South Africa now more than ever needs to have a sound National ICT strategy highlighting its priorities in all areas from infrastructure, which is already fairly strong, to software development (and software industry at large) which seems to be lagging significantly (DOC, 2012). This is necessary if the country is to leverage the collective investment and access to market brought about by the partnership.

Research Focus

Having acknowledged ICT as one of its key growth sectors, in 1999 the government of South Africa through the Department of Trade and Industry identified the need 'to build a strong content and application development for domestic and international market' as one of the key national ICT strategies (Moodley, 2003). Since then, the software industry has grown from R3.8 billion in 1998 to R13.3 billion in 2004 with projections of reaching R 21.7 in 2009 (James, Esselaar, & Miller, 2001; Wills, Pater, King, Booie, & Netshisaulu, 2005).

With such a steady growth coupled with the country being amongst key emerging economies, South Africa's software sector holds the potential to become one of the key players in the provision of software products and services within the country, on the African continent and even as a global competitor.

However, at the infancy of an industry and in this case software industry, a discourse on understanding the need of the industry is vital (Parthasarathy, 2004). Therefore, to fully exploit the potential of South Africa's software industry, it is important to first explore and develop an understanding of the sector looking at the unique social and contextual issues (Tessler, Barr, & Hanna, 2003). Such an understanding, or at the very least the attempt towards developing it, is crucial if the industry is to have a sustainable and meaningful impact both economically and in a broad society. As posited by Hilsop (2010), for it to be effective, sustainable and relevant, the South African software industry cannot simply rely on copying winning models from other countries. Instead, there is a need to build a software industry that will recognise innovation and excellence within its own contemporary society. This study represents one of such efforts.

Overall Research Aim and Individual Research Objectives

According to Avgerou (2008) a need exists for research that links software development, as an ICT innovation practice, to its socio-economic context. Research that will consider technological innovation as a practice enacted by social actors and which will emphasise understanding the practices within the power dynamics of the immediate settings of the innovating organisation. As put by Tessler et al. (2003, p. 1), “every software-exporting country has evolved a unique industry shaped by its own resources and situation and by the particular global opportunities present at the time”.

This study is an attempt to landscape the software industry in South Africa with a special focus on the Western Cape region. Being socially embedded, the study aims at looking at the unique contextual issues surrounding an industry that is positioned to emerge as the strongest software industry on the continent. An understanding emerging from this study forms part of a crucial step towards building a competitive, innovative and sustainable software industry that can effectively serve not only South Africa, but also the continent and compete with other emerging markets worldwide.

This study, within the context of the software industry, aimed at achieving the following main research objectives:

1. Identify the major pressure points in the industry.
2. Explore the broad parameters of the identified pressure points, their interactions and impact on the overall industry.
3. Formulate a systemic view of how these pressure points interact dynamically in the region.

The objectives outlined above by no means represent separate, unrelated set of activities. Instead, they represent a compounded effort towards achieving the overall purpose of this study.

At the onset, the study wanted to get, from the leaders of companies operating in the industry, a sense of key issues (including opportunities, strengths, weaknesses and threats) they see facing their businesses (and the industry at large) in terms of their ability to enable service delivery or business competitiveness within the region in which they operate. The study then wanted to categorise these issues or ‘pressure points’ as referred to in the list of objectives, so as to look at each of the issues in more detail relating it to literature on software industries in

other countries. This was an attempt to get a more in-depth understanding of each issue specifically with relation to its unique context. Lastly, the third objective was, without oversimplifying to the level of losing relevance, to make an attempt to systemically fuse the issues and present a regional perspective highlighting the dynamism that will capture key interactions within the industry. An understanding of a systemic view of the industry (the whole) is important if one is to set strategies that will incorporate a collective effort from all stakeholders in building a more sustainable and competitive software industry for the benefit of the businesses serving and being serviced by it as well as the entire economic sector.

Therefore, apart from being an academic work, this study also broadly aimed to serve multi-stakeholder initiatives to improve the competitiveness of the software sector both regionally as well as nationally for the sake of wider societal benefit. The multiple stakeholders it is meant to serve are NGOs (Section 21 companies such as CITI, CHEC), Government (national and regional), Academia (such as UCT, SU, CPUT and UWC) and Industry.

The next chapter – Literature Review – as the title suggests, examines literature pertinent to the objectives of this study.

Chapter Two: Literature Review

This literature review will explore issues around a national software industry. It will do so by first looking at several emerging software industries, believing that such understanding is necessary to focus the review of the South African software industry which in turn will inform the empirical work. While the empirical work will focus on a regional perspective (Western Cape), the literature review will focus at the national level. This is due to the realisation that, there exists limited publicly available literature that can meaningfully inform a regional perspective of the industry. This could be attributed to the infancy of the industry in the region as well as countrywide.

The review aims at building a ground work for fulfilling objective one and partly objective two of the study, setting the groundwork for the empirical study which will in turn respond to objective three. However, before embarking on a detailed review, it is important to first elaborate on a few key terminologies and broadly look at the role of the software industry.

The Classification and Role of the Software Industry

The term software industry has been used to refer to (or include and exclude) different things at different times. Figure 1 shows an attempt by Heeks (2006) to categorise five overlapping sectors falling under the broad umbrella of the IT Industry.

The five sectors include:

- **“Goods:** *Production of ICT consumer goods such as computer hardware and digital telecommunications, plus ICT producer goods: both capital goods (e.g. automated machinery for manufacturing PCs) and intermediate goods (chips, motherboards, hard disk drives, DVD drives, etc. used in computer manufacturing).*
- **Software:** *Design, production, and marketing of packaged and customised software.*
- **Infrastructure:** *“Development and operation of enabling network infrastructure” (Wong 1998,325); both foundational telecommunications plus value-added networking services.*

- **Services:** *The professional services not covered in other categories such as consulting, training, and technical services.*
- **Content:** *production and distribution of data content, including back-office processing and digitisation.”*

(Heeks, 2006 , p.6)

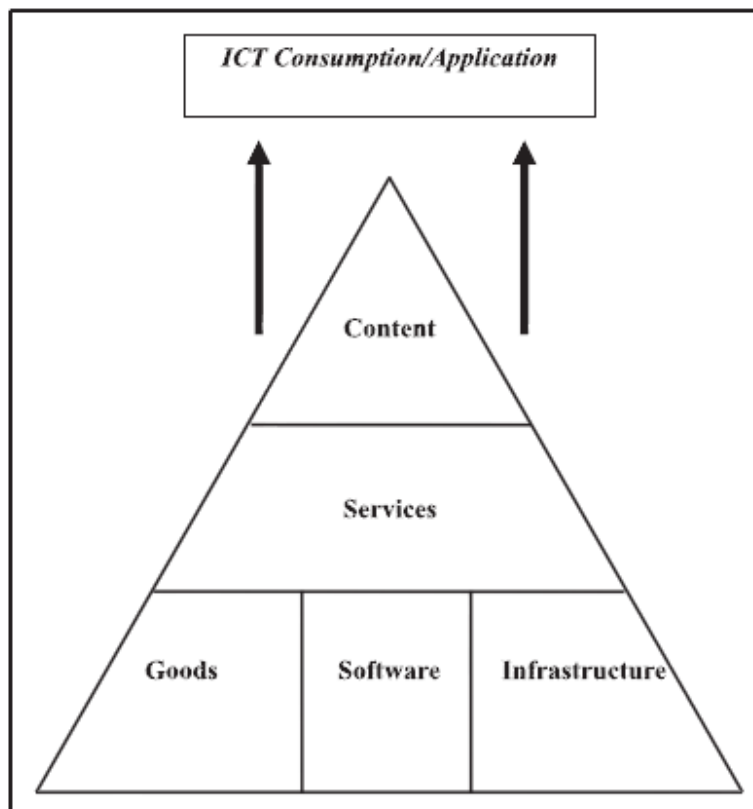


Figure 1: Classification of the IT industry (Heeks, 2006)

Heeks (2006)' categorisation of software as a subcomponent of the IT industry seems to take a narrow focus on just software products. A broader categorisation of the software industry is adopted by UNCTAD (2012), grouping software into two major groups: products and services.

According to the UNCTAD (2012) classification, software products include both system software (such as operating systems) as well as application products which include general purpose applications such as Microsoft Word, as well as industry-specific applications such

as banking and manufacturing, just to name a few. Figure 2 provides a more comprehensive categorisation of the software industry and this study sees fit to adopt such classification.

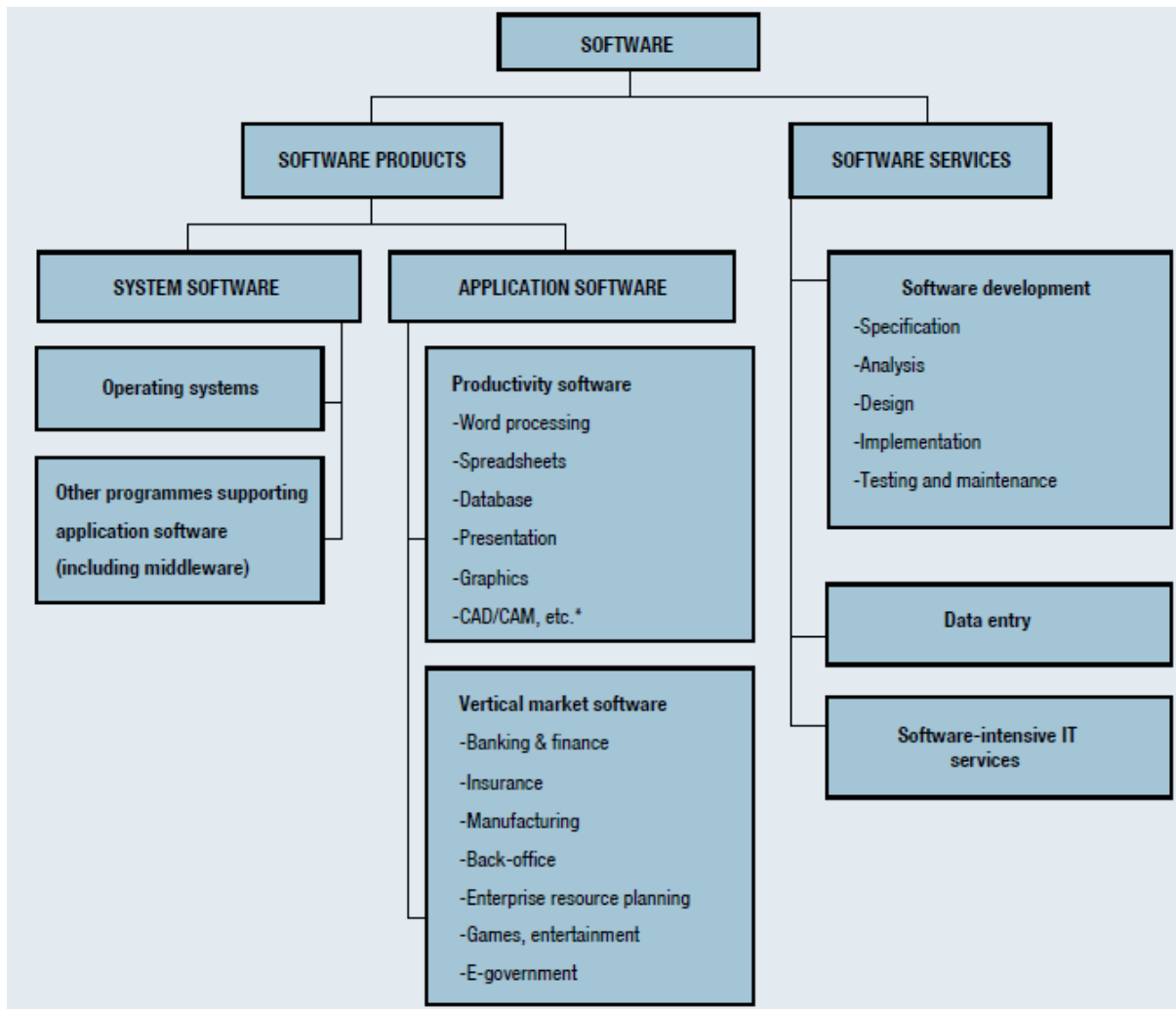


Figure 2: Classification of the software industry (UNCTAD, 2012)

As the world gets deep into the information and knowledge-based economy, the software industry is increasingly becoming more than just another industry. Research highlights a crucial role that can be played by an active software industry both directly and indirectly, especially in emerging countries. According to Athreye (2005), software is the central intermediate good, “its role is analogous to that played by the capital goods sector in an economy based on mechanized technologies” (p. 7). One must recognise that, the functional versatility of new technologies is brought about by the possibility to program and embed them with software that will enable them to undertake a range of tasks. For instance, in the United States, software spending has significantly increased from 32 per cent in 1990 to almost 60 per cent of total corporate IT investment in 2011 (Sarrazin & Sikes, 2013). This is

a result of software's potential to transform an organisation's front-end by introducing new ways of delivering services and products, as well as back-end in the form of increased automation, integration, and standardisation that can lower cost and boost performance significantly.

For businesses, a strong domestic software industry is a backbone for innovation necessary to enable them to meet the needs of local markets. Because software is embedded in many final goods, equipment and productive processes; the ability to develop, manipulate and integrate software is crucial if organisations are to successfully adopt new technologies. Moreover, businesses operating internationally need competitive software solutions that will enable them to participate in international supply chains.

In the public sector, a strong domestic software industry is equally important. In today's world, effective service delivery in areas such as health care, education as well as governance greatly relies on the effective and creative use of software. For instance, governments need software that can collect, store and analyse data on health care and provide insights necessary to formulate effective health policies. Moreover, the software industry has recently been attributed to making a great contribution in terms of generating new job opportunities especially to the young generation, as well as bring about export revenue (UNCTAD, 2012).

Therefore, the software industry seats at the heart of the third (and fourth) industrial revolution because of its potential to transform production methods as well as other economic activities through its ability to constantly offer new, better and innovative ways of doing things.

The Software Industry in Emerging Economies

The emergence of the software industry globally dates back to the 1980s primarily in developed countries focusing mainly on the provision of packaged software and later moving to systems, applications as well as software solution for larger companies (Commander, 2005).

However, as of the mid-1990s, the focus started to move from developed western nations to emerging economies. Currently, a large body of literature exists discussing the state as well as the role of the software industry in emerging economies (Arora & Gambardella, 2006;

Carmel, 2003, 2003b; Commander, 2005; Heavin et al., 2003). The increase in research is a result of what is seen as a significant growth in size and importance (in terms of contributing to economic growth) of the software industry in emerging countries such as India, Brazil, China, Israel as well as Ireland.

A review of literature on software industries in several emerging economies highlights that, in spite of a common engagement in software development, the countries remain very heterogeneous in their characteristics as well as in terms of the local dynamics of the industry. For instance, while India, Ireland and Israeli's software industries have been fuelled by exports, those of China and Brazil have grown largely due to their domestic market (Arora & Gambardella, 2006).

The emerging countries have also explored different niches within the software industry. With both Israel and China focusing on mainly software products, Israel is seen to focus more on technologically sophisticated products, whereas China's focus is mostly on financial software packages for the local accounting system (Commander, 2005).

Even in those countries with what can be perceived as a similar market orientation, a review of literature reveals vast differences in their industry development paths. A vivid example is India and Israel. While they are both known for significant exports to Europe and America, India's software industry originates from its popularity in bodyshopping and the provision of large numbers of low to mid-range software development skills. Israel on the other hand, has a background of extensive research and development (R&D) with the software industry being championed by research centres and academic institution.

For an industry to achieve sustainable growth, a discourse on understanding the dynamics of the industry with relation to the national economic strategy is essential. So far, no country has been able to build a successful software industry by simply copying the successful models from other countries. On the contrary, a successful software industry requires one to first recognise innovation and excellence within its own community. As asserted by Schware (1992), the leading international software players all started with a local focus in terms of creating capabilities in the strategic segments of the industry. Once a clear national strategy had been realised, with the support of businesses and public institutions, these industries were easily able to expand and grow and compete both domestically as well as internationally.

The following sections take a detailed look at the emergence as well as characteristics of software industries of the several emerging markets.

Brazil

With a \$212 billion market and 8.5 per cent of the country's gross domestic product by 2011, Brazil is currently the fifth largest ICT market in the world, just behind the United Kingdom, United States, China and Japan (Nusca, 2012).

The Brazilian software industry can be traced back to the 1970s, the era of a nationalist military government when much of the focus was on hardware which was also protected. The software industry only started to take pace early in the 1990s after the protection was lifted and as the economy started to stabilise (Commander, 2005).

With the growth of the country's economy, the Brazilian software industry also grew, mostly focusing on meeting domestic needs. According to Arora, Arunachalam, Asundi, and Fernandes (2001), a decade after the ban was lifted, the share of the software industry on GDP had tripled, positioning Brazil amongst the ten largest software industries in the world. However, as the Brazilian software industry grew, its difference from other emerging counterparts was clear. Instead of focusing on exports and the internationalisation and specialisation in software production, the Brazilian software industry was growing to mostly serve the domestic market and targeting heterogeneous regional clients.

The domestic market orientation has afforded the Brazilian software industry several advantages. The presence of leading domestic client sectors for software firms provides opportunities for learning and competence deepening, a necessary preparation if you endeavour to effectively compete at a global scale (Arora & Gambardella, 2006). As explained by Schware (1992), the ability to sustainably export software depends on many factors, the most important one being a strong domestic experience and expertise. A related advantage of Brazil's domestic market orientation is that "it naturally builds vertical industry segment specific skills in the local software supplier firms"(Arora & Gambardella, 2006, p. 123). This is important if a country is to develop a software industry that will innovatively integrate and enable other domestic economic sectors such as financial and retail sectors to achieve a broad-based economic impact.

Though fairly robust, the reliance on the domestic market in the Brazilian software industry had its fair share of challenges. In an increasingly globally connected world, the largely

defragmented and domestically focused Brazilian software industry is increasingly under pressure from global competition, as other international software companies have started penetrating the Brazilian market. The challenge is due to the fact that most of the Brazilian software companies have no international recognition, hence failing to capitalise on the globalisation of the industry (Commander, 2005). There is increasingly a situation where “large domestic users tend to favour established foreign suppliers, whereas smaller users are often unwilling to pay a premium for the domestic firms’ unique knowledge” (Arora & Gambardella, 2006, p. 124).

Being the only Portuguese speaking country on a mainly Spanish continent, language has also been identified as one of the key challenges for the Brazilian software market and ICT in general. The language barrier significantly deters Brazil’s ability to expand its software market to the continent as well as the rest of English speaking countries (Nusca, 2012).

China

Since its early days, the Chinese software industry has had one distinct feature, an overwhelming support from the government. Government support has come in many forms, the most notable one being preferential treatment that systematically favours domestic firms over foreign competitors. Such selective treatment has had a significant impact on the make-up of China’s software industry, considering that state-run institutions make up a significant portion of the domestic software market (Kshetri, 2005).

According to Commander (2005), the Chinese software industry still remains mainly focused on the domestic market with figures showing exports contributing not more than six per cent of the total sales figures. Furthermore, the industry is mainly composed of small fragmented firms mostly involved with adopting software products to Chinese language, as well as systems integration software.

The focus on the domestic market is being fuelled by an increasing adoption of software across many sectors of the economy including services, production and manufacturing. The uniqueness of some of the domestic practices in industries such as financial, also contributes to the growth of domestic industry. Moreover, China is well known for its mass production of electronics. These electronics are in many cases embedded with software, hence creating another important software market.

Another important characteristic of the Chinese software industry is its ties with academic and research institutions. According to research conducted by Tschang and Xue (2005), more than half of companies involved, were either started by research institutions, university students or faculty. These companies also formed the majority of those which were referred to as large companies. The prevalence of companies originating from universities is also another indication of the government's involvement in the development of the Chinese software industry.

However, as for Brazil, China's reliance on the domestic software market has not been without its challenges. The local and fragmented nature of most operators has significantly hindered their growth into large-scale specialised software manufacturers which is essential considering the growing interest of international firms to break into the Chinese market. The small and fragmented nature of local software firms has also prevented them from undertaking large-scale projects. A good example is a decision by Huawei, a large telecom manufacturer, to set up a large development centre with over 400 engineers in Bangalore instead of China, partly due to the mere fact that China doesn't have the software process capability to run such a big project (Tschang & Xue, 2005) .

Israel

Although a much smaller country and not part of BRICS, the Israeli software industry offers rich lessons on a potential path for the growth of a software industry. Unlike other software industries from emerging economies, the Israeli IT industry in general and its software industry in particular, followed an R&D intensive, original product-based as well as export-oriented business model. The software industry was preceded by a strong hardware industry which was an important stepping stone as many software companies were just an extension of IT hardware shops. According to Tessler et al. (2003), most of the technological innovations that emerged from Israel were a result of state-of-the-art military research projects.

The evolution of the Israeli software industry is characterised by three key features. The first one, as highlighted earlier, is the existence of a large, well established, internationally successful, innovative as well as product-oriented local hardware industry. Secondly, the strong focus on industrial innovation through Research and Development as led by the state policy, making use of academic and research institutions. As put by Breznitz (2005), success in the software industry is an outcome of the significant involvement of the academia in the high-tech industries and the highly advanced level of scientific research conducted in the

country. The last and arguably still very influential feature is the massive inflow of foreign direct investment in terms of venture capital from American investors (Tessler et al., 2003).

It is also important to point out that while Israel's software industry is currently known for exporting sophisticated software, it owes much of that to its local market. Initially, the domestic market was of immense importance with the export sales surpassing local sales only in 1997 (Breznitz, 2005). The importance of a strong local software market in subsequent success in international markets is well explained by Schwabe (1992).

To date, the Israeli software industry is increasingly becoming an important economic player as the sector has recorded the largest share of local and foreign investments (compared to other IT sectors) for the first time in four years. The first quarter of 2013 has seen thirty-four software companies raising \$136 million (29%), compared with \$105 million (21%) and \$107 million (22%) in Q4 2012 and Q1 2012, respectively (IVC Research Centre, 2013). However, the significant equity investment from American investors (more than 50 per cent) together with the significant export of software to American financial institutions, makes the Israeli software industry more of a subset of American software and financial sector than an independent local industry (Breznitz, 2005).

India

So far an extensive amount of research has been done in an attempt to explore and explain the Indian software industry, amid its popular exponential growth from the 1990s onwards. With nearly 80% of its revenue coming from exports, the Indian software and services industry has grown from less than \$100 million in 1985–1986 to nearly \$50 billion in 2006–2007 (Parthasarathy, 2010). This meant that the share of the software sector in the country's GDP had reached 5.4 per cent, up from less than 2 per cent at the beginning of the decade, with the software sector increasingly becoming a significant contributor of overall export earnings (UNCTAD, 2012). For instance, “the proportion of software exports to merchandise exports grew from insignificant amounts in 1990 to 18 per cent in 2002–03” (Arora & Gambardella, 2006, p. 6) . The predominance of exports marks the Indian software industry as an export-led industry, and as such is different from its other emerging markets such as China and Brazil.

When compared with the equivalent exporters like Israel and Ireland, the Indian software growth also manifests several differences. For instance, the Indian software industry was built

mostly around customised software services, unlike Israel which focuses on high-end specialised products. The customised software services market is a high volume low value market. However, with time, Indian software industry is evolving and a small proportion of firms has advanced into providing higher value services in the form of larger and more complex projects. Furthermore, contrary to countries such as Ireland, research shows that up to date, India's software exports are largely attributed to Indian (domestic) firms and not foreign-owned firms (Athreya, 2005; UNCTAD, 2012).

The success of the Indian software industry is attributed to a number of factors. By its nature, software production mostly demands skilled labour and requires relatively little capital. This particularly suits the resource endowments of the Indian economy which has abundance of skilled labour, but with limited capital and physical infrastructure (Arora & Gambardella, 2006). Second was the issue of government involvement in the form of setting up policies which promoted the growth of the software industry. These policies included the liberalisation of policies related to the software industry, to the creation of Software Export Parks; autonomous bodies to encourage and support small software exporters (Athreya, 2005). Furthermore, state interventions included "the development of the higher education system in engineering and technical disciplines, the creation of an institutional infrastructure for science and technology policy making and implementation, the setting up of centres of excellence and numerous other institutions for technology development along with the private sector" (UNCTAD, 2012, p. 41). Lastly, there is the geographical advantage, in terms of the time zone difference between India and the United States (as well as other parts of the world) which provided an opportunity for delivering round-the-clock services, especially with regard to call centres for software support services (Chaminade & Vang, 2008).

The success of the Indian software industry is not without challenges. One of the biggest challenges has been the slow rate of adoption or integration of the software industry to other local economic sectors (Arora & Gambardella, 2006; Athreya, 2005). This is seen as a result of a mainly export-oriented software industry which hampers the distribution of resources evidently by the personnel from domestic market-oriented firms in other skill-intensive sectors to export-oriented software firms (UNCTAD, 2012).

Another challenge is the slow pace in converting the Indian software industry from a body-shopping and low value, high volume industry to an innovative high end industry (Arora & Gambardella, 2006). This transformation is necessary for India to sustain its software

industry in terms of growth as well as ability to compete globally (Parthasarathy, 2004). According to Parthasarathy (2010), the lack of innovation is partly a result of a limited domestic market as well as the lack of firm-to-firm interaction, within the local space. Most companies are solely focusing on addressing their overseas market, hence failing to take advantage of the ‘walking on two legs’ idea put forward by Schware (1992).

All in all, considering that India is amongst those considered as poor countries, lacking some basic infrastructural investment (generally and in IT) and with an illiteracy rate of over 33 per cent, its overall success and growth of the Indian software industry is quite extraordinary. As put by Arora and Gambardella (2006, p. 8), “This paradox of India’s success in a technology service industry when the economy itself is technologically backward, excites debate even as it raises hopes of similar success in other developing economies”.

Table 1 provides a summary of profiles of four emerging software industries highlighting the key strengths and challenges of each industry. Apart from market orientation, the summary points to the issue of skills as well as the government policies as key aspects that inform the success or setbacks facing the implementation of a national software industry strategy.

Table 1: A summary of the Brazilian, Chinese, Israeli and Indian software industry

	Brazil	China	Israel	India
Market Orientation	Focus mostly on serving domestic market	Focus mostly on serving domestic market	Focus mostly on exports	Focus on exports and body-shopping
Strength	The presence of lead domestic client sectors for software firms provides opportunities for learning and competence deepening, a necessary preparation if you want to effectively compete at a global scale	Strong government support especially to local companies. The large size and broad, rapid economic growth of the Chinese economy and its increasing use of IT has generally benefited the industry by providing demand for software	A highly innovative industry due to significant involvement of the academia in the high-tech industries and the highly advanced level of scientific research conducted in the country. Massive inflow of foreign direct investment in terms of venture capital from American investors	Abundance of skilled labour Strong government involvement in terms of setting policies which have been favourable to the software industry. The time zone difference between India and US, which provided an opportunity for providing round-the-clock services -A large body of English-speaking personnel allowing them to swiftly operate in the international space
Challenges	The pressure of global competition as other international software companies start penetrating the Brazilian market. Most of the Brazilian software companies have no international recognition making it difficult for them to compete globally. The language barrier makes it difficult to expand in the region as well as worldwide	The local and fragmented nature of most operators has significantly hindered their growth into large scale, specialised software manufacturers which is essential considering the growing interest of international firms to break into the Chinese market. The language barrier making it difficult for Chinese firms to expand into global space	Lack of market diversity, since the industry relies mostly on American investors or exports to America	Slow rate of adoption or integration of the software industry to other local economic sectors. A limited domestic market as well as lack of firm-to-firm interaction within the local space which seems to hamper the innovativeness of the industry
Sources	(Arora & Gambardella, 2006; Botelho, Stefanuto, & Veloso, 2005; Breznitz, 2005; Nusca, 2012)	(Commander, 2005; Kshetri, 2005; Tschang & Xue, 2005)	(Breznitz, 2005; IVC Research Centre, 2013; Tessler et al., 2003)	(Arora & Gambardella, 2006; Athreye, 2005; Chaminade & Vang, 2008; Parthasarathy, 2004, 2010; UNCTAD, 2012)

The South African Software Industry

A review of literature on the four emerging software industries points to a number of issues that play a big role in the emergence of a country's software industry. The three key issues that vividly emerged are:

- Market orientation (or industry focus)
- Skills availability
- The role of the government

This is not to say these are the only factors. Other factors include things such as availability of infrastructure, the role of academic and research institutions, as well as other geopolitical issues.

Given limited resources in terms of time as well as number of words, in order to gather a deep and meaningful picture of South Africa's software industry the study will mostly focus on a review of those three key issues. This is important if this study is to achieve one of its key goals of making sure that its findings are relevant and its recommendations actionable.

The Software Market Orientation

In the past decade, the South African software industry has experienced a tremendous growth from an estimated worth of under R4 billion in 1998 to above R20 billion in 2009 (James et al., 2001; Wills et al., 2005).

Currently, the local market seems to represent the majority of the overall software industry in South Africa. Reports show that countrywide, exports only constitute 6% of the software industry (Melina, 2007). A more recent study done in the Western Cape indicated that only 39% of the software companies surveyed make any revenue from exporting their products and services (Gale & McKinnell, 2011).

For those companies involved in software export, 76% export within the continent, 32% trade with Europe, 17% with North America and 7% with the Australasian region. Only 4% of exporting companies trade with South Asia, the Far East and South America (Wills et al., 2005). These figures clearly indicate that the South African software industry is currently focused on serving the country and to an extent the African continent.

Industry reports point to a wide variety of software solutions being developed in the region, from back-end business support systems to web-based front-end systems. There is a noticeable amount of attention directed toward developing typical solutions to support key activities in businesses. This includes software products and services aiming at enhancing and supporting the management of information, documentation and business processes. Systems developed and supported range through point of sale, ERP, CRM, Operational support, e-Commerce, to booking and payment. Although there seemed to be a bias towards the financial industry in the markets targeted, there is still a wide variety of industries being served such as legal, business process outsourcing, health, travel and tourism, real estate, NGOs, government, retail and education (Gale & McKinnell, 2011).

Looking at the market alone, the software industry displays some resemblance to China and Brazil whose focus have also been mainly on serving domestic markets. This brings about an important question of whether the focus on the local market is a sign of inferior capabilities and reveals an inability to develop an internationally competitive industry, or rather an alternative strategy to prepare and structure the industry for it to be ready to enter the more competitive international domains (Botelho et al., 2005).

Skills Sourcing

One can hardly discuss the South African software industry without touching on the issue of skills availability. According to a series of private as well as government sanctioned reports on the software industry as well as the ICT industry in general, skills availability is a principal challenge facing the industry (Wills et al., 2005).

In a recent study conducted in Western Cape, 65% of organisations operating in the region sighted availability of appropriate IT skills as one of their critical challenges (Gale & McKinnell, 2011).

Studies on profiling of ICT skills have highlighted a contradiction implying that while the country in general is faced by significant levels of unemployment, the ICT sector is faced by a shortage of skilled workers (Melina, 2007).

In addition to that, companies are also sceptical about the quality of ICT graduates from local universities. Most graduates tend to struggle to attain productivity once placed in projects. This has resulted in organisations questioning the relevance and suitability of programmes offered by high learning institutions.

On the other hand, higher learning institutions have attributed the source of the problem to the overall shortage of students enrolling in ICT-related degrees as well as the ability of those students to successfully complete the training (Melina, 2007). Studies show that learners are rather choosing careers in medicine, arts, engineering, law, accounting and politics (Calitz, 2011). Even worse, those who enrol in ICT-related degrees and who graduate with high grades, tend to migrate overseas in search of not only better payment, but also exciting ICT careers in large multinational companies as well as better quality of life in European and other western countries. This applies to experienced professionals as well, for instance, “29% of programmers and 23% of analyst/programmers and systems analysts who voluntarily changed jobs, left the country. At management level, this amounts to about 31%” (SAITIS, 2000, p. 12).

According to James et al. (2001), the issue of skills shortage needs to be seen in the context of the entire education system from the primary and secondary school education to the potential pipeline of students who will be emerging from tertiary education systems with appropriate subjects in the areas of science, mathematics and technology-related disciplines.

The low supply of ICT graduates within the country has resulted in an increase in the cost of sourcing ICT professionals. Salaries have gone up resulting in not only large, but also small to medium companies to look for alternative sources of skills including seeking and sourcing professionals outside the country.

Government Support

As highlighted in the review of software industries in emerging economies, success greatly depends on how well the government has set its strategies in terms of regulations and policies to support the software industry.

Just a few years after the end of the apartheid, the newly formed South African government identified the significance of fostering a strong ICT sector as a key enabler for national development. This came hand to hand with the recognition of the importance of fostering a strong local ICT sector as a means to effectively exploit the ICT revolution worldwide (Moodley, 2003). Tasked with the responsibility of driving the ICT strategic plan, the Department of Trade and Industry (DTI) identified eight key success factors for the ICT national strategy which included:

- “Developing human capacity: skills and knowledge;

- Cost effective and ubiquitous ICT network infrastructure;
- Sustainable growth of the domestic ICT industry;
- **Strong content and application development for domestic and international markets;**
- Rapid diffusion and adoption of ICTs through the economy;
- Government as a model user of ICTs;
- Enhanced innovation and R&D capabilities; and
- Proactive, coordinated and transparent policy and implementation processes.”

(Moodley, 2003, p. 112).

These key success factors were then used to set focus in various programmes, new and existing. Examples of such programmes include: The Technology and Human Resources for Industry Programme (THRIP) which was a joint research venture between government, industry and academic institutions; the Innovation Fund, aiming at supporting large scale science, engineering and technology innovation programmes with social implications (Moodley, 2003; SAITIS, 1999).

Other initiatives from the government involved the formulation of the State Information Technology Authority (SITA), tasked with consolidating and coordinating the State’s information technology resources.

At provincial level, we find organisations such as the Cape Information Technology Initiative (CITI) established in 1998, which operates on a vision of creating an “ICT cluster that is regionally and internationally recognised for excellence in its ability to innovate, generate investment, create jobs and grow revenue” (CITi, 2009).

With a current investment of about R187 billion, it is clear that the government has given some attention to the ICT the sector (Pule, 2011). Both the central as well as the provincial government have recognised the importance of the ICT sector and specifically software industry as an important catalyst for economic development.

However, in spite of such investment there is a general feeling in the industry as well as among academia that there is room for the government to do more in support of the software sector within the broader ICT industry.

From the baseline studies commissioned by the DTI in 1999 to a most recent study of the software industry in the Western Cape, a lack of a coherent government strategy towards supporting the ICT industry has been identified as one of the key challenges faced by existing as well as upcoming businesses (Melina, 2007; SAITIS, 1999, 2000).

Currently, none of the government ICT strategy documents, including the Minister of Communications' most recent budget vote speech, clearly articulate the country's strategy with regard to the software industry. The focus has mostly been put on implementing the infrastructure (telecoms & broadband) with little attention given to content and applications development as initially outlined by the DTI.

A survey of the Western Cape software industry revealed that 49% of companies sighted government regulations as a constrain towards effectively doing their business (Gale & McKinnell, 2011).

Therefore, although the government, specifically in the Western Cape Province, has directed some level of attention to the software sector, concerns exists ranging from bureaucratic incompetence, contradictions, as well as incoherence and inconsistency of policies which result in shortcomings during implementations (Singh, 2010).

Emerging Issues and the Need for a Systemic View of the Industry

As postulated by Carayannis and Sagi (2001), to be competitive in today's 'new economy' of the global e-marketplace, an Information Technology firm cannot go at it alone. A successful company must compete within a proactive industry that has a focused government support; several established consortia, a selective consumer base, and an innovation strategy that is open to change and has the organisational freedom to collaborate.

A literature review of industries in other emerging countries strongly suggests that national strategy based on consultation with all relevant stakeholders is a useful starting point. Among other things, the strategy should also focus on capacity development to enable and nurture local capabilities such as skills development. Such capabilities are crucial to development and to the enablement of a strong and competent software sector. It will be interesting to see how this capability is experienced in the South African context when regimes of training are prescribed from afar. Equally interesting in the South African context is how this capability

will be developed with government capacity needed to be supplemented by partnerships with NGOs, higher education institutions and businesses.

Literature also strongly points to the need for governments to take an active role in fostering software capabilities, taking the needs of both public as well as private sector into account. As put by UNCTAD (2012, p. xv), “Governments are important buyers of software. They determine the educational curricula for the production of software engineers as well as the availability of affordable ICT infrastructure. They shape legal and regulatory frameworks that influence the extent to which ICTs are taken up and used productively in the economy and society”.

Based on the literature review, there is little doubt that the South African software industry needs a viable ‘industry orientation’ or a niche which will enable firms within it to set innovation, production and market objectives that will enable their performances and compete favourably with other countries’ software sectors. Such orientation may be geared towards modernising the orientation driving business designs, objectives setting and strategic planning in the South African software sector.

The implication of this study is that it can be used to assess the challenges of lack of skills, competitiveness and industry enablement in South Africa as highlighted in a literature review. Overall, most of the factors identified in the literature review are practical manifestations of the wicked triple helix of a lack of skills, competitiveness and industry enablement. Unfortunately, if one is to critically analyse the literature as well as on-going practices within the industry, it is clear that the ways in which South Africa, including its scholar populace, has addressed these challenges, show nothing but a trivialised attempt to solve problems that are wicked but are being addressed as tamed.

The inclination to trivialise wicked problems by societies (including their scholars) has been observed by Churchman (as cited in Wexler (2009)) when he indicated that “whoever attempts to tame a part of a wicked problem, but not the whole, is morally wrong” (p. 142).

According to Wexler (2009), wicked problems are unique. Efforts made towards the solution of one [wicked] problem are difficult to generalise. Those working on wicked problems cannot easily determine when the problem has been solved. Economic, social and/or political constraints shift as problem-solvers work on the problem.

System Thinking as a Methodology to Make Sense of the Complexity

So far it has been well established that in going forward the Western Cape Province as well as South Africa as a country is faced with a complex or wicked challenge entangled within issues of business enablement, competitiveness and skills. The challenge marks the difference between the current pre-industrialisation economy (mode of production) and the post-industrialisation mode of production which is necessary if it is to play a significant role in the global economy while taking advantage of increasing opportunities emerging out of Africa as a continent. Any attempt to set future policies and strategies for the region without effectively addressing the posed challenge is, as asserted by Senge (2006), “painting a lovely picture of the future with no deep understanding of the forces that must be mastered to move from here to there” (p. 12). This phenomenon is also very well articulated in the following paragraph by Parthasarathy (2010, p. 247);

“The work of Gerschenkron (1962) on nineteenth-century Germany and Russia, and that of Johnson (1982) on mid-twentieth-century Japan, showed that late industrialization cannot be left to ‘free’ markets; instead, societies must develop the institutional means to construct comparative advantage rather than relying exclusively on natural endowments. On the basis of the studies of South Korea and Taiwan, Amsden (1989) and Amsden and Chu (2003) propose a general theory of industrial transformation in the late twentieth century (or late-late industrialization) that emphasizes technological upgrading. They argue that reciprocity between the state and industry is a key premise of late-late industrialization amid economic globalization.”

However, before embarking on addressing such challenges, it is important to first acknowledge and come to the realisation that most challenges facing the industry are a result of the inability to grasp and manage the increasingly wickedness, complexity and interconnectedness of the problems facing our growing economy and society at large.

Management research advocates a technique of dealing with such complex problems through a change of problem-solving methodology from a typical analytical and reductionist approach to a more systemic approach that pays more attention to the whole (the system). This systemic problem-solving approach is embedded in what is commonly referred to as ‘systems thinking’.

Senge (2006) defines systems thinking as “a conceptual framework, a body of knowledge and tools that has been developed over the past fifty years, to make full patterns clearer, and to help us see how to change them effectively” (p. 7). It is essentially a use of system ideas in trying to understand the world’s problems and the complexity within which they are embodied.

System thinking and its application in the context of this research rest on the need for a change of focus from merely looking at the parts (skills shortage, costs of production, infrastructure, lack of strategic policies) separately to looking at the whole (production system). It involves application of closed-loop thinking which involves understanding the feedback effects of causality. This means an ‘effect’ in part A of the system will affect part B. Consequently, affecting part B will affect part C, which will also in turn go back and affect part A. This phenomenon is also articulated by Maani and Maharaj (2001), “an ‘effect’ usually feeds back to influence one or more of the ‘causes’, and that the ‘causes’ themselves affect each other. It is important as part of closed-loop thinking not to prioritise ‘causes’ as being most or least important but rather to understand how dominance amongst them may shift over time” (p. 3).

Jay Forrester, a pioneer of system dynamics (which also falls under systems thinking discipline) goes further into attributing much of today’s world challenges to policymaking that is trapped into setting up interventions that focus on obvious symptoms and not underlying causes. This tends to produce short-term benefits but long-term malaise, and fosters the need for even more symptomatic interventions (Senge, 2006). To date, system thinking has successfully informed management strategy and policy formulation both in the public and private sector, especially when it comes to dealing with complex problems (Jackson, Johnston, & Seddon, 2007; Maani & Maharaj, 2001; Senge, 2006; Zokaei et al., 2010).

Therefore, if the Western Cape as a region as well as South Africa at large, wants different outcomes from the current situation, we have to understand and thereafter apply systemic changes to the system that underpins the situation in such a way that it delivers different outputs. This study is one of such attempts.

Chapter Three: Research Methods

This research study is guided by three key inter-related objectives set within the context of an emerging software industry:

1. *Identify* the major pressure points in the industry.
2. *Explore* the broad parameters of the identified pressure points, their interactions and impact on the overall industry.
3. *Formulate* a systemic view of how these pressure points interact dynamically in the region.

A valuable aspect of this research is in the compounded nature of its objectives. However, it is important to point out that each of the three objectives can only be effectively met through a careful integration of the understanding collected via the existing literature, most of which seems to be a result of similar regional researches, as well as that emerging from the empirical data collected by this study.

Chapter two highlighted a gap in existing research that there is a need for South Africa as a country and the Western Cape as a region to identify and explore the dynamics of an emerging software industry so as to establish a contextually grounded understanding of a trajectory of the industry. Among other ways, such an understanding can only come from an effort to amalgamate perspectives and interests of key players such as business, government, as well as academia. Therefore an important contribution of this research work is to study and analyse empirical data on the perceptions of key players from the three aforementioned stakeholder groups as to the state of the Western Cape software industry. The study will go further and make an effort to highlight the systemicity of the various issues put forward by the stakeholders.

Apart from highlighting the gap, the literature review has also shed some light on objective one and to an extent objective two. A careful look into the history and trajectory of other emerging software industries has informed this research on what could broadly be considered as areas of interest. However, although these areas of interest arose from emerging software industries, one must take cognisance of contextual difference before applying them to South Africa, hence the need for this study. For that matter, the identified areas of interest were used to formulate themes which were in turn used in providing focus for this research as it

tries to meet objective two and objective three. Therefore, this study's empirical work directed its resources towards gathering data on the software industry from Western Cape-based entities, allowing key stakeholders to share what they consider as key characteristics of the industry i.e strengths, weaknesses, opportunities, as well as possible threats. Making use of systems thinking theories, the study tried to amalgamate the findings and put forward an argument for what can be considered the current state of the software industry and the dynamic interplay amongst its key issues.

This chapter – Research Methods – provides details of the research strategy adopted to address research issues highlighted in the literature review, together with means used to collect and analyse data.

Research Strategy

The empirical research in this study is interested in an *in-depth* study to explore the broad parameters of the identified pressure points, their interactions and impact on the overall software industry, as perceived by key actors operating within (affecting and/or affected by) the industry .

In this study, the researcher embraces an interpretative perspective of the world rather than a positivist worldview. Orlikowski and Baroudi (1991) proposed three categories underlying qualitative research epistemology: positivist, interpretive and critical. Interpretative researchers believe that an understanding of the world can only be accessed through social interaction, and that such interaction in turn is understood in terms of the context of the interaction (time and place). On the contrary, a researcher with a positivist view of the world believes that reality is objective and independent of the observer and thus can be measured and predicted. This researcher does not hold a positivist view of the world, nor is he trying to test theories and make generalisations from a sample population. A researcher with a critical perspective of the world, views that reality is historically based and that people are influenced consciously and subconsciously by social, cultural and political circumstances, and that it is the researcher's task to focus on such constraining conflicts and in doing so, assist in removing the 'causes of alienation and domination' (Myers, 1997). Therefore, as mentioned earlier the interpretative perspective of the world fits in with this researcher's view of the world and his aim of gathering different stakeholder perspectives to 'gain an understanding of the constructions held by people [related to software industry] in [the] context of the Western Cape region. This researcher accepts that the world has much conflict and restricting forces

that are historically based, and that aspects of his research work may overlap with such sentiments (e.g. strengths and weaknesses of the industry), but that the main focus of his research is not on identifying distinct factors affecting the industry, but instead to better understand the interaction amongst various issues and players operating in the industry.

This research is primarily qualitative in nature, not quantitative. Qualitative studies involve studying ‘things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them’ (Denzin & Lincoln, 1994, p. 12). This is in line with the study’s interpretive philosophy outlined earlier, as well as the study’s aim of soliciting understanding of stakeholders’ perspectives towards the software industry. On the other hand, quantitative studies are mostly applied in natural sciences (such as physics) studies on natural phenomena, using methods such as laboratory experiments and mathematical modelling.

The research strategy used to implement the empirical research is a case study. A case study is concerned with close observation of how a particular population group behave in a particular context. According to Yin (2002, p. 13):

‘A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident’.

This research is concerned with studying a phenomenon of an emerging software industry in a contemporary context [Western Cape, South Africa] where the boundaries between the characteristics of a software industry per se and that of the region are not particularly obvious. This is in line with the review of literature on other emerging software industries presented in Chapter Two, which has shown variations of industry characteristics from one region to another.

Another definition of a case study is put forward by Cohen, Manion, and Morrison (2011, p. 296) who describe a case study as a form of inquiry where:

‘a researcher typically observes the characteristics of an individual unit – a child, a class, a school or a community. The purpose of such observation is to probe deeply and to analyse intensively the multifarious phenomena that constitute the life cycle of the unit.’

According to this definition, a case study is therefore a careful observation of how a particular population group behave in a particular context. A case study approach will thus enable this study to carefully study the characteristics of various players implicated by the software industry in the Western Cape context. A case study will enable a deep understanding of how businesses, policy makers as well as educators play a role in shaping the emerging Western Cape software industry.

A more encompassing description of a case study is the one put forward by The U.S. General Accounting Office and it states that (as cited by Biggam (2011, p. 227)):

‘A case study is a method for learning about a complex instance, based on a comprehensive understanding of that instance obtained by extensive descriptions and analysis of that instance taken as a whole and in its context’.

This definition, in a way, combines both aspects of Yin’s (2002) as well as Cohen et al.’s (2011) definition. It captures Cohen et al.’s (2011) emphasis on the depth of a study and focuses on a particular phenomenon, while recognising Yin’s (2002) view that an understanding of a phenomenon in a particular setting is done in a complex context that requires ‘extensive description and analysis’ to arrive at meaningful interpretations.

Therefore, the researcher is confident that given the nature of this research – an in-depth study of a contemporary phenomenon (characteristics of an emerging software industry) in a complex environment (Western Cape, South Africa), where a variety of stakeholder perspectives are sought (mostly focusing on IT leaders of both consumers and providers of software products and services) and where the underlying research philosophy is based on an interpretive understanding of the world – a strategy that best meet the needs of this research is a case study.

The use of a case study in this research thus exploits the concept of relatability, where other institutions in relating to situational aspects of the case study and recognising similar issues and problems described in this research work can learn from the findings. Bassey (1981, p. 85), for example, is a strong supporter of the concept of relatability and believes that ‘relatability of a case study is more important than its generalisability’.

In an effort to improve the rigour of the study, the researcher has done four things. Firstly, the nature and philosophical underpinning of case study research has been discussed openly and related to the nature of this work; secondly, well established data collection methods were

used to collect the empirical data; thirdly, a structured, disciplined, approach to data analysis was adopted; and fourthly, precise details of data collection and data analysis techniques applied to this empirical research were fully described.

Data Collection

The case study is generally considered to be a qualitative strategy. Bell (2005, p. 7) states that, researchers “adopting a qualitative perspective are more concerned to understand individuals’” perceptions of the world. They seek insights rather than statistical interpretations of the world. This is the central ambition of the empirical aspect of this project: to understand what key issues around the software industry are, its weaknesses, strengths, opportunities and, above all, to seek individual perspectives from those stakeholders involved in shaping the industry. To gain such an understanding of the embedded characteristics of the industry requires an in-depth probing that is more than simply gathering of facts and figures.

The main data collection technique for this study was semi-structured interviews. Interviews are an appropriate means of collecting qualitative data, and are commonly used in case studies. Indeed, Yin (2002, p. 89) believes that “interviews are essential sources of case study information”, principally because most case studies are human affairs (as is this case study) and because interviews can provide insights into complex situations (an expectation of this research). This technique, although time-consuming, provides the opportunity to obtain qualitative data in a manner that has the benefit of providing an overall question framework and focus for the interviewer, yet also providing the opportunity for the interviewees to express their views. Additionally, the interviews were not restricted to questions that the interviewer initially intended to pose. In other words, if issues arose during the interview process, and were deemed relevant to the research issues, then these issues were pursued.

The interviews were in some way structured (or focused) to ensure that the interview has a clear direction and theme, but there were opportunities for participants to express their views, explain individual perspectives and expand on answers. The focused interviews met the researcher’s aim of respecting ‘how the participant frames and structures the responses. This, in fact, is an assumption fundamental to qualitative research – the participant’s perspective on the social phenomena of interest should unfold as the participant views it, not as the researcher views it’ (Biggam, 2011, p. 281). As such, to provide an overall structure to the interview, and seek the collection of quantitative and qualitative data, a combination of

closed and open-ended questions were utilised (Grummitt, 1980; Moser & Kalton, 1971; Robson, 2002).

In the process of collecting qualitative data via interviews, attempts were made to also collect quantitative data. Examples of this include the size of the IT budget in an organisation, the number of staff involved, and their categorisation (eg business analysts vs developers). It is then hoped that such an approach, combining both quantitative and qualitative methods, will assist in understanding the issues developed in the section on ‘Issues and Review of Related Literature’ by providing a ‘thick description’ (Geertz, 1994) of the emergent nature of the industry. Nonetheless, the primary focus of this research strategy is the gathering of qualitative data.

Between December 2011 and July 2012 a series of interviews were conducted featuring 18 companies operating in the Western Cape Province (Table 1). Due to resource (specifically time) constraints only the first 12 of the 18 interviews were used for this study.

Table 2: A list of interviews conducted

Interview Code	Role of Interviewee	Role of Organisation
I1	CEO	Solutions provider
I2	Executive Development	Solutions provider (inhouse)
I3	Innovation Director	Solutions provider (inhouse)
I4	Executive Team	Solutions provider
I5	Director	Solutions provider
I6	CEO	Solutions provider
I7	CIO	Solutions provider (inhouse)
I8	Executive Team	Solutions provider
I9	Executive Team	Solutions provider (inhouse)
I10	CIO	Solutions provider (inhouse)
I11	Executive Team	Solutions provider
I12	CIO	Solutions provider (inhouse)

Each of the interviews lasted approximately 1.5 to 2 hours. The sample is made up of companies operating within the Western Cape who are either external solutions providers or in-house solutions providers. These interviews were open-ended but focused using a checklist of issues. With the permission of the interviewees, all interviews were recorded. The recording for each interview was thereafter transcribed, analysed and then synthesised abductively to generate key issues as articulated in the following sections.

Collaborating with Department of Economic Developments and Tourism of the Western Cape Province, a set of open-ended questions were set up to guide the interviews. However, due to a number of issues such as size of the organisation, role of the interviewee in the organisation, and nature or focus of the business, some questions were more relevant to a particular type of organisation and it was at the discretion of the interviewer to determine so. Appendix A contains the collection the research questions used.

Due to the sensitive nature of some of the issues discussed in the interviews, respondents requested that the recording and transcripts should not be made public.

Framework for Data Analysis

To help focus the interviews in terms of reflecting the main objectives of this research and ease the analysis of the qualitative data, the issues explored in the interviews were broadly categorised into six key themes. It is important to acknowledge that the themes were determined partly by the understanding gathered in the literature review and partly by the content of the interviews (dominant issues). Apart from aiding the data analysis process, these themes tie into the overall aim and objectives of this research, which is to identify the key pressure points in the industry. The six themes are Budget, Costs and Sourcing Pattern, Labour Profile and Skills Needs, Technology Platforms, Performance and Productivity Measures and Standards, Methodologies and Frameworks.

It is important not to view these themes as separate topics, they are interrelated. The themes were useful in helping the interviewer and interviewees focus, and aided the analysis of the interviews. Additionally, as an indication to the quest for depth as well as focus to this research, respondents were also encouraged to reflect on their overall perspective of the industry in terms of its strengths, weaknesses, opportunities, as well as threats.

Furthermore, as highlighted in the previous section, the question of how to record the interviews was given much consideration in this case study. Taking notes as respondents talk was one simple alternative. However, the disadvantage of having to write as respondents are talking, involves failing to give respondents your full attention and, in turn, perhaps omitting crucial comments and nuances, together with the problem of having to interpret summary comments some time after the event. Such issues made this [taking notes] mode of recording unsuitable. Instead, all interviews were recorded by an audio recorder and later transcribed. Such an activity, though time-consuming, was crucial in fulfilling the researcher's aim of gathering rich qualitative data. Overriding advantages include the freedom to concentrate on the interview process and, crucially, to capture of everything said by the respondents.

An important part of this research was to analyse the case study data, highlight any key emergent collective perspective of the industry as well as reflect on the case study results with respect to the findings in the Literature Review. Figure 3 depicts an overview of this overarching reflective process.

As portrayed in Figure 3, the process of data collection and analysis was an iterative approach. As soon as interviews were recorded, researchers took time to do a first round of analysis. The iterative approach allowed the researcher to refine the focus of the interview as well as the structure of the questions so as to effectively capture the essence of the study.

In terms of analysis, the study made use of an abductive technique to generate insights on key issues that emerged from the interviews. The next section goes into details explaining what abductive technique is, as well as its application in this study.

The Abductive Logic of Research

There are three paths of research logic that connect theory and data: deductive logic, inductive logic and abductive logic. As highlighted in the previous section, this study applies an abductive logic to analyse its findings and generate conclusions (or hypotheses as known in abductive terminology). To justify the choice of abductive reasoning for this study, the researcher will first explain the alternatives, deductive logic and inductive logic, and why they are not suitable for this study. Thereafter, a comprehensive explanation on abduction logic and its application in this study will be presented.

In deductive logic, there is a valid logical connection between the hypothesis and a previous theoretical assumption. Using the words of Levin-Rozalis (2008, p. 3), “The hypothesis is an *explanandum*, meaning that it is explained by deductive premises derived from a theory; [Whereas] the a priori theoretical assumptions are the *explanans*, which explain the hypothesis”.

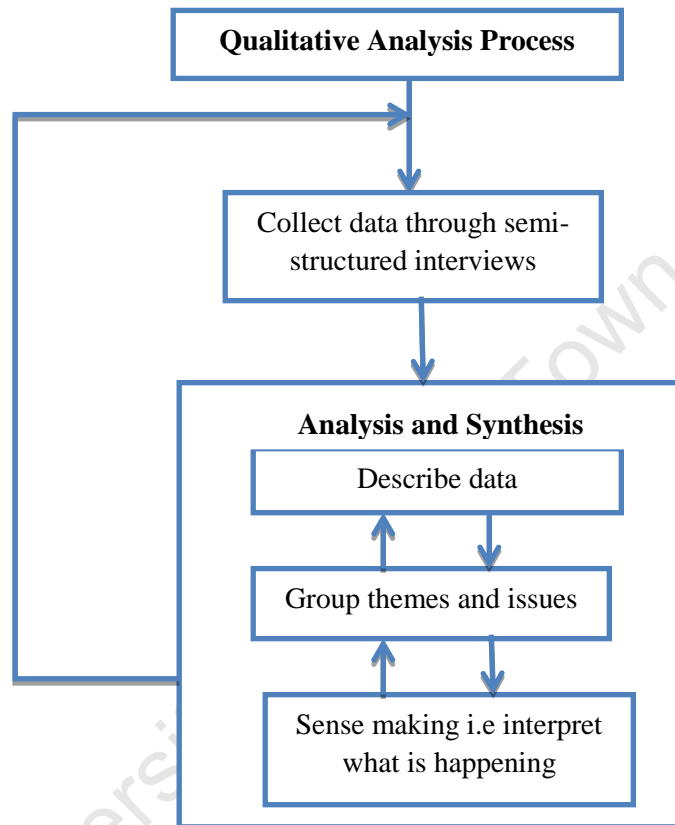


Figure 3: Qualitative data analysis process adopted for the study

There is nothing new in the hypothesis, nor is anything new permitted. No matter what else may be true in the world, or what other information may be discovered, the validity of the connection between the a priori premises and the hypothesis is not affected. This method of formulating hypotheses is mostly suited for research that examines a theory or tries to refute it. It assures the researcher that there will be no deviation from the application of the theory in question. Phenomena that appear within a particular context which is a subject for observation, are not subject to deductive logic at all; the context is merely the court in which the a priori hypotheses can be examined (Copi, 1963; Copi & Burgess-Jackson, 1995).

Deductive logic is completely different from the logic used for this study. The key objective for this research is examining the manifestation of a phenomenon in a specific context in order to reveal the variables and the elements that play a role, as well as the connections between them. The study does not use the context to validate any form of variables and prepositions from an existing theory.

In inductive logic, hypotheses are formed according to empirical generalisations, such as a repetitive or recurrent phenomena that are observed in the field (Strauss & Corbin, 1998). From far, inductive reasoning looks like a fit for this particular study. However, upon close observation, one can realise that inductive analysis tends to focus on achieving some form of generalisation sometimes referred to as ‘a theory’. As put by Strauss and Corbin (1998, p. 12) in their description of inductive analysis, “The researcher begins with an area of study and allows the theory to emerge from the data”. In order to claim empirical generalisation, the characteristics of the phenomenon have to be known ahead of time – they have to have been examined earlier. This research begins early in this examination hence the title “Landscaping....”. It attempts to uncover initial understanding of the phenomena in a specific context, thus cannot yet examine their characteristics and the probability of their occurrence.

Contrary to inductive and deductive approaches to analysis, the principles of abduction are based on the notion that there are no a priori hypotheses, no presuppositions, no theorising in advance.

In his research on strategy formulation, Chamberlain (2006) argues for the suitability of abductive methodology in researching a phenomenon which “lacks definition and established knowledge surrounding the processes for forming a subjective social construct” (p. 295).

Probably a more precise definition is the one given by Peirce 1955 as cited by Levin-Rozalis (2008, p. 151):

“Abduction is a process of drawing conclusions that includes preferring one hypothesis over others which can explain the facts, when there is no basis in previous knowledge that could justify this preference or any checking done.”

From the two definitions presented above, it is easy to argue that the abduction approach allows one to explore a situation, in this case the unexplored emerging software industry in

the Western Cape, analyse it, and put forward several proposition based on the understanding gathered from the empirical data and not any prior theory. Propositions will not particularly constitute a theory but will emerge from the researcher's 'inference to the best explanation'.

The strategy adopted by this study is best described by Chamberlain (2006, p. 295) words:

"The research project is addressed by the researcher becoming sufficiently engaged, or even immersed, in the interpretivist reality of the situation to perceive whatever is remarkable or noteworthy, and then insightfully speculate on likely associations or causations of it".

Ethical Issues

Authors who have discussed the qualitative research approach have in many cases pointed out the importance of ethical considerations (Cavana, Delahaye, & Sekaran, 2001; Creswell, 2008). In this study, the researcher understands the obligations to respect the confidentiality, rights, and values of research participants. Having business leaders discuss intimate aspects of their business and how they are impacted by the software industry, makes confidentiality a very sensitive matter in this study. To ensure all ethical and confidentiality matters were addressed, the study worked closely with the Faculty's Ethics Committee making sure that all necessary measures were considered. Each participant (interviewee) was informed on all data collection procedures and devices. Transcript notes and all recordings made during the interview are stored in a secure web portal where access is carefully controlled. Respondents' IP rights and interests were carefully considered when decisions were made regarding analysing as well as presenting empirical data, and the research participants had the final decision regarding their anonymity.

Limitations and Potential Problems

Just like any other study undertaken, there are limitations to this research. This study only managed to interview business leaders operating in the Western Cape region. The decision was mainly due to resource constraints. That said, it is important to point out that although the impacts of a software industry can be traced at a regional level, most cases strategies and policies are set at a national level.

Moreover, as highlighted under the 'Research Methods' chapter, for the same reasons (lack of resources, specifically time) of the nineteen interviews conducted in the Western Cape region, only the first twelve were transcribed, analysed and used in this study.

The study also recognises that the issues affecting software the sector goes beyond the ones given much attention in this study. Given the limitation of a master's study, a decision was made to only focus on those issues which were identified as 'key' both in the literature as well as the empirical data. There is a need for a much bigger, well resourced study that will commit resources into the investigation of all issues, and interviewing business leaders from all regions to get a complete picture of the industry and its key challenges as well as opportunities. Such a comprehensive study is essential if the software industry is to be positioned as a key strategic business enabler and source of competition within the continent as well as internationally.

For the literature review, one might have noticed that the chapter covered all BRICS countries except one, Russia. It's important to acknowledge that the inclusion of Russia would have been useful in terms of spreading the breadth of the literature review. However, the author was unfortunately not able to gather enough published literature on Russian software industry to gain a meaningful understanding of the industry.

Another limitation of the empirical study was that although the literature review pointed to three key players namely: government, academic institutions and businesses, the study (data collection) only focused on business leaders. Government leaders were not interviewed at all, whereas academic leaders and NGOs were only informally consulted. However, insights on the government's position were sourced from official government sources such as budget vote speeches by ministers as well as official strategy and policy documents.

Chapter Four: Research Findings: Description, Analysis and Synthesis

This chapter reveals the results of the empirical research as described in Chapter Three (Research Methods). Aiming at landscaping the software industry in the Western Cape Province, this research was conducted as a case study, targeting key stakeholders operating in the industry. These stakeholders, mostly composed of top IT leaders operating in the software space, were asked through interviews, to reflect and share their perspectives as well as experience on various aspects (also referred to as ‘themes’) of the industry including what they perceived as its strengths, weaknesses, threats, as well as opportunities. The purpose of the study is, making use of stakeholders’ insights as well as existing literature, to formulate what can be considered as a base knowledge on how the software industry in the province operates, including its key pressure points. Such an understanding is not only crucial for decision-making by both businesses as well as policy makers, but also for researchers who want to conduct more focused studies on various aspects of the industry.

Having collected all data, this chapter will present the findings in a highly structured way. First a description is provided of stakeholders responses, theme by theme. Following the simple description of the results will be a discussion on such findings which will be referred to as analysis. Finally, the analysis of the empirical findings will be synthesised with literature review to allow key insights to emerge in an abductive process as described in Chapter Three.

Findings

As highlighted above, respondents were asked questions which were categorised under six key themes namely IT Budget, Software Costs & Sourcing Pattern, Labour Profile and Skills Needs; Technology Platforms, Performance and Productivity Measures, as well as Standards, Methodologies and Frameworks.

The following is a summary of the key responses under each theme:

Theme 1: IT Budget

Among the *in-house* service providers, the budget seems to range from just below one per cent of overall organisation turnover [for small organisations] to around three per cent for

larger organisations and is set based on the past year's budget and adjustments for inflation. As one of the respondents put it:

".....It gets formulated as an increase or a decrease from last year's budget and it gets benchmarked as a percentage on turnover" [I3]

Another responded echoed that by citing:

"It is definitely looked at in the context of the previous year's trends of what has IT cost the business" [I2]

It was also pointed out that the IT budget is an easy target to make way for cost pressures as well as external economic pressures.

In terms of the classification of IT spending, the most common classification seems to be that of operational (sometimes referred to as maintenance) versus strategic spending. This was observed in three of the in-house service providers.

"We differentiate our IT budget in three categories"...maintenance or day-to-day running [90%], strategic [6%], emergency or any unplanned/unexpected/unscheduled activity [4%]" [I5]

Another respondent also mentioned:

"...there is an element of fixed costs because of the history of the organisation and the massive legacy we have, there is a big support cost which is a given.... and then there are strategic projects you do which are funded out of a strategic pool and so we are very formalised in terms of what is our strategy, how do we fund it, and so the whole strategic landscape competes for funding" [I2]

Moreover, several respondents mentioned the classification of their IT spending activities as projects. The most popular categorization being spending on *application* projects versus spending on *infrastructure* projects.

".... I do not know what the exact ratio is but for us it is ...the application side is about 85 mil per annum and then the infrastructure it is another 60 or so on that..." [I2]

Theme 2: Software Costs and Sourcing Pattern:

This issue sits between service providers who have an option to outsource some complementary software services and local software vendors who have to sell their services. When asked for a main reason for outsourcing development, one in-house service provider made it clear that cost is the main factor:

"difficulty to find quality guys(Java developers) and if you find them they are very expensive" [I11]

As highlighted by the respondent, the popular perspective amongst businesses is why the need to incur more costs with local service providers if the same service can be sourced from overseas (India being the popular destination). However, according to three respondents, projects that have been outsourced to India (at a lower cost) are increasingly becoming less feasible. Slowly executives are starting to come to the realisation that there are substantial resources needed to specify and imagine the needs and explain these to development teams which are currently not sufficiently considered:

"We tried the India route over the past five years and we found that there wasn't a business case in terms of benefit and cost and for the last two years we found out it was going to cost us more to offshore....we basically became a commodity and they were simply pushing code which is not what we wanted because we then had to have QA people on this side..." [I8]

The respondent went further and suggested that there is a need to look systemically at cost. He advised that costs in the context of software solutions delivery must be seen from the perspectives of contribution to business goals and the flexibility of the design and architecture to cater for emergent needs. This requires a longer-term view of costs and seeing solutions delivery as an emergent process. It also requires a different perspective towards sourcing relationships, reflected in the following responses:

" the challenge we are facing with outsourcing is not necessarily the lack of productivity it's more of the ability to scale, the ability to grow, the ability to be reactive at a short time" [I11]

"...we decided we rather keep it onshore for two reasons, first was to keep the skill set within our teams where it adds value and the other one was to find onshore

partners who will assist us with any development work....we'd rather partner with vendors and the benefit we found were two things; one is we get things done quicker, a lot quicker than when we offshore..., and the second thing is they are entrenched and fully understand our business..” [I8]

With regard to the potential of becoming an important offshoring destination, it was also revealed that it is becoming less effective and sustainable to position provinces' (as well as countries') competitiveness through a cost lens. This is due to the increasing personnel costs (partly due to the decrease in skills pool), as well as significant cost inflation as compared to other popular offshoring destinations such as China and India. As one executive explained it:

“Your biggest cost is your personnel cost in any sort of consulting organisation and our wage inflation outstrips – and for that matter, India and China’s wage inflation massively outstrips the US and a lot of the developed world. So what is happening with our wage inflation is meaning that the competitiveness gap from a cost perspective we used to have is disappearing extremely quickly” [I1]

Finally, there is a perception amongst the big consumers of IT services that local SMMEs do not have enough resources to undertake big software projects as their counterparts in India and European countries. On the other hand, service providers claim they have the capacity to take on large projects and grow their staff complement in parallel without compromising delivery. As one service provider put it:

“And I would fervently deny that statement where we do not have the ability to put together large software projects. We definitely do have the ability. We have the technical know-how without any doubt whatsoever, and we have the scale and capacity to do that absolutely” [I1]

The respondent also added:

“In this region, we definitely do have the capacity to be doing an undertaking either within companies or across companies, undertaking very significant software development or application development projects without any doubt whatsoever.” [I1]

An initial analysis reflects a sense of confusion towards an appropriate sourcing model for software development projects that will enable the industry to take in big IT projects at a competitive cost. At the moment the issue of development costs seems to be the driving force towards sourcing decisions. If cost were used as a primary measure, it is assumed that software projects can be fully specified upfront and that the stakeholder needs and project conditions remain stable. This approach underestimates the substantial resources needed to specify and imagine the needs and explains these to development teams. If this is considered properly, it will become apparent that software needs are emergent and fragile, and if this reality is embraced, there would be greater successes and opportunities.

The literature review clearly indicates that the majority of the software market for the local software vendors is local. However, as pointed out, local businesses are currently considering other options in order to cut costs with India being the popular substitute. On the other hand, local vendors are finding it challenging to lower their costs given the challenges surrounding them such as a shortage of skills and the demand for high quality software.

Theme 3: IT Labour Profile and Skills Needs

Looking at the overall supply and demand of IT skills necessary to boost the industry, the overall consensus amongst respondents is that the skills pool is so small that it is causing both in-house and external suppliers of the skill to source from the same market, making it very costly. Some of the responses on the issue of skills supply and demand included:

“Weakness is in skills. Actually trying to get the right people to be able to do certain things” [I3]

“We are talking specifically Western Cape, there is a lot ...incompetence will be a strong word, but there is an apathy and a lack of skill in the large corporates...” [I6]

“...that is where it comes back to competing with the Indians or because they have got these okes that are just pumping out code, and provided they have got the right processes around them and the right senior guys there, it becomes very commercially viable” [I6]

“... IT professionals need to be really much more specialised and much more highly skilled to compete as IT professionals on the world stage, and South Africa has to operate on a world stage, we cannot pretend we are not there” [I1]

Overall, there seems to exist three critical issues around the problem of skills shortage. Firstly, there is a noticeable decline of in the supply of university graduates. As one respondent put it:

“UCT as an example and for us at UCT a very important indicator of this is – you know, I look at IS and computer science honours – a third year group in honours 10 to 15 years ago was a class of 100 to 200 people, it was 150 plus, and now it is very small, hopefully you can get only 30..... that is frightening” [I1]

Secondly, there is an increasing appetite for senior experienced people. This is due to the nature of the complexity of the projects currently undertaken, as well as a growing fear of spending money to train junior, inexperienced people and then losing them to rival companies in the industry:

"where we currently are we are battling to take junior resources(graduates) because they just don't have the ability to help. It actually takes more of my resources to have a junior guy brought on board than just doing things without him....our environment is not an easy environment to work in and it takes a long time to get a new (junior) developer to become productive...we are of course working to simplify that because it is a very complex environment" [I12]

“So in this market ...it is more difficult to bring junior consultants into...We will have a few junior consultants but the major demand is going to be for the more seniors” [I9]

" we are paying a lot of money to keep people...we don't have a good experience with growing peopleI can give you ten names of people that we grew and put a lot of attention and then another company comes and doubles the salary" [I12]

Thirdly, as more and more companies (specifically retailers) embark in huge ERP implementation project and Microsoft Ecosystems continue to grow in popularity amongst both solution providers, companies are now faced with a growing shortage of Java developers as well as SAP qualified employees.

"I am currently looking for a junior Java developer for 20K a month and I can't find one....I am battling with Java skills, really battling" [I12]

"Difficulty to find quality guys (Java developers) and if you find them they are very expensive" [I11]

"What we expect from IT and specifically IT skills, we are looking for people who can use tools like the Microsoft platform who can use SAP in the most creative way in order to address our organisation's business requirements" [I7]

That said, companies are now starting to realise that the only way out of the skills shortage problem is to invest in internship and employee development programmes both internally as well as through partnership with universities.

"we have got a university graduate internship programme and we are getting two interns now...one developer one BA...we have started this this month and we have quite an attractive offer salarywise and we are giving them ipads...we have got the whole training programme...we are spending a lot of money and we are hoping that it will motivate and keep them on" [I12]

"Now, we cannot always afford them which then brings me on to my next point which is, we have actively grown within our organisation through internships and things like that, we have grown the SAP competency" [I7]

Moreover, according to all service providers interviewed there is a growing need of what can be termed as an analyst-developer skill. IT leaders in the region seem to believe that an analyst developer is crucial to demand generation and identifying future business and new opportunities. This is a strategic point considering that South African businesses are not winning the race with expanding into Africa because they have not been competitive and innovative enough. Alternatively, do we have the correct ability among those stimulating demand and/or do the conditions in business allow for these ideas to emerge:

..."From a session where we reviewed what we did, we are looking at our core competencies to go forward. And what has been highlighted as our core competencies that we cannot do without is the analyst developer that understands the business and is able to produce code. So in our world that is a very, very powerful person " [I4]

Theme 4: Technology Platforms

From the interviews it became clear that all service providers have development ecosystems on either Microsoft .Net or Java (or both) platforms. The choice of focus seems to be based on the nature of project and customer demands. As put by one of the solution providers:

“...Java is very large in financial services, it is not that large elsewhere. Your medium-sized organisations tend not to choose – your small to medium organisations tend not to adopt a Java platform and once they become bigger they have got so much entrenched in the Microsoft stack that it becomes quite difficult for them to move to a Java type environment. It is a big C change. There needs to be a massively compelling reason...” [I1]

Another one also highlighted the dominance of the two platforms in the region:

“We then saw an opportunity to actually get that Dot Net competency and that has grown phenomenally so that you are on the back of us having quite a bit of Java work in a certain technology sack, where we now find that our Dot Net, we have been able to sell into our same set of clients because they have both needs. So we are predominantly Java and Dot Net” [I4]

The sustainable way forward according to those who run both platforms would be to make people comfortable to span both platforms. This is the human resource strategy they are pursuing.

Other common platforms mostly supported by in-house solution providers include the typical ERPs (predominantly SAP) as well as legacy systems (two of the service providers also supported COBOL applications):

“So our IT strategy, and I do generalise a bit when I make these statements, is really around, how we use perhaps existing technologies most effectively in order to run an organisation of this size. So it has come down to if I speak specifically to technologies it’s SAP/ERP architecture and a Microsoft platform on which we used to address the organisation’s standard requirements to a large extent” [I7]

“So we are running NAV ERP with Wise Fish with it, then as our BI tool we are running Click View which basically is not cubes, they call it something else but anyway. Sitting on top of this system and extracting information..” [I3]

Few respondents mentioned that they still maintain their legacy systems:

"we have at the one end of the spectrum 4th generation language called power house now being bought by IBM, but some of our key piece engines are in COBOL" [I11]

"I have a mainframe which has an assembler and then there is COBOL and then I have a Dot Net world, and now we are creating a Java on UNIX World" [I2]

Theme 5: Performance/Productivity Measure

It seems each company has its own approach. The following are some of the responses provided when interviewees were asked to describe how they measure/track employee productivity as well as performance.

"So we are very output driven. So if everyone is making their target and that kind of thing in terms of the project. The project is on track, the client is happy, blah, blah, blah, a positive outcome that is easy.... And I say to people, look guys, I do not sit with you, I do not code with you. So we have career discussions and we will have objectives" [I6]

"We do not measure our developers on line code developed. We are ...although we are getting a little tighter on those sort of lower level metrics ...so we have brought in SCRUM and we are working on SCRUM velocity, so essentially it is coming down to the quality of code and then the velocity of the team" [I9]

"...maybe you can prove you are efficient but consider the cost of doing all that tracking and measuring. The number of bees versus the number of bee counters you need to have to produce honey, yes you might be very efficient producing honey in that model but you could actually convert ten of those bee counters to bees and produce more honey by having a more lightweight process" [I11]

One in-house service provider claimed they use function-points, but he does not believe this method is accurate. It is done this way because it has always been done this way:

"So I do have a problem with efficiency. But then now you start talking about a number of hours but then nobody is watching that person to make sure he is working every single hour, and then the person when he is not at his desk and he is

at the coffee shop thinking or just chilling for two days trying to work out this thing, is he productive or is he just loafing?” [I2]

In general, respondents reported that performance measurement is complex and not primarily based on time or tracking the number of errors. It seems the respondents are afraid of staff becoming too risk averse or thinking of contribution and productivity as hours spent behind a desk from eight to five. There is genuine appreciation that work environments have to promote creative work. There is recognition amongst all that the nature of software projects does not map to the traditional management metrics and measures, and better approaches need to be found. There is a systemic problem here which causes unreasonable focus on seeing software projects as linear well defined processes. Better approaches to governance are needed if we are to make the measures more realistic to enable ongoing management and improvement.

According to all respondents, a number of traditional principles around business modelling (process and information) need to be resurrected. It appears as if poor design and architecture is resulting from a lack of practising these basics.

Theme 6: Standards, Methodologies and Frameworks

According to all service providers interviewed, 90% of them do not consider adopting CMMI because it adds cost overheads and bureaucracy without providing any explicit advantage. Responses included:

“I think some of the methodologies or certifications and so on end up restricting.....a lot of Indian companies are level 5 certified. Well, that is great but that means that onto every project you are going to put this, this, this and this overhead before we even start” [I1]

“So the devil is in the detail. And it is the lazy way to say you must be CMMI 3 because that means you do not even have to have that conversation. It is like a safety blanket. So government says well, I have got to be level 3 to be able to get the contract/tender. It is like a one size fits all safety blanket kind of thing” [I6]

One in-house service provider who is currently working within the CMMI framework has had mixed feelings about the value of the framework. On one side he claims to see some

value in adopting a framework such as CMMI. One being the fact that the framework is highly endorsed by the government which happens to be his biggest customer:

"In my personal opinion CMMI can be tremendously effective, and I am not just talking that is what I believe, in balancing agile, in making sure that where agile could be done very loosely CMMI could provide that rigour and control and that assuredness, it is a way to bring a stamp of quality, but CMMI done wrongly could kill a business...I think it is very difficult to put CMMI in if people don't see the return in it and I think at CMMI level two it is very difficult to see the return, most people will see just processes. CMMI appealed to us because it speaks as a stamp of qualification ...It also helps the fact that the government believes in it because the largest percentage of our business is government" [I11]

However, the respondent went on and highlighted his frustration with the framework:

"from my perspective right now we are grappling with taking the next step, we've got a process that we are following and that we have passed CMMI with, but the quality is not there....how do we improve that?" [I11]

Almost all service providers claim to have competitive advantage embedded in their delivery processes and the blind adoption of a process framework will erode their competitive advantage. This correlates with perspectives published in respected international journals (Hansen, Rose, & Tjørnehøj, 2004; Mathiassen, Ngwenyama, & Aaen, 2005; Ngwenyama & Nielsen, 2003) as summarised by Conradi and Fuggetta (2002, p. 8) "In our opinion existing SPI frameworks are unable to address the critical challenges of a software development company causing this lack of interest, commitment and goal-oriented success"

A SWOT Analysis of the South African Software Industry

As part of the analysis of empirical data, an attempt was made to do a mapping of the key strengths, weaknesses, opportunities and threats (SWOT) according to responses obtained from the interviews as well as literature review.

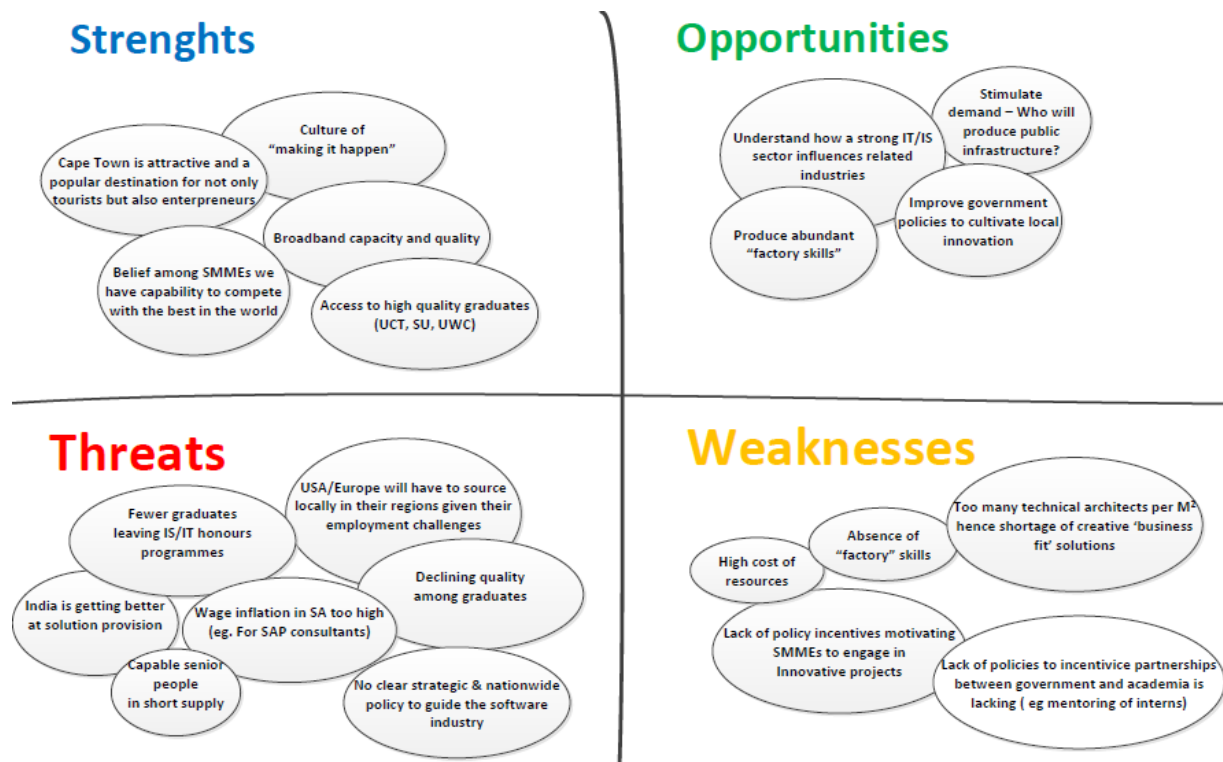


Figure 4: A mapping of key strengths, weaknesses, opportunities, as well as threats as highlighted by respondents

Strengths

The Western Cape (specifically Cape Town) as a region is attractive to people who are keen to move from different parts of the world and come settle and start or run a business here. A number of respondents have done so. According to our respondents who do businesses beyond Western Cape Province, the bandwidth at Cape Town is much better compared to other provinces (as well as other African countries). For businesses with global customer-base and SaaS or cloud based business model, reliable bandwidth is a key factor. There is also genuine belief among the SMMEs in the region that they can deliver any project irrespective of size and complexity. The cultural trait of ‘making a plan’ among South Africans is seen as a strategic advantage that needs to be leveraged. According to respondents, South Africans are mostly motivated with a spirit to prove a point that they are just as good as Europe and America and that pushes them to go an extra mile to making sure things work, hence the term ‘make a plan’. Lastly there is the access to the best of breeds. Western Cape host three of the ten best universities in the entire continents. Businesses operating in the region have an advantage of being able to build relationship with these universities and hence an opportunity to recruit (head hunt) the best students.

Weaknesses

At a national level, the most acknowledged weakness is the lack of a clear and well informed national policy, strategy or vision that recognises software industry as a key sector for business, as well as economic enablement[according to literature review]. At company level, there is the lack of policy incentives to mentor and take on interns to train them to become proficient. Companies are worried about investing resources on an intern or recent graduates only to see them being poached by other companies. This has resulted into companies only hiring experienced employees from competitors or other businesses, by offering them a better package, which has ended up increasing the cost of resources in the industry. There seem to be a need for the government to act as a mediator by setting up policies and programmes that will incentivise businesses to invest on interns and graduates. An in depth analysis of these issues reveals systemic relationship between the issues of high cost of resources, absence of enough factory skills (e.g. developers), lack of appropriate government policy and monetary incentives for companies to take on interns and an over-emphasis on technical architecture (see the causal model on p. 54).

Threats

The foreseeable threats to the software services industry identified by the respondents are as follows: Firstly, competitors are more likely to come from the USA and Europe given that they have to have programs to create employment much like we have to do. Secondly, the Indians are getting better at solutions provision and are immersing themselves in understanding the South African culture. Thirdly, there is a declining number and quality of graduates (countrywide), while simultaneously the ICT industry in general is experiencing a short supply of executives able to lead in this industry and who are able to think holistically and creatively about enabling businesses and industries with IS/IT solutions. Perhaps the biggest threat, which was also identified as a weakness, is not being able to align the software sector behind a nationwide strategy and policy direction.

Opportunities

One clear opportunity is seen in the potential the IT/IS industry in general has in terms of enabling other industries as well as pursuing innovative projects that will potentially stimulate the country's economy, and help tackle the challenges of unemployment as well as inequality. The recently recorded economic growth rate of African countries is also seen as

potential as it will create software demand that can easily be met by South African companies which have the advantage of geographical and in some case cultural proximity.

A Systemic View of the Industry

Having argued for the need to apply systemic thinking in addressing complexities such as the ones peculiar to emerging software industries, this study has made use of a causal loop model in an attempt to provide an integrative synthesis of the empirical findings and literature review.

Causal Loop Model

Causal loop models are useful in presenting the systemic nature of social phenomena (social systems), including their interaction with subsystems. Causal loops are increasingly becoming popular tools for modelling complex problems (Senge, 2006). Originating from the field of Systems Dynamics, the usefulness of causal loop models stems from the ability to effectively model hypotheses on the dynamism that exists within the various agents implicated in a phenomenon by making use of feedback loops (Sterman, 2000). Causal loop models are increasingly becoming the tool of choice in exploratory researches that explore policies and strategy formulation and/or evaluation across fields such as Information Systems (Campbell, Kay, & Avison, 2005; Fowler, 2003; Ghaffarzadegan, Lyneis, & Richardson, 2011; Homer & Hirsch, 2006; Senge, 2006; Warren, 2004).

To be able to read and make sense of the model used in this study, it is important for one to take notice of a number of basic instructions. Arrows indicate the direction of causality. Signs (+ or -) at the arrowheads indicate the polarity of relationships; a + denotes that an increase in the independent variable causes the dependent variable to increase, *ceteris paribus* (and a decrease causes a decrease). Similarly, - indicates that an increase in the independent variable causes the dependent variable to decrease (Ghaffarzadegan et al., 2011). The sign —||— implies a delay, when the effect of one variable on another takes time. The loop identifier (R1) indicates a reinforcing feedback loop, meaning that any action falling within this loop (sequence of actions), has a snowballing/amplifying effect. Reinforcing feedback loops are engines of growth. An important thing to take note of is that in systems thinking as presented by causal diagrams, every influence is both a cause and an effect. “Nothing is ever influenced in one direction” (Senge, 2006, p. 75).

Discussion on the Model

As highlighted in the literature review, the study seems to have identified the government as the most influential stakeholder. There is a strong call for the government through its various organs, to take initiative in setting the pace towards building a strong software sector. The empirical data as well as a review of government policies and strategic plans reveals a serious lack of attention directed towards the software industry, despite the fact that its role in business enablement and service delivery and the overall economic impacts are well documented. Any meaningful attempt to build a strong software industry will have to start with government taking initiative to do a review of the industry involving all key stakeholders such as business leaders (consumers of software), software companies (suppliers), teaching and research institution, NGOs as well as all relevant government departments. The review will not only be essential in formulating policies and strategies that will benefit all stakeholders, but most important it will provide an avenue to create partnerships necessary to make sure that all sector developments projects are strategically working towards a common vision.

The government can also play a critical role in mediating businesses and academic institutions in an effort to address the well recognised issue of skills misalignment (skills shortage in certain fields, while there is an oversupply of skills in other fields). This can be achieved by directing the necessary resources (mostly financial) to fund projects that promote partnership between businesses and academia. Such a partnership is essential if universities are to produce the necessary skills, in both quality and quantity, a crucial pillar for a strong software sector.

Currently, the industry is crippled by a serious shortage of the necessary skills such as software developers, business analysts as well as other special skills that are currently in grave demand. Availability of such skills locally will offset the current trend of offshoring expertise which has proven to be unreliable, costly and a big hindrance to a sustainable growth of the software industry.

In an attempt to 'fit in', South Africa has always been forthcoming when it comes to adopting what is mostly referred to as best practices. Such practices are normally resource intense and require the importation of expertise at high cost to help in training and implementation. The empirical study has revealed a growing frustration in terms of the ability of businesses to effectively adopt such practices and still remain competitive. As indicated on the model, a

Research Contribution

This study was an exploratory project, aimed at gathering an initial understanding of the emerging software industry in the Western Cape region. The research was motivated by two circumstances: Firstly, is the increasingly potential of a software industry given the economic stage that the country is currently at, and secondly, the lack of a reliable published work explaining or exploring the various issues implicated in the industry.

To understand the contribution of this study it is important to first revisit the description of an exploratory research as put forward by Bhattacharjee (2012, p. 10):

“Exploratory research is often conducted in new areas of inquiry, where the goals of the research are: (1) to scope out the magnitude or extent of a particular phenomenon, problem, or behavior, (2) to generate some initial ideas (or “hunches”) about that phenomenon, or (3) to test the feasibility of undertaking a more extensive study regarding that phenomenon”.

This study has achieved all three goals. The study has managed to research the largely unexplored area of the software industry in Western Cape region and South Africa at large, and unearthed what can be considered as key issues or key areas of focus. These areas were then analysed with insights gathered from experiences published in researches conducted in other countries in an attempt to generate initial ideas on how the phenomenon (software industry) can be approached if it were to play its role. Finally, as part of the discussion on the study's limitations as well as recommendations, a proposal was put forward on how future researches are necessary if the area of software industry is to be well understood and strategically addressed.

Furthermore, publications produced as a result of this research have contributed to the field of Information Systems in terms of how it can play a role in facilitating regional business enablement and competitiveness (Sewchurran, Mwalemba, de la Harpe, & McKinnell, 2012). A contribution has also been made by presenting findings as well as recommendations of this research, in a form of a research report, to the provincial government for actions.

Chapter Five: Conclusion

This research focused on understanding the systemic issues affecting the growth of the local software industry in order to drive business and government enablement for greater competitiveness and job creation. The need for such an understanding has emerged from the recognition of the role an ICT industry and specifically the software sector can play in enabling the growth of an emerging economy. More specifically, the study aimed at fulfilling three objectives: a) Identify the major pressure points in the software industry; b) Explore the broad parameters of the identified pressure points, their interactions and impact to the overall industry; c) Formulate a systemic view of how these pressure points interact dynamically in the region.

This chapter will conclude the research report by summarising all key findings linking them to specific as well as a broader research objectives highlighted. Thereafter, recommendations will be put forward, informing both researchers as well as practitioners in terms of possible steps going forward if the software industry is to play a role in enabling and advancing businesses, government and the society at large.

Summary of Research Findings and Conclusions

It is well documented that the domestic use of software is the most important driver of software industry growth, especially in emerging economies. This study has confirmed such sentiment. The private sector is expected to stimulate the industry by generating demand for software products and services, as well as the development of such software. The government on the other hand, has a much bigger role to play. Not only it has the capacity to formulate policies and regulations that will orientate and steer the industry towards growth, by playing its role effectively the government will also create demand by virtue of information system that are necessary for the running of government's day-to-day operations as well as deliver basic services to the society.

The skills need will always be a function of contemporary technologies in use, available regimes of training and certification, commissioned projects, skills available and desirable skilled roles. Consequently, we can assume that within the South African IT industry, skill requirement will be a function of available technologies or the technologies South Africa is planning to adopt. The notion that labour demands can be influenced by two factors namely,

changes in production methods and changes in the structure of the economy, is confirmed by the findings of this study.

Moreover, it seems that off-shoring will continue and grow because South African universities are just not delivering enough skilled resources to bring down the price points for developers and consultants with special skills (e.g. ERP configuration and implementation). At the moment, local training needs are driven by global technology fashions. South Africa cannot sustainably compete in the global software production space by trying to produce more skills than India. There is a need for another strategy to keep a foot-hold in this space.

South Africa can focus on the skills which are more difficult to mass-produce such as analyst developers, graduate level software development skills in Dot Net and Java, as well as graduate-level business analysts who have skills in BI, SAP and sharepoint. The aforementioned skills can be focussed on developing people who are able to span a number of roles or who can be resilient in a number of contexts. The demand for these aforementioned skills is latent among South African businesses because there is a growing realisation that they need skilled business analysts and analyst developers to play a role in imagining solutions, specifying them and working alongside development teams from India. This is due to realisation that Indian resources do not want to veer too far away from the technology, and the business context is not something they can easily learn and if they do, an intimate grasp of local challenges will be a serious shortfall.

If nothing is done about skills, South African companies risk not being able to find talented resources and they may then have no option but to rely solely on resources from India. If this scenario materialises, there is strong likelihood South African businesses would not grow their competitiveness with software development and IT at large, as the solutions are bound to be more technology-focused rather than business benefit focused.

Being a sourcing destination for high-end software development skills remains viable as South Africa does have good examples of companies that are competing in international markets. The future of these companies is fragile and depends on South African universities producing more graduate level skills. However, as it stands now, universities are finding it difficult to attract more students to degree programmes in Computer Science or Information Systems because the entry requirements set by faculties are high, whilst at the same time the country is faced by a the shortage of students enrolling(or doing well) in maths and science (hence IT) classes. The response to shortages is therefore fragile and risks being largely un-

coordinated with the implication that the Western Cape region and the country at large could become a net consumer of technologies and skills from abroad.

The role of sector development agencies in improving national competitiveness is well reported in the literature. The observation of the sector development within the IT/IS industry in this study is through the experience of organisations such as the Cape IT Initiative. The study unveiled that sector development is not well resourced and often government departments (in charge of policy formulation and implantation in the ICT space) are not close to the situation on the ground and are not willing to engage with the research findings from higher education institutions. There is a preference for silver bullet strategies rather than seeing the triple challenge of skills, ICT industry competitiveness and business enablement as interrelated. The support for wider dissemination of international frameworks, certifications and training despite the increasing evidence of frustration and immense challenges in adopting them as well as their 'fitness for purpose' given the local context, is one example of a silver bullet strategy being pursued. These projects are well resourced with funds that could have been directed towards cultivating more locally researched and produced techniques that are sensitive to the South African business context and could arguably bring sustainable results. For example, it is widely acknowledged that software development is underpinned by a different logic of operational management and governance and there is a need to define new ideologies to enable IT/IS 'production methods'. Internationally, the number of government-funded Software Process Improvement/Improvising efforts indicates this. The South African government however persists with borrowed frameworks (CMMI and COBIT), which do not enable the new methods of production. This situation points to a lack of understanding, leadership and ownership. Government (such as in the Western Cape) has become preoccupied with clean audits and a tick-box approach to governance, rather than enabling the software sector so that it can eventually develop transversal systems for better service delivery such as patient care.

The extent to which the change in production methods is understood as we move into the digital era is at best poor, and is masked as a struggle between those who made the investments in closed system practices (PMBOK, CMMI etc) or more widely known as those inspired by *Taylorist* ideology and those who search for new alternatives. *Taylorist* ideology is inspired by Frederick Taylors writing on scientific management and this influence is experienced as role separation, heightened visibility and monitoring of work. It suits the manufacturing of discrete products, but does not suit the development of IT/IS artefacts

which are more conceptual and abstract. These artefacts require new production methods (agile, scrum, iterative, lean, TQM, Kanban, design thinking) because they embrace a more trust-based approach which is dependent on human interaction and co-creation of solutions, and which also requires a partnering spirit where the goal is customer value. The practices which enable the new production methods are still emerging and need better coherence and this is only likely to happen if there is better focus on developing new operational management practices and IT leadership. As the knowledge emerges, these will be the new practices for training and education. The success of SPI efforts funded by governments in Nordic countries confirms that ideology does indeed work.

Recommendations

Having presented a summary of key findings, highlighting the systemic issues implicated in the regional as well as the country's emergent software industry, the study recommends a number of actions going forward necessary for the software sector and the ICT industry in general to play its critical role of business enablement which is a backbone for a competitive and sustainable economy. These recommendations are informed by both the empirical data as well as a detailed literature review into the national software industry. The key recommendations are as follows:

1. The government through its relevant departments needs to convene a forum where all software agents will be invited and allowed to openly and lengthily discuss all key issues impacting the industry as well as to set priorities. The outcomes of this forum should thereafter inform a policy that will set a vision for the South African software industry.
2. All existing policies and strategies should be made public and the public, especially researchers, should be encouraged to make use of them so as they can fulfil their role which includes making a critical, informed and well researched contribution to the sector.
3. Centralise the computing orientated faculties in universities to allow for a focused effort to enable business and society better with more and relevant skills and research. UCT has already started discussions to find a way to bring its Computer Science and Information Systems Departments under one unit, be it a faculty, school or college.

4. Start to promote teaching both Java and Dot Net to create more flexibility among graduates and supply the industries two broad thrusts. This should be coupled with a research project to investigate the role of a choice of a particular software development platform in businesses as well as in universities(for teaching), and its long term implication.
5. View certification as a capping process and not as competence development. Competence development can only really take place within a capstone process and/or internships where there is on-the-job practice, mentoring and reflection. There is a need to nurture lifelong learning to ease the future training burden that each new technical innovation on popular development platforms will create.
6. Unite universities behind a unifying strategy to ensure that concerted efforts are not manipulated for narrow ends. The CMMI project is a prime example of how a system can be manipulated for narrow ends.
7. Given the wicked nature of the challenge in this industry, institutional memory and capacity development will always be required and cluster development offers a proven model to allow for this. This should go hand in hand with establishing a Software Productivity Institute to develop institutional ability to focus on the industry enablement through new production methods as a long to medium-term project.
8. The emphasis on process improvement, innovation and productivity must be seen more holistically needing a contextual driven bottom up effort instead of top-down compliance game. Both approaches can and must co-exist at some level, but the focus must be on understanding software processes as business processes at various levels of knowledge funnel.
9. Increase efforts to actively lobby government for more funding support for software skills development as currently done by organisations such as CITI.
10. There is a need for more programmes to train IT leaders and to train business to better understand the emergent nature of software development. Software development is a creative practice and there is a need to recognise this in the development of resources.

11. If we are to generate relevant business and societal value effectively and sustainably through the software industry and ICT at large, there is a need to better understand where the future needs are going to come from and communicate that to our regional IT sector.

12. There is a need for an in-depth, nationwide research that will explore the issues impacting the software industry at a national level, consulting all key stakeholders from the business, academia as well as government.

University of Cape Town

Chapter Six: References

- Arora, A., Arunachalam, V. S., Asundi, J., & Fernandes, R. (2001). The Indian software services industry. *Research policy*, 30(8), 1267-1287.
- Arora, A., & Gambardella, A. (2006). *From underdogs to tigers: the rise and growth of the software industry in Brazil, China, India, Ireland, and Israel*. New York: Oxford University Press.
- Athreye, S. S. (2005). The Indian software industry and its evolving service capability. *Industrial and Corporate Change*, 14(3), 393-418.
- Avgerou, C. (2008). Information systems in developing countries: a critical research review. *Journal of information Technology*, 23(3), 133-146.
- Avgerou, C. (2010). Discourses on ICT and Development. *Information Technologies and International Development*, 6(3), 1-18.
- Bassey, M. (1981). Pedagogic research: On the relative merits of search for generalisation and study of single events. *Oxford Review of Education*, 7(1), 73-94.
- Bell, J. (2005). *Doing Your Research Project*: Open University Press.
- Bhattacharjee, A. (2012). *Social Science Research: principles, methods, and practices*: Open Access Textbook.
- Biggam, J. (2011). *Succeeding with your master's dissertation: a step-by-step handbook*: Open University Press.
- Botelho, A. J. J., Stefanuto, G., & Veloso, F. (2005). The Brazilian software industry. In A. Arora & A. Gambardella (Eds.), *From Underdogs to Tigers: The rise and growth of the software industry in Brazil, China, Ireland and Israel* (pp. 99-130). New York: Oxford University Press.
- Breznitz, D. (2005). The Israeli software industry. *From underdogs to tigers: The rise and growth of the software industry in Brazil, China, India, Ireland, and Israel*, 72-98.
- Calitz, A. (2011). Averting an ICT Crisis 101. Retrieved 11 July, 2011, from <http://mg.co.za/article/2011-07-11-averting-an-ict-crisis-101>
- Campbell, B., Kay, R., & Avison, D. (2005). Strategic alignment: a practitioner's perspective. *Journal of Enterprise Information Management*, 18(6), 653-664.
- Carayannis, E., & Sagi, J. (2001). "New" vs. "old" economy: insights on competitiveness in the global IT industry. *Technovation*, 21(8), 501-514.

- Carmel, E. (2003). The new software exporting nations: success factors. *The Electronic Journal of Information Systems in Developing Countries*, 13.
- Carmel, E. (2003b). The new software exporting nations: Impacts on national well being resulting from their software exporting industries. *Electronic Journal on Information Systems in Developing Countries*, 13(3), 6.
- Cavana, R. Y., Delahaye, B. L., & Sekaran, U. (2001). Applied business research. *Qualitative and Quantitative Methods*.
- Chamberlain, G. P. (2006). Researching strategy formation process: An abductive methodology. *Quality and quantity*, 40(2), 289-301.
- Chaminade, C., & Vang, J. (2008). Globalisation of knowledge production and regional innovation policy: Supporting specialized hubs in the Bangalore software industry. *Research policy*, 37(10), 1684-1696.
- CITi. (2009). History of the Cape IT Initiative (CITi). Retrieved December, 2011, from <http://www.citi.org.za/about-citi.html>
- Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education* (7th ed.). New York: Routledge.
- Commander, S. (2005). *The software industry in emerging markets*: Edward Elgar Pub.
- Conradi, H., & Fuggetta, A. (2002). Improving software process improvement. *Software, IEEE*, 19(4), 92-99.
- Copi, I. M. (1963). *Introduction to logic*: Macmillan.
- Copi, I. M., & Burgess-Jackson, K. (1995). *Informal logic*.
- Creswell, J. W. (2008). *Research design: Qualitative, quantitative, and mixed methods approaches*: SAGE Publications, Incorporated.
- Denzin, N. L., & Lincoln, Y. (1994). *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage Publications.
- DOC. (2012). *Defining a New Era in ICTs for All South Africans: The path to creating a National Integrated ICT Policy for South Africa*. Department of Communication, Republic of South Africa
- Fowler, A. (2003). Systems modelling, simulation, and the dynamics of strategy. *Journal of Business Research*, 56(2), 135-144.
- Gale, D., & McKinnell, J. (2011). The Western Cape IT industry sector intelligence(Economic Indicator) Survey. Cape Town: Cape Information Technology Initiative.

- Geertz, C. (1994). Thick description: Toward an interpretive theory of culture. *Readings in the philosophy of social science*, 213-231.
- Ghaffarzadegan, N., Lyneis, J., & Richardson, G. P. (2011). How small system dynamics models can help the public policy process. *System Dynamics Review*, 27(1), 22-44.
- Grummitt, J. (1980). *Guide to Interviewing Skills*: Industrial Society Press.
- Hansen, B., Rose, J., & Tjørnehøj, G. (2004). Prescription, description, reflection: the shape of the software process improvement field. *International Journal of Information Management*, 24(6), 457-472.
- Heavin, C., Fitzgerald, B., & Trauth, E. M. (2003). Factors Influencing Ireland's Software Industry *Organizational Information Systems in the Context of Globalization* (pp. 235-252): Springer.
- Heeks, R. (2006). Using competitive advantage theory to analyze IT sectors in developing countries: a software industry case analysis. *Information Technologies and International Development*, 3(3), 5.
- Hilsop, D. (2010). *Rewards and recognition for software development in South Africa: A proposal*. Paper presented at the Proceedings of the 3rd Software Engineering Colloquium SE10, Cape Town.
- Homer, J. B., & Hirsch, G. B. (2006). System dynamics modeling for public health: background and opportunities. *American Journal of Public Health*, 96(3), 452-458.
- IVC Research Centre. (2013). Summary of Israeli High-Tech Company Capital Raising Q1 2013
- IVC and KPMG Report. 2013. <http://www.ynetnews.com/articles/0,7340,L-4376936,00.html>
- Jackson, M., Johnston, N., & Seddon, J. (2007). Evaluating systems thinking in housing. *Journal of the Operational Research Society*, 59(2), 186-197.
- James, T., Esselaar, P., & Miller, J. (2001). Towards a better understanding of the ICT sector in South Africa: problems and opportunities for strengthening the existing knowledge base. *Cape Town: Tina James Consulting and Miller, Esselaar and Associates. Mimeo.*
- Kshetri, N. (2005). Structural shifts in the Chinese software industry. *Software, IEEE*, 22(4), 86-93.
- Levin-Rozalis, M. (2008). Searching for the unknowable: A process of detection—Abductive research generated by projective techniques. *International Journal of Qualitative Methods*, 3(2), 1-18.

- Maani, K. E., & Maharaj, V. (2001). *Systemic Thinking and Complex Problem Solving. A Theory Building Empirical Study*. Paper presented at the Proceedings of the 19 th International Conference of the System Dynamics Society 2001.
- Mathiassen, L., Ngwenyama, O. K., & Aaen, I. (2005). Managing change in software process improvement. *Software, IEEE*, 22(6), 84-91.
- Melina. (2007). *Research Report for preparation of SE07*. Cape Information Technology Initiative. Cape Town.
- Moodley, S. (2003). Cluster Formation in the ICT Sector: The Case of South Africa. *Journal of Information Technology Impact*, 3(3), 111-120.
- Moser, C. A., & Kalton, G. (1971). Survey methods in social investigation. *Survey methods in social investigation*.(2nd Edition).
- Myers, M. D. (1997). Qualitative research in information systems. *Management Information Systems Quarterly*, 21, 241-242.
- Ngwenyama, O., & Nielsen, P. A. (2003). Competing values in software process improvement: an assumption analysis of CMM from an organizational culture perspective. *Engineering Management, IEEE Transactions on*, 50(1), 100-112.
- Nusca, A. (2012). Taking the pulse of Brazil's ICT sector. Retrieved 15 March, 2013, from <http://www.zdnet.com/taking-the-pulse-of-brazils-ict-sector-7000006448/>
- Orlikowski, W. J., & Baroudi, J. J. (1991). Studying information technology in organizations: Research approaches and assumptions. *Information Systems Research*, 2(1), 1-28.
- Parthasarathy, B. (2004). India's Silicon Valley or Silicon Valley's India? Socially embedding the computer software industry in Bangalore. *International Journal of Urban and Regional Research*, 28(3), 664-685.
- Parthasarathy, B. (2010). The computer software industry as a vehicle of late industrialization: lessons from the Indian case. *Journal of the Asia Pacific Economy*, 15(3), 247-270.
- Pule, D. (2011). *Budget Vote Speech*. Ministry of Communication, Republic of South Africa.
- Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers* (Vol. 2): Blackwell Oxford.
- SAITIS. (1999). A Survey of the IT Industry in South Africa. Pretoria: South African Information Technology Industry Strategy project.
- SAITIS. (2000). A Survey of the IT Industry and Related Jobs and Skills in South Africa. Pretoria: South African Information Technology Industry Strategy.

- Sarrazin, H., & Sikes, J. (2013). *Competing in a digital world: Four lessons from the software industry* www.mckinseyquarterly.com, *McKinsey Quarterly* Retrieved from https://www.mckinseyquarterly.com/High_Tech/Software/Competing_in_a_digital_world_Four_lessons_from_the_software_industry_3058
- Schware, R. (1992). Software industry entry strategies for developing countries: a “walking on two legs” proposition. *World Development*, 20(2), 143-164.
- Senge, P. M. (2006). *The fifth discipline: The art & practice of the learning organization*: Crown Business.
- Sewchurran, K., Mwalemba, G., de la Harpe, A., & McKinnell, J. (2012). *Making sense of the IT/IS industry to enable better business enablement and competitiveness: A case-study of the Western Cape in South Africa*. Paper presented at the Software Engineering Colloquium (SE), 2012 4th.
- Singh, S. (2010). The South African ‘Information Society’, 1994–2008: Problems with Policy, Legislation, Rhetoric and Implementation. *Journal of Southern African Studies*, 36(1), 209-227.
- Sterman, J. (2000). *Business dynamics*: Irwin-McGraw-Hill.
- Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research*. 1998. Thousand Oaks: Sage Publications.
- Tessler, S., Barr, A., & Hanna, N. (2003). National software industry development: Considerations for government planners. *EJISDC: The Electronic Journal on Information Systems in Developing Countries*(13), 9.
- Tschang, T., & Xue, L. (2005). The Chinese software industry. *From Underdogs to Tigers*. Oxford University Press, Oxford, UK, 131-167.
- UNCTAD. (2012). *Information Economy Report 2012: The software industry and developing countries*. New York and Geneva: United Nations.
- Warren, K. (2004). Why has feedback systems thinking struggled to influence strategy and policy formulation? Suggestive evidence, explanations and solutions. *Systems Research and Behavioral Science*, 21(4), 331-347.
- Wexler, M. N. (2009). Exploring the moral dimension of wicked problems< sup>*</sup>. *International Journal of Sociology and Social Policy*, 29(9/10), 531-542.
- Wills, A., Pater, D., King, I., Booii, M., & Netshisaulu, K. (2005). *South African Software Market 2005: Market Overview and Value Proposition Analysis*. Pretoria: Saré Grobler

Yin, R. K. (2002). *Case study research: Design and methods* (3rd ed. Vol. 5). Thousand Oaks, CA: SAGE Publications.

Zokaei, Z., Elias, S., O'Donovan, B., Samuel, D., Evans, B., & Goodfellow, J. (2010). Lean and systems thinking in the public sector in wales. *Lean Enterprise Research Centre report for the Wales Audit Office, Cardiff University*.

University of Cape Town

Appendices

Appendix A: Research Questions

Characterisation / Size of IT capability

1. Size of IT/IS budget. How does this get formulated?

Probe for and Add:

2. *IT spend breakdowns - % budget spent on major IT expenditure: Infrastructure? Projects? Software Development spend?*

Probe for and Add: (Could be here or under the Sourcing Patterns, Section).

3. *What percentage of IT budget is outsourced?*
4. *Of the outsourced budget, what percentage is then off-shored and to which locations?*
5. *Which components of the SDLC are outsourced?*
6. *Which components of the SDLC that are outsourced, are off-shored?*

7. Number of concurrent projects/programmes.

Probe for and Add:

8. *As a way to gauge the efficiency, also ask "what is the split between IT projects that address Maintenance and Development?"*

Probe for and Add:

9. *What types of projects are being worked on? e.g.: proportion of projects :*
a) *Are related to reducing cost?*
b) *About reducing IT risk?*
c) *About increase revenue (new product development)?*

Probe for and Add:

10. *How many of the projects are:*
a) *Infrastructure projects ?*
b) *Application projects?*

11. *What are the budget splits between Infrastructure and Application projects?*
12. *What percentage of new projects are outsourced versus internally done?*

Probe for and Add:

13. *What technologies are the new projects being developed on?*

14. Number of business cases awaiting consideration and implementation.

Probe for and Add:

15. Average time for decision making around the go-ahead of a project?
16. Ratio of Approved / Declined projects?
17. Reasons for the decline of projects?
18. What is the average cost of projects being declined?

IT Labour Profile, Costs & Skills Needs

19. Gain a deeper understanding of the profile and number of the skills and respective costs : Current situation, Past and Future (future = 12 – 18m)
20. Number of people working in IT/IS roles. Proportions in each professional role. Centres of excellence and points of pain.
21. Resources which are a key constraint in delivering value to customers or growing the value-proposition.
22. Split: resources which are a key local constraint and key (general) constraint?

DEDT Requirement is for a comprehensive analysis combining the:

Type, Nature & Cost of IT personnel within the business

Therefore, critical that this section includes an analysis & presentation of:

23. What languages are employed (percentage of IT staff)? And on which platforms are you developing on?
24. What is the cost to your business on those platforms?
25. Underlying technologies deployed?
26. Price point / IT labour cost (percentage of the business)

Probe for and Add question around **Skills Demand:**

27. Over next 12 – 18 months, what would your skills demands & capabilities be?

IT and the Business

28. Technology Architectural considerations and priorities – data, applications, process, technology.
29. Kinds of priority risks and failures.
For example, in financial services, legislative compliance will be the biggest priority risk. Other risks could include business continuity (business risks), technology risks, etc?
30. Relationship with business: agility, alignment, technology leadership.

Sourcing Patterns:

31. Perceptions of sourcing alternatives in the local environment. Wishes, gripes and possibilities.
32. Thoughts on outsourcing / off-shoring

Probe for and Add:

- | |
|--|
| <ol style="list-style-type: none">33. <i>What % of IT outsourced to local suppliers?</i>34. <i>What components of the SDLC are outsourced to local suppliers?</i> |
|--|

Probe for and Add:

- | |
|---|
| <ol style="list-style-type: none">35. <i>What has been the historical motivation & experience around off-shoring?</i>36. <i>Has it worked? Has it not worked?</i>37. <i>If not worked, what would be the key factors affecting failure (success) of the off-shored project?</i> |
|---|

IT Productivity (Cost reduction)

38. *Operational management ideology and improvement philosophy.*
39. *Perceptions on the value of ITIL, CMMI, COBIT – where does the pressure to adopt come from – risk, opportunities, perceived benefits, audit reports etc.*
40. *How (thoughts on) is efficiency / productivity / cost measured and tracked : Ideals, KPIs and Problems in frequency and data to measure KPIs*
41. *In terms of KPIs for software productivity, what productivity measures are being employed, functional points? Defects per Line of Code (KLOC)?*

Probe for and Add:

- | |
|--|
| <ol style="list-style-type: none">42. <i>What type of government assistance would be required? (respondents could possibly indicate need for a software institute? Need for a graduate qualification on adopting & implementing Lean methodologies in IT? Etc)</i> |
|--|

- | |
|---|
| <ol style="list-style-type: none">43. <i>Specifically probe / ask for Cobol – is there appetite or any assistance required for Cobol, given that in both Financial Services and Retail, 75% are still employing Cobol?)</i> |
|---|

Trends

44. *Areas of immense opportunity on the horizon and major fads to stay clear off for the future.*
45. *Identify trends \ hypes : Technology (cloud etc.), Budget, Productivity and Process*
46. *Thoughts on the value and relevance of domain knowledge requirements*
Industry frameworks
As-is business activities

University of Cape Town