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A Systemic View of South Africa's Software Industry

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Abstract
Computer software are increasingly becoming an integral part of how businesses and society at large can innovatively use technology to increase efficiency, set up new business models as well as improve their overall productivity. Developing countries are also realising the potential impact of a successful software industry on structural transformation, education, innovation, service delivery, job creation and export revenue. While these positive impacts of a successful software industry have been well documented, there is also evidence that failure to establish the right policies can severely hinder prospects of a country in realising the benefits. The paper makes use of system thinking techniques to explore the systemic issues implicated in the South Africa's software industry and advocates for the government to take an active role in spearheading an industry that can have a sustainable and meaningful impact to businesses and the society at large. This requires the government to carefully and strategically mediate the efforts and interests of stakeholders in private sector as well as academia.

Keywords
Software Industry, Systems Thinking, Causal Loop, Abduction, South Africa

1. Introduction
The function versatility of Information and Communication Technologies (ICTs) is 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". This is to say computer software forms an integral part of the third industrial revolution, and this has positioned the software industry as one of most influential industries and, subsequently, the fastest growing globally.

While developed countries have always lead the way when it comes to production and supply of various technologies, software included, 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 with India being the most prominent, followed by countries such as Brazil and China (Carmel, 2003b; Commander, 2005). This growth in the software industry has been partly attributed to strong cost

advantages favouring developing nations, as well as the relatively low physical capital requirements, including access to relatively cheap skilled labour (Commander, 2005).

The positive impacts of a successful software industry to the overall economy of a developing country are well documented. However, there is also evidence that this is often achieved when there is a good understanding of the unique social and contextual issues implicated (Avgerou, 2008; Parthasarathy,2004; Tessler, Barr, & Hanna, 2003). Avgerou (2008) goes even further and warns of potential trade-offs that exist between efforts to foster a particular (unfit) model of software industry and promoting innovation within the local industry.

Building on previous studies, such as Mwalemba, Sewchurran, & Ajumobi (2015), Sewchurran, Mwalemba, de la Harpe, & McKinnell (2012) and (Hilsop, 2010) that focused on issues faced by the South African software industry, this study presents an attempt to systemically fuse the issues and present a regional perspective highlighting the dynamism that captures key interactions within the industry. We argue that an understanding of the systemic relationships amongst issues implicated within the local industry is important if one is to set strategies that incorporate collective efforts from all stakeholders in building a more sustainable and competitive national software industry.

2. Background on Software Industry in Emerging Markets

In spite of a common engagement in software development, the software industries of countries categorised as emerging markets remain very heterogeneous in their characteristics. For instance, while India's, software industries has 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; Joseph, 2014).

Emerging markets have also explored different niches within the software industry. For example, with both countries focusing mainly on 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, etc.) 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, concentrate more on providing software services (compared to producing software products).

A literature review of software industries in emerging markets strongly suggests that a national strategy based on consultation with all relevant stakeholders is a useful starting point (Commander, 2005; Parthasarathy, 2010; Tessler, Barr, & Hanna, 2003; UNCTAD, 2012). Among other things, the strategy should focus on capacity development to enable and nurture local capabilities such as skills development. Such capabilities are crucial to development and the enablement of a strong and competent software industry. As pointed by Carayannis and Sagi (2001), to be competitive in today's 'new economy' of the global e-marketplace, an Information Technology (IT) organisation cannot go at it alone. A successful company must compete within a proactive industry that has 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 (Carayannis & Sagi, 2001).

Literature also strongly points to the need for governments to take an active role in fostering software capabilities, taking the needs of both the public as well as the 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".

3. South Africa's Software Industry

Literature on South Africa's software industry points to several issues. Firstly, is the aspect of market orientation. A wide variety of software solutions are being developed in the country, from back-end business support systems to web-based front-end systems. Contrary to countries such as India and Malaysia, South Africa's software industry seem to focus more on serving domestic market as well as the African market which represents more than three quarter of all exports (Gale & McKinnell, 2011; Wills, Pater, King, Booi, & Netshisaulu, 2005). Similar market orientation pattern is observed in China and Brazil (UNCTAD, 2012).

Shortage of the necessary skills such as software developers, business analysts, UX designers, testers, just to name a few, which are needed to support the software industry is another key challenge facing the industry (Calitz, Greyling, & Cullen, 2014; Gale & McKinnell, 2011). A closer look at the issue of scarcity of relevant skills reveals a slightly more complex issue of lack of alignment of strategies between government, who are the policy makers, Higher learning institutions who are in charge of producing relevant skills, and private sector or businesses, who are the biggest consumer of these skills for the purpose of growing and sustaining the economy. For instance, as the ICT sector is faced with shortage of skills, the country in general is faced with significant levels of unemployment (Melina, 2007; Sewchurran et al., 2012). In addition to the shortage of skills, there are also concerns with regard to the quality of graduates produced by higher learning institutions in terms of their ability to attain productivity once placed in projects. There seems to be a mismatch between skills (both soft and technical skills) deemed as crucial by industry and skills developed through various IT programs offered by training institutions within the country (Calitz et al., 2014).

The next challenge is the uncritical reliance on international frameworks and methodologies such as CMMI and COBIT which are seen as a shortest path to achieving credibility. For instance, in the year 2006 the government in partnership with Johannesburg Centre for Software Engineering (JCSE) made a decision to invest on an initiative to set up a CMMI training centre (Dwolatzky, 2008). This was followed by an effort to encourage as many government IT agencies as well as companies doing business with the government to adopt CMMI framework. However, research points to increasing frustration amongst business owners as they struggle to adhere to prescribed frameworks while at the same time pursue innovation that will make them unique and competitive (Sewchurran et al., 2012; (Utulu, Sewchurran, & Dwolatzky, 2013).

The last issue is that of government lack of a government led national strategy on advancing the software industry. While it's clear that the government realizes the importance of the ICT sector in the economy, so far the emphasis is only placed on setting up the infrastructure to allow the public to access various electronic services such as e-government e-health and e-banking

(Moodley, 2003; Mwalemba et al., 2015; UNCTAD, 2012). As far as government policies and strategies are concerned, software development is still not seen as a key aspect within the broader ICT industry. Despite the government setting up structures and funds to oversee and support various ICT initiatives, there is still lack of a coherent and well-coordinated policy that guides and aligns efforts by key stakeholders such as the private sector as well as learning institutions (Hilsop, 2010; Sewchurran et al., 2012).

Based on these observations, there is little doubt that the South African software industry needs a viable industry orientation which will enable companies within it to set innovation, production and market objectives that will enable their performances and allow them to compete favourably with companies operating in other countries. Such an orientation may be geared towards driving business designs, objectives setting and strategic planning in the South African software industry.

4. The Need for Systemic View of the Industry

It has been established that South Africa is faced with a challenge of lack of an effective strategy to drive and co-ordinate the efforts of various stakeholders implicated within the software industry (Mwalemba et al., 2015; Sewchurran et al., 2012). This has led to the software industry not being able to play its key roles as observed in other emerging markets. The challenge marks the difference between the current pre-industrial economy (or mode of production) and the post-industrial mode of production which is seen as the necessary and logical step if the country is to play a significant role in the global economy while taking advantage of increasing opportunities emerging from 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 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 software industry are a result of the inability to grasp and manage the increasingly wickedness, complexity and interconnectedness of the problems facing the country's 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) (Dunne & Martin, 2006; Senge, 2006). 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 making 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 the 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 the systems thinking discipline) goes further in attributing much of today's world challenges to policymaking that is trapped into setting up interventions that focus on obvious symptoms and not on 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, systems thinking has successfully informed management strategy and policy formulation both in the public and private sectors, especially when it comes to dealing with complex problems (Jackson, Johnston, & Seddon, 2007; Maani & Maharaj, 2001; Senge, 2006; Zokaei et al., 2010).

Therefore, if South Africa wants a different outcome from its software industry, it has to understand and 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.

5. Abductive Reasoning and Causal Loop Model

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 combination of abductive reasoning and causal loop diagram in an attempt to provide an integrative synthesis of the issues raised in the literature.

The researcher made use of abductive technique to identify and seek relationships (associations & causations) between what could be considered as the key issues implicated in the industry. Abduction reasoning, commonly used in design thinking, is a technique used to engage problematic phenomenon by proposing ideas based on observation and inference to best explanation (Leavy, 2010). It is seen as a middle ground between analytical reasoning and intuitive thinking, and aims at generating new ideas that can be further explored as or used as potential solution (Martin, 2010). 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 Pierce (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."

On the other hand, causal loop models are useful in presenting the systemic nature of social phenomena (social systems), including their interaction with subsystems. Causal loops are becoming increasingly popular tools for modelling complex problems (Senge, 2006). Originating from the field of Systems Dynamics, the usefulness of causal loop models stems from their ability to effectively model hypotheses based 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).

The literature review has raised a number of issues that currently face South Africa's software industry. These include shortage of local skills, reliance of international practices and modes of production and the lack of an effective national strategy to guide the industry. This has resulted to the software industry failing to effectively play its role of stimulating innovation that is necessary for the industry to grow and support businesses, government and the overall economy. Using a combination of a system thinking and causal loop diagram we are proposing a model that summarises and captures potential causal relationships that exists between the key issues raised.

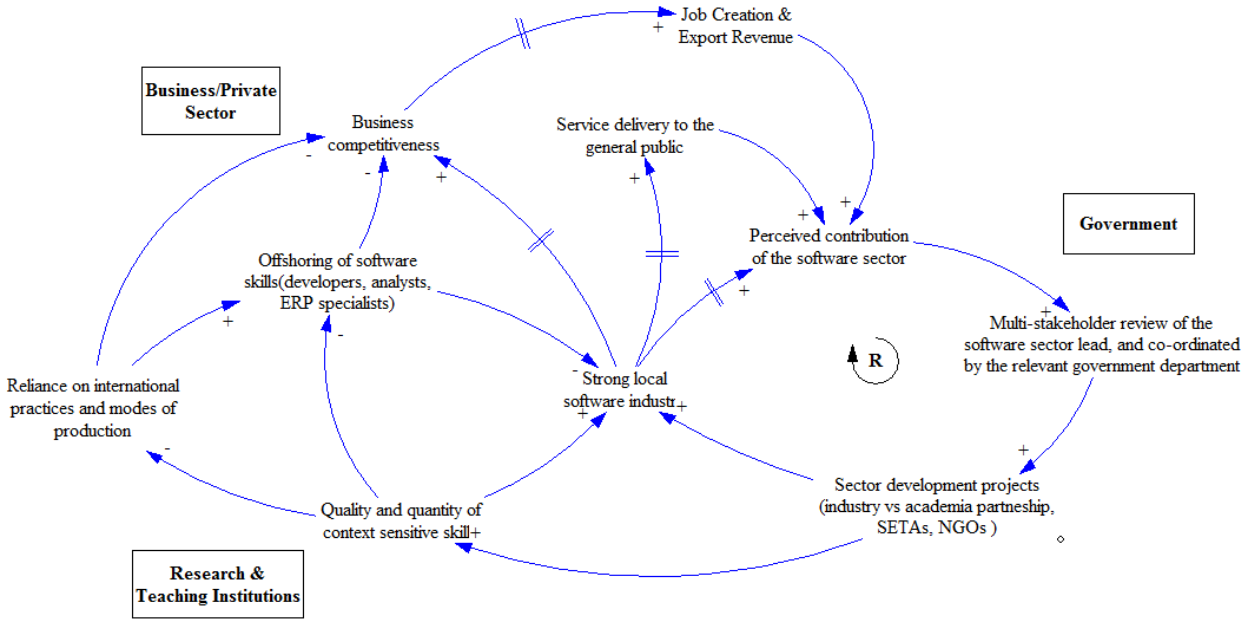

Figure 1: A causal loop model highlighting the dynamism amongst factors impacting South Africa's software industry

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; + 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).

6. Discussion on the Model

As highlighted in earlier sections, literature points to national government as the most influential stakeholder. There is a strong call for the government, through its various organs, to take the initiative in setting the pace towards building a strong software industry. Literature 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, service delivery and overall economic impact is well documented. Any meaningful attempt to build a strong software industry will have to start with government taking the 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 institutions, 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 importantly, it will provide an avenue to create partnerships necessary to ensure that all sector development 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 with an oversupply of skills in other fields). This can be achieved by directing the necessary resources (mostly financial) to fund projects that promote partnerships 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 industry.

Currently, the industry is crippled by a serious shortage of necessary skills, such as software developers, business analysts and other special skills currently in great 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 intensive and require the importation of expertise at high cost in order to help in training and implementation. Literature points to a growing frustration in terms of the ability of businesses to effectively adopt such practices and still remain competitive. As indicated in the model, partnerships between

businesses and research institutions, operating under a common vision informed by a review with all stakeholders, can help in formulating practices that are context sensitive. The resources that are currently directed at fostering international practices can be redirected towards research, training and the implementation of practices which are consistent with the strengths, challenges, and priorities of the local industry and the country at large. Such practices are more likely, in time, to be not only sustainable, but also crucial in building a strong local software industry that can lead to business enablement, job creation and increase in export revenue as an outcome of increased business competitiveness.

7. Conclusion & Recommendations

This research focused on exploring systemic issues affecting the growth of a software industry of an emerging economy 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, as pointed out in literature review, of the role an ICT and, specifically, the software industry can play in enabling the growth of an emerging economy. There is already a strong desire, predominantly from the private sector, to address existing challenges and grow the industry to develop competencies that will enable them to competitively service both local as well as international markets.

This study has challenged the current approach of looking at different issues implicated in (influencing and influenced by) the industry as separate and addressing them independently, with limited interaction between the three major stakeholders, namely: government, research and teaching institutions, and the private sector. Instead, a more systemic view of the industry has been recommended and presented. The suggested view, which focuses on the whole instead of the parts, takes into account the interaction (associations & causations) between the various issues raised by key players, with government taking the lead. Going forward, this study makes the following recommendations: Firstly, the government, through its relevant departments, needs to convene a forum where all stakeholders will be invited and allowed to openly discuss all the key issues impacting the software industry as well as set priorities. The outcomes of this forum should, thereafter, inform a policy that will set a vision for the South African software industry. Secondly, all existing policies and strategies should be made public and the public, especially researchers, should be encouraged to make use of them so they can fulfil their role which includes making a critical, informed and well researched contribution to the industry. Thirdly, there is a need to centralise the computing orientated faculties and departments in universities to allow for a focused effort to better enable business and society with more and relevant graduate skills and research output. Lastly, there is a need for in-depth, nationwide research that will explore the issues impacting the software industry at a national level, consulting all key stakeholders from business, academia and government.

References

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.

Avgerou, C. (2008). Information systems in developing countries: a critical research review. *Journal of information Technology, 23*(3), 133-146.

Dwolatzky, B. (2008). CMMI making inroads in South Africa. Retrieved from http://www.ee.co.za/article/cmmi-making-inroads-in-south-africa.html

Calitz, A. P., Greyling, J. H., & Cullen, M. D. M. (2014). South African Industry ICT Graduate Skills Requirements. In *Southern African Computer Lecturers' Association (SACLA)* (pp. 25–26). Port Elizabeth.

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. (2003b). The new software exporting nations: Impacts on national wellbeing resulting from their software exporting industries. *Electronic Journal on Information Systems in Developing Countries, 13*(3), 6.

Chamberlain, G. P. (2006). Researching strategy formation process: An abductive methodology. *Quality and quantity, 40*(2), 289-301.

Commander, S. (2005). *The software industry in emerging markets*: Edward Elgar Pub.

Dunne, D., & Martin, R. (2006). Design thinking and how it will change management education: An interview and discussion. *Academy of Management Learning and Education*, *5*(4), 512–523.

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.

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.

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.

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.

Jackson, M., Johnston, N., & Seddon, J. (2007). Evaluating systems thinking in housing. *Journal of the Operational Research Society, 59*(2), 186-197.

Joseph, K. J. (2014). India's Software Industry in Transition: Lessons for Other Developing Countries and Implications for South-South Cooperation. *Productivity, 54*(4), 329 -341.

Leavy, B. (2010), Design thinking - a new mental model of value innovation. *Strategy & Leadership,* 38 *(3),* 5 - 14.

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 19th International Conference of the System Dynamics Society 2001.

Martin, R. (2010). Design thinking: Achieving insights via the "knowledge funnel. *Strategy & Leadership,* 38(2), 37 - 41.

Melina. (2007). *Research Report for preparation of SE07*. Cape Information Technology Initiative. Cape Town.

Mwalemba, G., Sewchurran, K., & Ajumobi, D. O. (2015). Software Industry of an Emerging Economy : A Case of the Western Cape, South Africa. In *Proceeding of the African Conference on information Systems and Technology (ACIST)* (pp. 1–14). Accra.

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.

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.

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.

Sterman, J. (2000). *Business dynamics*: Irwin-McGraw-Hill.

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.

UNCTAD. (2012). Information Economy Report 2012: The software industry and developing countries. New York and Geneva: United Nations.

Utulu, S., Sewchurran, K., & Dwolatzky, B. (2013, July). Systematic and Grounded Theory Literature Reviews of Software Process Improvement Phenomena: Implications for IS Research. In *Proceedings of the Informing Science and Information Technology Education Conference* (Vol. 2013, No. 1, pp. 249-279).

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. *International Journal of Sociology and Social Policy, 29*(9/10), 531-542.

Wills, A., Pater, D., King, I., Booi, M., & Netshisaulu, K. (2005). South African Software Market 2005: Market Overview and Value Proposition Analysis. Pretoria: Saré Grobler.

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*.