

Collaborative Regional Organisational Networks: Cultivating regional knowledge diffusion to become globally competitive

by

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SUMMARY

The thesis takes as its focus collaborative regional organisational networks. It is argued that in knowledge intensive sectors, such collaboration clusters are an important factor for being competitive in a global economy. To substantiate this claim, both a regional case study of the KwaZulu-Natal Information and Communications and Electronics Technology (ICTE) cluster forum is undertaken and a single firm case of MicroVision Software, a member of the cluster forum.

The introductory chapter provides background about the global extent of collaborative activity especially in the high technology and knowledge-intensive sectors.

Chapter 2 examines how regions across the world have developed strategies to grow and maintain their economic strengths in the knowledge economy. This is primarily described through two reference cases studies.

The case of the Humberside Training and Enterprise Council (TEC) conducted by Fryer, comprising around 70 organisations, is an example of how the principles of complexity theory can be implemented to yield a network model based on autonomy, connectivity, feedback, community and leadership. This case provides a reference model for how to provide an enabling environment for collaborative knowledge networks.

The flat panel display (FPD) research done by Spencer demonstrates the effectiveness of successful regional strategies for convergent, knowledge-diffusion networks.

Spencer's work shows that whilst most FPD technologies were initially invented in US laboratories in the 1960s, all portable computers produced after 1989 contained Liquid Crystal Display (LCD) screens that were primarily manufactured in Asia. Spencer found that regions were most competitive when the regional knowledge-diffusion networks are at their highest density levels and when guided by a strategic centre.

Chapter 3 turns to the macro case study of the KZN ICTE Cluster Forum. The forum was established to address factors identified in a study commissioned by the KZN DEDT, which found that whilst the electronics sector in KZN has many innovative firms and skilful graduates, knowledge diffusion networks are virtually non-existent. The case study shows how this forum tried to encourage collaboration, but failed to accomplish most of its goals.

Chapter 4 provides a micro case study of a particular organisation, MicroVision Software, that participated in the KZN ICTE Cluster Forum. The case takes the form of participatory or action research, because it is about the author's own journey as an entrepreneur. The case study shows the critical role that network ties and networked organisation played in the projects undertaken. It is shown how the organisation underwent many phases of re-invention

as a result of changes in the ICT environment. It is argued that the various education management systems developed, which involve large systems integration challenges, can only succeed if a clustered organisation is developed around it.

The concluding chapter considered how the ICTE Cluster Forum could be re-invigorated, given the lessons from the reference case studies.

OPSOMMING

Hierdie tesis fokus op organisatoriese streeksamewerkingsnetwerke. Hierin word daar argumenteer dat in kennis intensiewe sektore in die globale ekonomie sulke samewerkingsnetwerke 'n sentrale kompeterende faktor is. Om hierdie stelling te bevestig word twee gevallestudies ondersoek, naamlik die KwaZulu-Natal Information and Communications and Electronics Technology (ICTE) groepsforum en 'n enkele firma, MicroVision Software, wat 'n lid is van hierdie forum.

Die inleidende hoofstuk skets die agtergrond van die globale omvang van samewerkingsnetwerke met die klem op die hoë tegnologie- en kennis- intensiewe sektore.

Hoofstuk 2 ondersoek hoe streke wêreldwyd strategieë ontwikkel het om hulle ekonomieë te groei en hulle ekonomiese voordeel te handhaaf in die kennis- ekonomie. Dit word hoofsaaklik beskryf met die hulp van twee gevallestudies wat as verwysingspunt dien vir die latere gevallestudies wat uitgevoer is.

Die geval van Humberside Training and Enterprise Council (TEC), 'n ondersoek van ongeveer 70 organisasies deur Fryer, is 'n voorbeeld van hoe die beginsels van kompleksiteitsteorie geïmplimenteer kan word om 'n netwerkmodel te vestig wat geskoei is op outonomie, konneksies, terugvoerlusse, en leierskap. Die geval bied 'n verwysingsraamwerk vir die skep van 'n vrugbare omgewing vir samewerkende kennisnetwerke.

Die platpaneelskerm (Flat Panel Display) industrie navorsing deur Spencer demonstree die effektiwiteit van suksesvolle streekstrategieë vir uiteenlopende, kennisgebaseerde verspreidingsnetwerke.

Spencer se werk illustreer dat alhoewel die meeste platpaneelskerm-navorsing aanvanklik in Amerikaanse laboratoria plaasgevind het, alle skootrekenaars wat na 1989 vervaardig is, vloeikristalskerms (LCD) wat van Asië afkomstig was bevat het. Spencer het bevind dat areas hoogs kompetend was wanneer kennisgebaseerde verspreidingsnetwerke op sy hoogste digtheidsvlakke was en deur 'n strategiese sentrum bestuur is.

Hoofstuk 3 fokus op die makro gevallestudie van die KZN ICTE groepsforum. Die forum is gestig om kwessies wat geïdentifiseer is in 'n studie aangevra deur die KZN DEDT aan te spreek. Dié studie het bevind dat alhoewel die elektronika sektor in KZN bestaan uit baie innoverende firmas en bedien is deur bekwame graduandi, het kennisgebaseerde verspreidingsnetwerke feitlik nie bestaan nie. Die studie toon hoe hierdie forum samewerking aangemoedig het, maar tog gefaal het in die meeste van sy doelwitte.

Hoofstuk 4 bied 'n mikro gevallestudie van 'n spesifieke maatskappy, Microvision Software, wat deel was van die KZN ICTE groepsforum. Dit handel oor die outeur se eie wedervaringe as 'n entrepreneur en is dus aksie navorsing. Dié gevallestudie belig die kritiese rol wat netwerke gespeel het in die sukses van die projekte wat die maatskappy onderneem het. Dit wys hoe die maatskappy verskillende fases van herontdekking en herposisionering as gevolg van voortdurende verandering in die inligtingstechnologie-landskap ondergaan het. Daar word geargumenteer dat die verskeie opvoedkundige bestuurstelsels ,wat grootskaalse integrasie-uitdagings bied, slegs suksesvol kan wees wanneer daar 'n samewerkingsnetwerk daar rondom gevestig word.

Die finale hoofstuk oorweeg die moontlikhede van herlewing en bemagtiging van die ICTE groepsforum.

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Chapter 1

1.1. Introduction

This thesis will argue that the formations of inter-connected and inter-dependent regionally-based collaborative organisations are critical in ensuring that the region's businesses are able to compete favourably within a highly competitive, highly complex, turbulent global economy. The Information and Communications and Electronics Technology (ICTE) sector is focus of this research.

In 2005, the KwaZulu-Natal (KZN) Provincial Department of Economic development and Tourism (DEDT) commissioned the establishment of an effective ICTE cluster forum whose stated mission was to be “the umbrella body of KZN-based ICTE companies that would lobby, represent and implement strategic initiatives to benefit the ICTE sector in KwaZulu-Natal”. Since inception, however, the forum struggled to acquire this status even though initially, a number of key industry players were intently involved. These participants included the Electronics Association, the Black IT Forum, the Computer Society of South Africa, all the major Higher Educational Institutions in KZN and the Provincial government. The forum fell far short of its vision and strategic goals and is currently not active at all. It is this failure of not being able to establish a regional cluster forum that could facilitate the formation of collaborative knowledge networks around many successful innovative companies and innovations in KZN that prompted the need to do this research.

Our failure to build a conducive environment that encourages collaborative, knowledge diffusion networks causes our region to fall further and further behind in a highly competitive global ICTE sector that spawned the knowledge economy. It is important to understand the reasons why we have not been successful in establishing a cluster forum. We also need to determine the critical factors that will create an environment within which the region's ICTE sector can flourish and compete effectively in the global economy.

In order to contextualise regional economic strategies that will improve its competitiveness and create extended periods of economic growth and stability, it is necessary to describe global economic trends and industry effects. In Chapter 1, the turbulent global knowledge economy is sketched indicating that in many economic sectors, low levels of profitability

were achieved during a 20-year period from 1990 to 2010. Complexity theorists describe this turbulent environment as containing multiple, complex inter-connected systems that give rise to order and chaos. They state that order arises spontaneously out of chaos through a process of self-organisation. At times, a single fluctuation within the environment may become so powerful that it completely shatters a pre-existing order, giving rise to a new higher level order which itself may dissipate over time as a consequence of disruptive forces. Since the 1990s, we have experienced this disruptive flip from 300 years of an industrial economy to a knowledge economy. The industrial revolution itself was a great turning period in history, during which manufacturing and industrial activity became the primary forms of social production.¹ During this period, economic society experienced a series of industrial revolutions causing cycles of boom and bust. Heilbroner identifies some of these disruptive innovations that include the steam engine and the power loom (1700-1830), as well as electricity and the internal combustion engine during the second industrial revolution, running from 1860-1900.²

Since the 1990s, our world experienced another economic revolution that brought about what is now commonly known as the Knowledge Economy. This disruption stems from rapidly developing technologies in electronics and telecommunications, especially computers and mobile technologies. These technologies have fundamentally changed what we produce, how we produce and how we buy. It has brought about new ways of communication, new forms of global collaboration, new ways of political mobilisation, and more. Fierce forces of high levels of global competitiveness, competitive products, balance of forces between suppliers and customers and new market entrants have resulted in low average profitability in many market sectors. In this climate, businesses need to adapt to withstand rapidly threatening conditions and to develop strategies that will lead to prolonged periods of stability. Businesses need to adopt a learning culture that helps develop the requisite knowledge to adapt to changing conditions.

It is evident that no single business can solve large complex problems on its own. Many tasks require an intersection of multi-disciplinary skillsets working together in tandem to solve the problem. The competitive climate has given rise to increased cooperation and collaborative forms of business. One of the reasons provided for the KZN ICTE Cluster forum not being able to build a collaborative unit was that a lack of trust existed amongst some of the stakeholders. My own experience in running my small business for 20 years has shown that it

¹ R. L. HEILBRONER, W. MILBERG: *The Making of Economic Society*. Twelfth Edition. 2008. Page 77

² R. L. HEILBRONER, W. MILBERG: *The Making of Economic Society*. Twelfth Edition. 2008. Page 195

is not always easy to cultivate collaborative organisation. Competition has always been touted as the most overwhelming driver in business, much like Darwin emphasises natural selection (the fittest survives) and mutation as the key drivers of evolution. Martin Nowak's research is dealt with at length and shows that cooperation is the "master architect of evolution". Nowak states that cooperation is the most creative force in biology and is manifested at every level of human society. According to Nowak, cooperation is more than just working together towards a common aim. There is a benefit to a receiver and a cost to the co-operator. When we cooperate, we pay a price and this could in the long run also derive a benefit could exceed the cost for the co-operator. There are many everyday examples of how we cooperate in society. For example, we may assist a stranger who has a tyre puncture and arrive late at work. People have sacrificed their lives for belief in a cause. Phrases such as "one good turn deserves another", "I scratch your back, you scratch mine", "Do unto others as you would them do unto you" all have a cooperative principles built into them. We are often faced with the dilemma of cooperating or defecting. We are faced with this dilemma in business. Some of the questions that participants in the ICTE Cluster forum would have been confronted with are: Is it worth the sacrifice to establish the forum? What will I gain by participating? What impact will the cluster forum have on me or my organisation? Am I willing to work with a potential competitor and share some of my intellectual property? Do we cooperate or do we defect?

In this chapter, background cases are provided that demonstrate extent of collaborative activity on a global scale. For example, SourceForge is a centralized source code repository on the internet that allows software developers across the globe to work in partnership to develop software applications. The site claims that 3.7 million developers were involved in collaborations in 430,000 projects³. Wikipedia, an open content encyclopaedia, had close to 49 million people who contributed to the content and has been translated into 287 languages as at October 2014. The highlights of remarkable achievements include

- the staggering scale of collaboration that produced complex work within a short space of time and
- overwhelming evidence that immense and complex works were performed without most of the elements of control.

Collaborative networked structure constitutes the organisational form prevalent in the knowledge economy more so than at any other time of our history.

³ <http://sourceforge.net/about>. Accessed on 31/10/2014

Next, Chapter 2 examines how regions across the world have developed strategies to grow and maintain their economic strengths that they have become known for. The work of Charles Hampden Taylor compares the economic models of North America, Greater Europe and Japan were reshaped to maintain dominance in their respective fields of strength. Hampden Taylor's suggests a scenario construction approach to determine possible futures. This involves creating models that help to recognise patterns in the world. By painting different possible scenarios, we will be able to notice opportunities and pitfalls. He warns that we should not stake our futures on any one preferred outcome but to work out how to prosper and survive across a number of potential futures no matter how foreign these may be. The principle of this approach is also captured in Karl Weick's property of sensemaking (making sense) that it is grounded in identity construction. Weick states that an organisation needs to project itself onto its environment and by so doing, it will develop a self-referential appreciation of its own identity, which in turn permits the organisation to act in relation to its environment.⁴ Both Hampden Taylor and Weick's approaches imply that organisations should adopt double-loop learning⁵ approaches. KwaZulu-Natal has a number of areas of regional strengths in ICTE, the most notable in the Electronics industry. The KZN DEDT commissioned for a number of roadmaps to be developed that examine the potential of these industries and possible areas of growth. The KZN ICTE forum will have to perform an identity construction exercise as well as the re-examine the possible futures of the industries that will allow the region to prosper.

The case study of the Humberside Training and Enterprise Council (TEC) is provided as an example of using the principles of complexity theory. This organisation was established by the UK government through privatising the civil service. The TEC comprised approximately 70 private companies. Fryer's approach was to push the organisation to the "edge of chaos" and removed most of the command and control style of management to a network systems model built on the 5 aspects of autonomy, connectivity, feedback, community and leadership. It is expected that the KZN ICTE would, as an umbrella body, utilise these characteristics to build an environment for inter-connected knowledge diffusion networks to flourish across multiple domains.

The flat panel display (FPD) research done by Jennifer Spencer is provided to demonstrate the power of how regional strategies of developing convergent, knowledge-diffusion

⁴ KARL E. WEICK. *Sensemaking in Organisations*. 1995. Page 22/23.

⁵ GARETH MORGAN 2006. *Images of Organisation*. Pages 85/86.

networks can be so powerful that it can result in the total domination of the global market. Her studies show that whilst most FPD technologies were initially invented in US laboratories in the 1960s, 100% of portable computers produced after 1989 contained Liquid Crystal Display (LCD) screens that became the dominant design in the FPD industry and that almost all the manufacturing took place in Asia. The key lessons here are examining network constructs of density (inter-connected organisation), centralisation (the strategic centres around which networks form), Euclidean Distance (how close actors are to one another), adjacency (percentage of network ties) and reachability (between domestic and foreign firms). Her studies found amongst others that regions displayed their highest degrees of competitiveness when their regional knowledge-diffusion networks at their highest density levels and when they were guided by a strategic centre. She also found that companies that act as global gatekeepers and representatives of the region managing knowledge and information flow between the region and the global market are more likely to sustain their investment *after* a dominant design has emerged in their industry.

The first 2 chapters provide a platform upon which we can project the ICTE Cluster forum to assess whether its identity and organisational structures are directed towards building a conducive environment for regional ICTE businesses to thrive. The case study for the ICTE Cluster Forum is provided in Chapter 3. The forum was established on the basis of a study that was done by a company called Kaiser and Associates that was commissioned by the KZN DEDT. This study highlighted amongst others that KZN has significant regional sources of competitive advantage around which to develop and grow specialised, globally competitive collaborative, networked organisation. The study found that the electronics sub-cluster, in particular, has a number of innovative companies that have international footprints. It points out that, despite having these firms that can serve as an anchor node for a cluster and also that KZN a good supply of graduates and a high degree of advanced skills, knowledge diffusion networks are virtually non-existent. The study goes on further to say that KZN has a number of research institutions capable of producing cutting edge research, but lack in the creation of new knowledge and innovation. The ICTE Cluster Forum was established to address these factors and its vision is articulated as follows:

“to make KwaZulu-Natal a vibrant, innovative, fully inclusive knowledge society with a strong ICT and electronics brand that speaks of innovative approaches to local and global challenges”.

Chapter 3 addresses some of the accomplishments and most notably, the development of strategy documents that generally speak of areas of focus and encourages collaborative organisation. The KZN ICTE cluster forum, having been in existence since 2005, was not able to accomplish most of its goals and objectives and the organisation is now in a dormant state.

Chapter 4 is a participatory study of my own journey as an entrepreneur. I started a software development company called MicroVision Software c.c. in 1993. The purpose of this study is to explain the critical role that network ties played in MicroVision's existence as well as the increased dependency we have on networked organisation. Our struggle for existence involved leveraging strong ties, weak ties and hubs in order to advance as a business. Throughout the 20 years, we operated in the "edge of chaos" zone and had to undergo continual phases of re-invention as a result of the dramatic changes in information technology and the extreme economic paradigm shifts. This arduous environment required for us to learn continuously, to take risks and to make adjustments as we saw fit. We developed our own schools management system three times over and serviced a number of schools in South Africa during the past 20 years. We also developed a number of bespoke systems for clients. It was during the web-based application development era (from 1995 onwards) when opportunities for integrating systems increased tremendously. Systems integration of large systems requires the need to establish communities of practice because of the interdependence of knowledge and because of the supportive roles that each party involved in the integration needs to play. Between 2002 and 2006, MicroVision developed 3 logistics management systems that needed to integrate with an access control system, closed circuit television, human resources management systems and business management systems. The access control system was developed by a Durban-based company called Impro Technologies (Pty) Ltd that uses Radio Frequency Identification (RFID) technologies. Impro's range of products are designed, developed and built in its Durban-based factory. The company has a strong global footprint with exports of their systems to 60 countries worldwide including Europe, Japan, the Middle East and the United States of America. It is during that time that I began to grasp the potential that exists if platforms could be created for the development of organisational clusters around areas of innovation. MicroVision's latest product called Myobuzz, which was developed over a 4-year period, is currently used as the Learning Management System by the Gauteng Department of Education in a pilot project roll-out providing eLearning to 2200 schools. Myobuzz requires multi-disciplinary skills to develop to its full potential and MicroVision does not have this capacity. Myobuzz can only have a

realistic chance of success if a clustered organisation can develop around this innovation. It is for this reason that environments that can support small businesses like MicroVision and even large business like Impro Technologies need to be created.

The cultivation of knowledge diffusion networks to solve large problems and to develop and sustain business and communities is an imperative for a region to flourish. It is my belief that the ICTE Cluster Forum needs to be re-invigorated and the critical success factors are addressed in the concluding Chapter 5.

1.2. Economic Turbulence

The pace of Globalisation, enabled largely by ubiquitous information and communications technology, has brought about tremendous complexity and turbulence in today's economy. We live in an extremely multifarious, highly complex world that requires much more survival skills than in the industrial age that dominated our world for 300 years up until the recent 1980's. Thomas Friedman, describes three eras of globalisation, culminating in an era of a flattened world, a metaphor for an environment where he argues that the economic playing field has levelled for all competitors⁶. Globalisation 1.0 – the globalisation of countries - happened until the 1800's where countries discovered and engaged with other countries. The key drivers of this era were muscle-power, gun-power, horsepower and steam power. Globalisation 2.0 – the globalisation of companies - happened between the periods 1800 and 2000 where companies drove the global agenda. This period saw the rise of multi-national companies. Friedman identifies some of the key enablers for this period of globalisation to be falling transportation costs resulting from the steam engine and railroad, falling telecommunication costs, the diffusion of the telegraph, telephones, the personal computers, fibre-optic cabling and the early version of the World Wide Web. Globalisation 3.0 – the global collaboration of individuals – started round the year 2000, is enabled by what Friedman calls the *flat-world-platform*. This is the product of a convergence of technologies of the personal computer, fibre-optic cable, mobile and satellite technologies, digital content and the rise of workflow software. Friedman argues that Globalisation 3.0 differs from the previous two periods, not only how it shrunk and *flattened* the world by empowering individuals across the globe, but how a much more diverse group of individuals and companies from every corner of the globe shapes the global system. The previous two

⁶ Friedman. *The World is Flat*. Pages 8-12.

periods of globalisation were orchestrated by Western countries whereas in the current climate, diverse non-Western, non-white groups of individuals, companies and countries are strong forces on the globally flattened field of play.

The chart below, compiled from Standard and Poor's and Compustat databases, illustrates the current degree of competitiveness in selected industries. The chart depicts the average return on equity for twenty industries over the twenty-year period from 1990-2010 on all companies that traded on the U.S. stock exchanges.⁷

Relative Industry Profitability: 1990–2010 Return on Equity

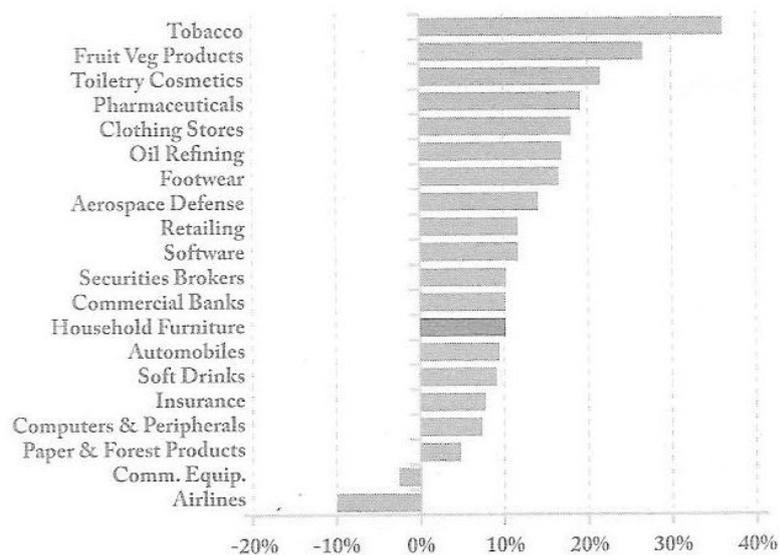


Figure 1: Degree of competitiveness in selected industries

Cynthia Montgomery⁸ highlights the magnitude of variation from the most to the least profitable industries. The average profitability of most profitable industries are significantly more than double those in the median industries and more than four or five times those at the bottom of the distribution. She also points out that researchers have found similar differences in other countries, in both advanced and emerging economies. Montgomery notes that these variations, too large and too consistent to be random, are caused by economic forces such as the nature of rivalry, the balance of forces between suppliers and customers, substitute products, and potential new entrants. She argues that the fiercer the forces are, the lower the profitability. On the other hand, the more benign the forces are, the greater the profitability. The collective impact of these industry forces, called the industry effect, impact on the

⁷ CYNTHIA A. MONTGOMERY. *The Strategist*. Page 27.

⁸ CYNTHIA A. MONTGOMERY. *The Strategist*. Page 27.

individual firms and consequently on the industries on which they operate. These competitive forces are beyond the control of individual companies and it is strategically imperative to understand the industry effect to be able to navigate companies through the tough conditions they face. The Information and Communications Technology (ICT) Sector, which is the focus area of this thesis, is covered in the following areas on the graph:

- Communication Equipment (average -3% profitability).
- Computers and Peripherals (average 8% profitability).
- Software industries (average 12% profitability).

The ICT segments listed above fall within the lower half of the industries listed on the graph.

This turbulent environment compels companies to continuously assess threats and opportunities and have the capacity respond quickly and with agility to changing environments. Max Boisot points out that in the 1960's after the Second World War, everything was scarce and, consequently, virtually everything that was produced could be sold⁹. During those times of low levels of competition, companies could embark on long-term strategies by anticipating future market demands and to adjust productive patterns to meet these. In the late 1960's, however, the economic pie stopped growing. Increased competition grew which greatly increased the strategic task of companies to remain profitable. Boisot considers four strategic options that can be adopted in the strategy-making process, namely strategic planning, emergent strategy, intrapreneurship and strategic intent. Boisot uses Ross Ashby's law of requisite variety as a basis for determining the best strategic approach. Ashby's law states that "for a system to preserve and maintain its integrity, the rate of learning must at least match the rate of change of its environment".

Strategic planning is formulated towards achieving long term goals. In cases of high turbulence however, the locus of formulation and implementation of long-term strategic planning is most likely not plausible as this is more suited to stable environmental conditions. In heavy turbulent environments where the future is uncertain, *emergent strategies* should be adopted and shaped by people, processes and technologies throughout the organisational framework to respond to opportunities or threats.

Boisot describes *intrapreneurship* as ad-hoc responses formulated and implemented in a decentralised manner when the environment is so turbulent that organisational integration of

⁹ Bob Garratt. *Developing Strategic Thought*. 2003. Chapter 3. Page 36.

action is not viable. In high degrees of turbulence, threats and opportunities need to be dealt with at a local level.

According to Boisot, *strategic intent* that relies on intuition rather than pure rational analysis is needed to energise the firm and its employees through the turbulent environment. The intended strategy is meant to provide a shared vision to align the organisation to a common purpose. Boisot's strategic options are applicable for large and small organisations subjected to the same industry effect. Organisations of all sizes need to be adaptive to changing conditions and will need to ensure that they have the requisite variety of mechanisms to navigate the environment. The optimal navigation of the turbulent environment requires a company to adopt a learning approach and to rely more heavily on strategies of emergence, intrapreneurship and intent whilst striving towards achieving long term goals.

Botsman and Rogers liken the evolutionary economic changes experienced in society of the past two decades to the theory of "punctuated equilibrium" formulated in 1972 by two palaeontologists, Gould and Eldredge, whose research indicate that fossil records show that evolution happened in rapid bursts of change punctuating prolonged periods.¹⁰ This contrasts the theory of "phyletic gradualism" which states that evolution is generally slow, uniform and gradual. Botsman and Rogers point out that the industrial revolution took about one hundred years to take root, whereas our life-altering technological and social advances are happening in a few years if not months. Over the past twenty years, we have seen a staggering impact of global innovation and market forces that have influenced our society, creating extremely complex problems that require extensive knowledge to solve. We now live in an era of increasing over-supply and heightened global competition making it increasingly difficult, if not impossible, for business to adopt the mechanistic strategies, formations and characteristics that were applicable in the industrial era. Dramatically, we have transformed into an extremely accelerated society where the principles of chaos and complexity theory are highly relevant.

¹⁰ Carol Kaesuk Yoon, *Bacteria Seen to Evolve in Spurts*, New York Times (June 1966), <http://www.nytimes.com/1996/06/25/science/bacteria-seen-to-evolve-in-spurts.html>

1.3. Complexity – a catalyst for increased cooperation and collaboration

According to complexity theorists, our world is characterised by multiple, complex, inter-connected systems that are both ordered and chaotic. If a sufficient degree of external complexity exists within the environment, randomness and diversity and instability become resources for change. Random disturbances in the environment can produce unpredictable events and relationships that reverberate throughout a system, creating novel patterns of change. Edward Lorenz's "butterfly effect" provides an illustration of how tiny fluctuations in initial conditions can lead to large differences in a later state. The famous image is that of a flapping of the butterfly's wings in Peking that can influence weather patterns in the Gulf of Mexico¹¹. In order for a hurricane to develop, the triggering or alignment or convergence of co-operative forces needs to happen. Morgan points out that the butterfly in China is not the 'cause' of a new weather pattern. Rather, it triggers a small change that triggers another small change and another. Ultimately, the incremental effects of the marginal changes have enough influence for a new system state to emerge.

Complexity theorists such as Lorenz and Prigogine argue that all large systems contain sub-systems that are in continual states of flux. Central to this theory is the idea that order arises spontaneously out of chaos through a process of self-organisation of elements within the system itself¹². During the systems' dynamic processes, stable structures are temporarily born between elements as they interact with each other and the environment. At times, a single fluctuation may become so powerful as a result of positive feedback that it shatters the pre-existing order, giving rise to a new higher level dissipative order. Prigogine points out that the new higher level is dissipative because energy is required to maintain the state and at some stage in the future, competing forces will shatter it. This revolutionary moment at which the new order obtains is called a "bifurcation".

Stacey identifies three different zones that all complex adaptive systems can operate namely: a stable zone, an unstable zone and at "the edge of chaos"¹³. In the stable zone, systems ossify. In the chaos zone, they disintegrate. At the "edge of chaos", in a state of 'bounded

¹¹ GARETH MORGAN 2006. *Images of Organisation*. Page 255

¹² RAMIREZ, SELSKY, VAN DER HEIJDEN. 2010. *Business Planning for Turbulent Times*. Page 68.

¹³ STACEY R.D. 1996. *Complexity and Creativity in Organisations*.

instability', systems behave like dissipative structures and display their full creativity and innovation. Stacey argues that in today's complex environment, the "edge of chaos" state is the preferable state for organisations to be in and suggests five 'control parameters' that will assist organisations reach their full potential within today's complex environments. These are: "information flow", "degree of diversity", "richness of connectivity", "level of contained anxiety" and "degree of power differential". In this complex and turbulent environment, organisations need to be much more adaptable to survive. Complexity theory holds that systems coevolve with their environments¹⁴. When systems are close to these bifurcations, points, small fluctuations can change the whole system. In the "edge of Chaos" zone within which these sensitive bifurcations occur, the creativity and innovative drive of a single actor may be enough to determine the survival or demise of the field as a whole. Thus, within this highly accelerated economy, our response, or non-response to withstand and potentially disrupt the collective forces impacting our industries will have a profound effect on our future state as nations, regions and businesses and individuals.

This is akin to Maturana and Varela's organisational theory of autopoiesis that argues that organisations and environments are part of the same inter-connected pattern. Fierce industry effects outside the influence of business organisations necessitate a need to develop knowledge and innovative techniques to engage with attractor patterns that lead to states of self-renewal punctuated by longer periods of relative stability. Open Systems thinkers such as von Bertalanffy and Ashby built their theory from a biological base of how living organisms interact with their environments to maintain their existence. Likewise, organisations need to be continually interested in the environment within which it functions and examine how best to fit in, deriving form and then how to contribute towards environment to maintain its existence. Organisations are operating in complex systems of destabilising forces and need to constantly seek new ways of reaching a period of stability through self-organisation.

Malcolm Gladwell's concept of "the tipping point", where he argues that little things can make a big difference, illustrates the impact of the how the alignment of cooperative forces can fuel massive change within a short space of time¹⁵. He analyses how some products, ideas and social behaviour cross a threshold, or "tip", and spread like wildfire. Gladwell suggests that we think of these mysterious changes we see in everyday life as epidemics.

¹⁴ MICHAEL JACKSON 2003. *Systems Thinking. Creative Holism for Managers.*(Page 118)

¹⁵ MALCOLM GLADWELL 2000. *The Tipping Point.*

Ideas, products and behaviours, he says, spread just like viruses do. According to Gladwell, epidemics are a function of three elements, namely, the people who transmit infectious agents, the infectious agent itself and environment in which the infectious agent is operating. Epidemics tip as a consequence of three rules, viz.

- *The law of the few.* A small number of people in a small number of situations that behave differently can result in a large number of people being ‘infected’.
- *The Stickiness Factor.* The epidemic agent is highly contagious.
- *The Power of Context.* Epidemics are strongly influenced by the particular circumstances and conditions that prevail during the time of operation. Changes happen in a hurry and can be triggered by the smallest, subtlest and most unexpected of factors.

The tipping point is a “bifurcation” point which is the point at which the energy a system self-organises and flips into a variation, stable state.

Globalisation 3.0, elucidated by Friedman, has forced a need for more fluid organisations to prevail as opposed to the large, bureaucratic forms that prevailed and still exist from the past. The complexity of the society has given rise to more complex problems to solve, and the resolution thereof requires agile approaches to problem-solving, diverse skill-sets and cooperative players to engage. Joel Cawley, IBM’s vice president of corporate strategy, makes this point:

“What we are seeing in so many different fields is that the next layers of innovation involve the intersection of very advanced specialities. The cutting edge of technical innovation is increasingly specialised. In most cases, your own company or own department’s specialisation is only going to be a small piece of any meaningful business or social challenge. Therefore, to come up with any valuable new breakthrough, you have to combine more and more of these increasingly granular specialities. That is why collaboration is so important.”¹⁶

¹⁶ THOMAS L. FRIEDMAN. 2006. *The World is Flat*. Page 437.

Friedman provides an example of this kind of horizontal, collaborative activity within the Grand Challenges in Global Health project funded by the Gates Foundation¹⁷. A call was made for horizontal collaboration within the scientific to define problems and find solutions in the health sector that would dramatically change the lives of billions of people with health problems. Forty three grants worth \$436 million in cash were awarded from one thousand five hundred proposals from scientists in seventy five countries. Rick Klausner, who directed the health programs for the foundation, indicated how quickly grant winners organised themselves into collaborative communities. He states the following:

“People said if you are really going to solve a big problem today, you need to do it with much more horizontal collaboration. And this [flat] world enables it. You can do a project on your own but you can’t solve a big problem on your own. But we did not expect this [cooperation between potential competitors]. Because while we talk about collaboration, competition is so ingrained in the creative steroid of science, it was just not clear that people would put down competition in order to be part of a larger community solving a problem. It is not a natural tendency. We were surprised by this¹⁸.”

The notion that collaboration, which is a cooperative behaviour, is not a natural tendency needs to be further examined because this is such a common perception. If it is true that cooperative behaviour flouts the laws of nature, it thus becomes an extremely difficult proposition within a business and indeed any environment.

1.4. Cooperation –the master architect of evolution

Martin Nowak, a Professor of Biology and Mathematics at Harvard university, criticises Charles Darwin’s theory of evolution that formulates the theory that “the fittest survives” by beating the competition motivated mainly by self-preservation and relentless competitiveness. Nowak argues that cooperation, altruism and self-sacrifice go hand in hand with our struggle to survive. Much of Nowak’s work is dedicated to showing that “cooperation is entirely compatible with the hard-boiled arithmetic of survival in an unremittingly cold-eyed and competitive environment”. Nowak explains that cooperation is more than just working towards a common aim. Cooperation hurts one’s own fitness and goes against the grain of

¹⁷ THOMAS L. FRIEDMAN. 2006. *The World is Flat*. Page 466-467.

¹⁸ THOMAS L. FRIEDMAN. 2006. *The World is Flat*. Page 467.

self-interest. When cooperating, there is a benefit to the receiver at the cost of the co-operator. He provides simple anecdotal examples of how we cooperate with each other in everyday life. For example,

- A friend takes you to the dentist though it makes her late for work.
- You donate to charity rather than spending the money on yourself.
- A bank clerk recommends to the customer an account that yields the best investment return for the customer and not the bank.
- You give a lift to someone whose vehicle has broken down.
- You risk your life to save that of a stranger.

Nowak states that from Darwin's formulation for the struggle for existence, it makes no sense to aid a potential rival, yet there is evidence that cooperation that seems irrational and goes against the grain of self-interest occurs among even the lowliest of creatures¹⁹. A number of examples in nature show that innate co-operative behaviour is prevalent in many species. After a night's hunt for food, Vampire bats regurgitate and share the night's prey with other bats who may not been successful. Bats are more likely to share blood with a bat that has previously fed them.²⁰ This form of direct reciprocity is also found on coral reefs, where, according to Nowak, fish of all kinds visit "cleaning stations" where they are scrubbed of parasites by smaller varieties of fish and shrimps. The former get cleaned and the latter get a free meal.²¹ Dolphins live in close-knit pods of about six to ten dolphins. Several pods may join temporarily for the purpose of "cooperative feeding". Dolphins encircle a shoal of fish and use team-based techniques forcing the shoal into a tight ball and work together to catch fish easily. The more dolphins in the herd, the easier it is to catch more fish. This cooperative behaviour has immense benefits for both the individual and the school of dolphins.²²

Cooperative behaviour by humans is recorded throughout the history of humankind. According to Botsman and Rogers, our Paleolithic ancestors in the Stone Age, humans grouped into tribes of app approximately twenty five to one hundred people who survived by gathering plants and hunting wild animals in packs. Following the kill, the meat was cut into

¹⁹ NOWAK M. 2011. *Super Cooperators*. Preface xv.

²⁰ NOWAK M. 2011. *Super Cooperators*. Page 21.

²¹ NOWAK M. 2011. *Super Cooperators*. Page 22.

²² BOTSMAN AND ROGERS: *What's mine is yours* (Page 67/68)

pieces and shared with everyone in the camp.²³ Nowak states that Darwin was troubled by this selfless behaviour and tried to explain it away. Darwin's theory emphasised two basic principles of evolution – mutation and natural selection. Nowak argues that cooperation is the master architect of evolution. In Nowak's words:

Cooperation - not competition - underpins innovation. To spur creativity, and to encourage people to come up with creative ideas, you need to use the lure of the carrot, not the fear of the stick. Cooperation is the architect of creativity throughout evolution, from cells to multi-cellular creatures to anthills to villages to cities. Without cooperation there can neither be construction nor complexity in evolution... Cooperation is the master architect of evolution²⁴.

Nowak addresses the dichotomy of self-interest and what is desirable for the society. These conflicts, he says are evident in global problems such as climate change, pollution, resource depletion, poverty, hunger and overpopulation. Nowak uses the prisoner's dilemma, a simple mathematical model first devised in 1950 that illustrates the three forces of mutation, selection and cooperation at play. The dilemma is described as follows:

Imagine that both you and your accomplice are both held prisoner, having been captured by the police and charged with a serious crime. The prosecutor interrogates you separately and offers you each a deal. If one of you, the defector, incriminates the other, while the partner remains silent, then the defector will be convicted of a lesser crime and his sentence will be cut to one year for providing enough information to jail his partner. Meanwhile, his partner will be convicted of a more serious crime and burdened with a four-year sentence. If you both remain silent, and thus cooperate with each other, there will be insufficient evidence to convict either of you of the more serious crime, and you will each receive a sentence of two years for a lesser offense. If, on the other hand, you both defect by incriminating each other, you will both be convicted of the more serious crime, but given reduced sentences of three years for at least willing to provide information.

²³ BOTSMAN AND ROGERS: *What's mine is yours* (Page 68)

²⁴ NOWAK M. 2011. *Super Cooperators*. Preface xvii-xviii

The payoff matrix²⁵ is summarised as in the following table:

		Opponent	
		cooperate	defect
Player	Cooperate	-2,-2	-4,-1
	Defect	-1,-4	-3,-3

The scores of the prisoner's dilemma is a mathematical model depicting the dilemma of natural selection and cooperation, and mutation is illustrated through the way in which the game is played. Defecting (natural selection) is considered the dominant strategy because you would score regardless of what the other person does. Defecting results in either 1 year or 3 years. The dilemma is that if both players choose to play the dominant strategy, both will get 3 years. This leaves both worse off if they choose not to cooperate with one another. If the parties trusted each other enough rather than take a selfish route, both would end up with 2 year's imprisonment.

We are confronted with this dilemma of self-interest or collective good in one form or another throughout our lives. Do I assist a person in need when I may be negatively impacted upon as a consequence? Must a firm go into a joint venture relationship with another firm and share in the profit or must it compete against them and either win the contract or lose out completely? Does a firm share its intellectual property with another company who can add value and increase the chances of getting its innovative idea to market or, should it go alone and increase the risk of being worse-off? Like in the prisoner's dilemma, a number of factors are taken into account when these types of questions are considered.

The notion that trust is an important and even necessary condition is widely held in the literature relating to the building of cooperative relationships. The Oxford dictionary describes the word *trust* to mean amongst others:

*A firm belief in the reliability, truth, ability or strength, etc. of someone or a thing; the state of being relied on; a confident expectation; an organised association of several companies for the purpose of reducing competition; take on trust is to accept without any evidence or investigation*²⁶.

²⁵ NOWAK M. 2011. *Super Cooperators*. Page 7

²⁶ EDITED BY R.E. ALLEN, 1992. The Concise Oxford Dictionary

Botsman and Rogers, for example, argue that our “inner ledger of fairness” is critical to what makes eBay, an on-line trading website between buyers and sellers work.

Nowak’s work shows that the decision to cooperate is not purely based on a relationship of trust. He argues that altruistic behaviour may very well come about as a direct consequence of the selfish motives of the rational player²⁷. If the game of prisoner’s dilemma is repeated, the likelihood is that previous decisions will affect the next decision. For example, if all defectors adopt the same strategy of defecting repeatedly, they will end up worse off than if they both cooperated. A player that cooperated whilst the other cheated could adopt the attitude of punishing the cheat in the future. Nowak states that society has a mix of co-operators and defectors and that cooperation and defection strategies wax and wane. This is evident in why great empires are destined to rise and fall, why there are economic cycles, why periods of hard work are followed by those of leniency, and so on²⁸. In the real world, he says, these cycles play out in predictable ways. A period of defector dominance is followed by a period of cooperation that is once again followed by a period of defection²⁹. This cycle supports complexity theorists who argue that order arises out of chaos through self-organisation within the system itself.

Nowak identifies five mechanisms that aids the evolution of cooperation and thus can counter the “relentless and depressing tendency of natural selection”. He also formulates rules for each to work. These mechanisms are:

1. Direct Reciprocity (Tit-for-tat).

This is evident in many commonly used phrases such as “I’ll scratch your back and you scratch mine”, “one good turn deserves another”, “an eye for an eye and a tooth for a tooth”, and so on. Direct reciprocity can only work when both sides are in contact with each other so that there is an opportunity to repay the act of kindness with one another. Previous outcomes will also need to be remembered to trigger the act of reciprocation. Nowak provides the following quotation by Scottish philosopher, David Hume who wrote in *A Treatise of Human Nature* in 1740: “*I learn to do service to another, without bearing him any real kindness: because I foresee, that he will return my service, in the expectation of the same kind*”³⁰. This statement

²⁷ NOWAK M. 2011. *Super Cooperators*. Page 27

²⁸ NOWAK M. 2011. *Super Cooperators*. Page 37

²⁹ NOWAK M. 2011. *Super Cooperators*. Page 36

³⁰ NOWAK M. 2011. *Super Cooperators*. Page 270

illustrates the point that trust is not a necessary condition for people to be cooperative or altruistic. Rather, Hume's statement shows that the potential benefit that could be gained is a key driver for paying a cost. Because a cost is involved when helping one another, there is the threat of exploitation. Our selfish motives can induce us to want to cheat or not bother to help one another. Repeated tit-for-tat could provide a strong motivation for cooperating because a person knows that if he or she cheats today, there is a very strong likelihood that he or she will be punished tomorrow. Nowak draws a number of insights through prisoner's dilemma-typed game simulations. He builds in strategies such as "generous tit-for-tat" (through forgiveness or leniency, defectors can have a chance to rise up again) and "Win-stay, lose-shift" (If I win, I repeat the same move the next time. Otherwise, I will change my previous move). Nowak's experiments show that whilst cooperation hurts our fitness levels and that a co-operator has a lower fitness level than a defector, a population of co-operators has a higher average fitness than a population of defectors.

Nowak's first rule for cooperation to evolve:

*Direct Reciprocity can lead to cooperation only if the probability of another encounter between the same two individuals exceeds the cost-to-benefit ratio of the altruistic act.*³¹

Direct reciprocity works well when interactions take place between relatives, neighbours or members of the same small village or when there is continual face-to-face exchange.

2. Indirect Reciprocity (The power of reputation)

Indirect Reciprocity thrives when there are repeated encounters within groups. Common phrases such as "Give and it shall be given unto you" and "What comes around goes around" are common phrases that illustrate the expectation of indirect reciprocity. The cooperative dynamic shifts towards "My behaviour towards you depends on what you've done to others". We will cooperate more with those who have a good reputation³². Like Heilbroner, Thomas Friedman, and others, Nowak points out that the increasing size of modern communities and the complexity of our environments supports a greater subdivision of physical and cognitive labour. This reliance on others in networks of indirect reciprocity enables a person or group to

³¹ NOWAK M. 2011. *Super Cooperators*. Page 270

³² NOWAK M. 2011. *Super Cooperators*. Page 64

establish a reputation for being skilled at a particular job³³. The correlation between size and complexity of societies and division of labour is not new. Nowak makes reference to a soldier's writings in the fourth century BC that indicates that,

*“in a small city, the same man must make the beds and chairs and ploughs and tables and often build houses as well... in the great cities, a single craft will suffice for a means of livelihood, and often enough in that; there are shoe-makers who will only make sandals for men and others for women...”*³⁴

In today's highly connected world, our reputational reach is unprecedented. Botsman and Rogers point out that as we interact on the web, we develop a cumulative reputational record of how well we collaborate and can be trusted³⁵. For example, on web sites such as eBay, bidorbuy and flickr, a facility is provided that provides for one transacting party to rate the other. Botsman and Rogers anticipate that by the end of the decade, power will shift to people with the best reputation and trust networks. They envision a platform that will aggregate our reputational trail across various communities³⁶. A pertinent feature of indirect reciprocity is that we help others without necessarily expecting an immediate return. Nowak argues that for productive indirect reciprocity to evolve, the ultimate expected benefit must exceed the cost of the altruistic act.

Nowak's second rule for cooperation to evolve:

Indirect reciprocity can only promote cooperation if the probability of knowing someone's reputation exceeds the cost-to-benefit ratio of the altruistic act.

Cooperation through indirect reciprocity is prevalent in small societies and communities. It is also central to the way in which we interact and cooperate through networks on a global scale.

3. Spatial Selection.

Nowak argues that our spatial clustering of villages, towns and cities rather than dotted at random is indicative of cooperation³⁷. He explains that much like on a

³³ NOWAK M. 2011. *Super Cooperators*. Page 53

³⁴ NOWAK M. 2011. *Super Cooperators*. Page 53

³⁵ BOTSMAN AND ROGERS: *What's mine is yours* Page 217

³⁶ BOTSMAN AND ROGERS: *What's mine is yours* Page 220

³⁷ NOWAK M. 2011. *Super Cooperators*. Page 70

chessboard, where each square on a chessboard is surrounded by 8 neighbours and will never be in direct contact with other squares, we play the game of life in ecosystems of neighbourhoods in which co-operators and defectors could coexist. An example could be the existence of peace-loving people and gangsters living in the same neighbourhood forever engaged in the struggle for light and darkness. Co-operators form networks and clusters of different composition in which they help each other. In such a neighbourhood, strategies of cooperation and defection could occur in ever-changing, dynamic patterns. In many situations, there may be no overall winners. The geography of the situation may result in co-operators and defectors living side by side in dynamic interplay. Nowak argues that clusters of co-operators can prevail when systems are designed to advantage co-operators and disadvantage defectors.

Nowak's third rule for cooperation to evolve:

The cost-to-benefit ratio must exceed the average number of neighbours per individual.

4. Group Selection

Selection does not only occur at an individual level, but also on groups, and groups of groups at multiple levels. This is often called multi-level selection³⁸. According to Nowak, Darwin acknowledges this cooperative behaviour as is evidenced in the following quote taken from *The Descent of Man* published in 1871:

*There can be no doubt that a tribe including many members who ... were always ready to give aid to each other and to sacrifice themselves for the common good, would be victorious over most other tribes; and this would be natural selection.*³⁹

This statement provides an indication that natural selection could spur cooperation. Darwin supports the notion that tribes of courageous, sympathetic and faithful members who were always ready to assist and defend each other would be victorious over other tribes. Darwin's view, however, is that natural selection *within* groups supersede cooperation and that it is unlikely that cooperative forces are dominant in the evolutionary process. Darwin's statement that supports this notion is as follows:

It is extremely doubtful whether the offspring of more sympathetic and benevolent parents, or of those who were the most faithful to their comrades, would be reared in

³⁸ NOWAK M. 2011. *Super Cooperators*. Page 84

³⁹ NOWAK M. 2011. *Super Cooperators*. Page 83

greater number than the children of selfish and treacherous parents of the same tribe. He who was ready to sacrifice his life, as many a savage has been, rather than betray his comrades, would often leave no offspring to inherit his noble nature. The bravest men, who were always willing to come to the front in war, and who freely risked their lives for others, would on and perish in larger numbers than other men⁴⁰.

Nowak also argues that whilst defectors can win within a group, at the levels of the group, groups of co-operators can triumph over groups of defectors. He describes the evolutionary process of natural selection versus cooperation succinctly as follows:

Natural selection actually opposes cooperation in a basic prisoner's dilemma. At its heart, natural selection undermines our ability to work together. Why is this? Because in what mathematicians call a well-mixed population where any two individuals meet equally often, co-operators always have a lower fitness than defectors – they are always less likely to survive. As they die off, natural selection will slowly increase the number of defectors when until all the co-operators have been exterminated. This is striking because a population consisting entirely of co-operators has a higher average fitness than a population made entirely of defectors. Natural selection actually destroys what is best for the entire population. Natural selection undermines the greater good⁴¹.

Nowak argues that intense between-group competition blur's a distinction between group and individual welfare. If the group either thrives or suffers through intense competitive action, individuals within the group will thrive or suffer. Different groups have different fitness levels which are directly proportional to the number of altruists participating in the groups. The more the number of altruists, the better the group's performance will be. We engage in multi-selection of groups that include groups within groups and groups that are inter-linked. These groups coevolve and create opportunities for direct and indirect reciprocity.

Nowak's fourth rule for cooperation to evolve:

The cooperative mechanism works well if there are many small groups and not so well if there are few large groups.⁴²

⁴⁰ NOWAK M. 2011. *Super Cooperators*. Page 83

⁴¹ NOWAK M. 2011. *Super Cooperators*. Page 10

⁴² NOWAK M. 2011. *Super Cooperators*. Page 270.

5. Kin Selection - Nepotism

Nowak points out that family and ancestry bonds are strong motivators for cooperation. This is captured in the phrase: “Blood is thicker than water”. It is common sense, he says, that cooperation can emerge among closely related individuals. He mentions that there is a stronger likelihood, for example, that a relative will be more likely to risk his or her life by saving their own drowning child than if the child were complete stranger. According to Nowak, gene that induces one to cooperate with your brother or sister can spread by natural selection because one’s relative very likely carries the same gene. The literature on this, he says is extensive.

Further to this, however, Nowak provides insights by Bill Hamilton who became aware of remarkable acts of altruism that go way beyond immediate relatedness. For example, Hamilton pondered why “from the time of the early Greeks, it had often been claimed that dolphins will save humans from drowning, or even defend them from shark attacks”. There are also cases where strangers who risk their lives to save a drowning person without considering the relatedness to the person in distress. Hamilton introduced the concept of “inclusive fitness”⁴³ that suggests that mechanism of cooperation through kin selection can also evolve through relatives instead of through the individual. Hamilton’s theory is describes as follows:

“An animal may pass on its genes by helping its kin to reproduce rather than reproducing itself, because they share genes in common. Take the Belding ground squirrel, a small brown creature with a short tail, short fur, and rounded ears. When an individual makes an alarm call to warn off a looming predator, he puts himself in increased danger by giving away his location but helps to protect his relatives and thus his genes. By willing to risk sacrificing himself, the squirrel might allow for greater inclusive fitness”.

Nowak also cites Edward Wilson that supported Hamilton’s theory of inclusive fitness as a powerful explanation of “eusociality”, a term to describe the way in which social insects and other animals cooperatively care for their young.⁴⁴

According to Nowak, Hamilton’s theory on kin selection suggests that the amount of cooperation that can be expected is a function of the degree of genetic relatedness.⁴⁵

⁴³ NOWAK M. 2011. *Super Cooperators*. Page 99.

⁴⁴ NOWAK M. 2011. *Super Cooperators*. Page 105

⁴⁵ NOWAK M. 2011. *Super Cooperators*. Page 109

Nowak's fifth rule for cooperation to evolve: (Hamilton's Rule)

The coefficient of relatedness must exceed the cost-to-benefit ratio of the altruistic act.

Nowak's five mechanisms for cooperative evolution generally indicate that cooperation is inversely proportional to the cost-to-benefit ratio. If the cost is high and the benefit is low, the level of cooperation will be low and vice versa.

Nowak's work shows that "cooperation arises out of competition, even though the two are locked together in ceaseless conflict. ... Like day or night, or good and bad, cooperation and competition are forever entwined in a tight embrace"⁴⁶. He observes the fragility of our current phase in our intelligent life, which he says does not seem to stay around for very long in relation to the 13.7 billion years that our cosmos has been in existence. He notes that we are on the brink of catastrophes that can be caused by extreme global challenges such as climate change, over-crowdedness and food security. The aversion of these complex challenges that we face will require a higher level of cooperation. Unlike Darwin, who emphasises a protracted and bloody struggle for survival through mutation and natural selection, Nowak proposes that "*cooperation is the principle architect of 4 billion years of evolution, ... first bacterial cells, then higher cells, ... Finally, cooperation constructed humanity... We are able to draw on all 5 mechanisms of cooperation ... We are SuperCooperators...*"⁴⁷

1.5. The economic paradox of self-Interest and collective Good

Nowak's formulation of the five mechanisms that trigger the evolution for cooperation provides an important lens through which we can view our economic existence.

Adam Smith (1723-1790), considered to be the founder of liberal economics, based his "invisible hand", self-regulatory concept of the free market on an anticipated healthy balance

⁴⁶ NOWAK M. 2011. *Super Cooperators*. Page 269

⁴⁷ NOWAK M. 2011. *Super Cooperators*. Page 280-284

between self-interest and the pursuit of the collective good. Smith proposed that only the market and competition driven by self-interest be the regulators of economic activity. This is reflected in Smith's statement:

“By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes that of the society more effectively than when he really intends to promote it. I have never known much good done by those that affected to trade for the publick good.”⁴⁸

Smith adopts a Darwinian approach in the formulation of his theory by specifying self-interest as the *only* driver of a person's security and that the collective good is a by-product of that intent. Smith de-emphasises the cooperative, self-sacrificing actions that we are virtually compelled to engage in and thereby increasing the average fitness levels of the communities we live in. There is a strong measure of self-interest that we focus on when engaging in economic activity as was illustrated in the prisoner's dilemma. However, we strongly recognise that cooperation with others enables us to better withstand the rigours of our environments for individual and collective benefit. By hurting our personal fitness through cooperation, we can survive longer. The current economic climate of complexity and turbulence is the “invisible hand” at play, driving a strong desire towards re-establishing communities. Botsman and Rogers suggest that we are experiencing a tipping point of “what's in it for me, to what's in it for us”. They highlight that it is in our self-interest to stop global warming, to participate in elections, to correct an on-line entry in Wikipedia.

1.6. Organisational forms prevalent in the Knowledge Economy

The relentlessly turbulent, competitive and knowledge intensive society is an environment where agile, inter-dependent networked organisational forms have gained much more prevalence than the mechanistic bureaucratic forms that were built over a period of 300 years in the industrial age. Communities of Practice (CoP), Knowledge Networks, Collaborative Organisations and Virtual Organisations are some of the terms used to describe forms of organisation that are prevalent today.

⁴⁸ ADAM SMITH An Inquiry into the Nature and Causes of the Wealth of Nations vol2, Page 350

The community is a basic, foundational structure of our existence. The term “Community” invokes images of connection, kinship, unity, cooperation, convergence and identity. A Community, by its very nature, involves people being together, cooperating according to agreeable standards. The underlying tenet for community formation is the need for survival. Heilbroner points out that on a decent diet, human beings can produce just about one horsepower-hour of work daily and that with that, their bodies need to be replenished⁴⁹. Individually, he says, we are economically helpless. In modern society, we are extremely inter-dependent on others. As society evolves and becomes increasingly complex, individuals or small communities surviving unaided is becoming more and more unimaginable. The term “community of practice” (CoP), was ostensibly coined by anthropologists Jean Lave and Etienne Wenger in the early 1990's. Wenger defines communities of practice as “groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an on-going basis”⁵⁰. This is a broad definition and Wenger sites a few examples to illuminate the concept.

“Communities of practice were our first knowledge-based structures, back when we lived in caves and gathered around the fire to discuss strategies for cornering prey, the shape of arrows or which roots were edible. Engineers who design a certain kind of electronic circuit find it useful to compare designs regularly and to discuss issues of their esoteric speciality. Soccer moms and dads take advantage of game times to share tips and insights about the subtle art of parenting. Artists congregate in cafés and studios to debate the merits of a new style or technique. Gang members learn to survive on the street and deal with an unfriendly world. Frontline managers running manufacturing operations get a chance to commiserate, to learn about upcoming technologies, and to foresee shifts in the winds of power.”

Collaborative Organisational networks, much like CoP, form when firms work jointly beyond their mere transactional relationships towards a common goal. Different organisations can have a strategy together and this is referred to by De Wit and Meyer as a network level strategy⁵¹. They point out that organisations must necessarily form relationships with other organisations. Whilst relationships can evolve without strategic intent or tactical calculation, the building of external relations (even the avoiding of some) is a significant strategic factor that organisations must address. De Wit and Meyer identify eight major groups of external

⁴⁹ HEILBRONER, MILBERG: *The Making of Economic Society*. Twelfth Edition. 2008 Pages 1-10.

⁵⁰ WENGER et al.: *Cultivating Communities of Practice*. 2002

⁵¹ DE WIT AND MEYER. *Strategy Synthesis*. 2005. Page 153.

relational actors with whom the firm can, or must, interact. These relations are depicted in the following diagram:

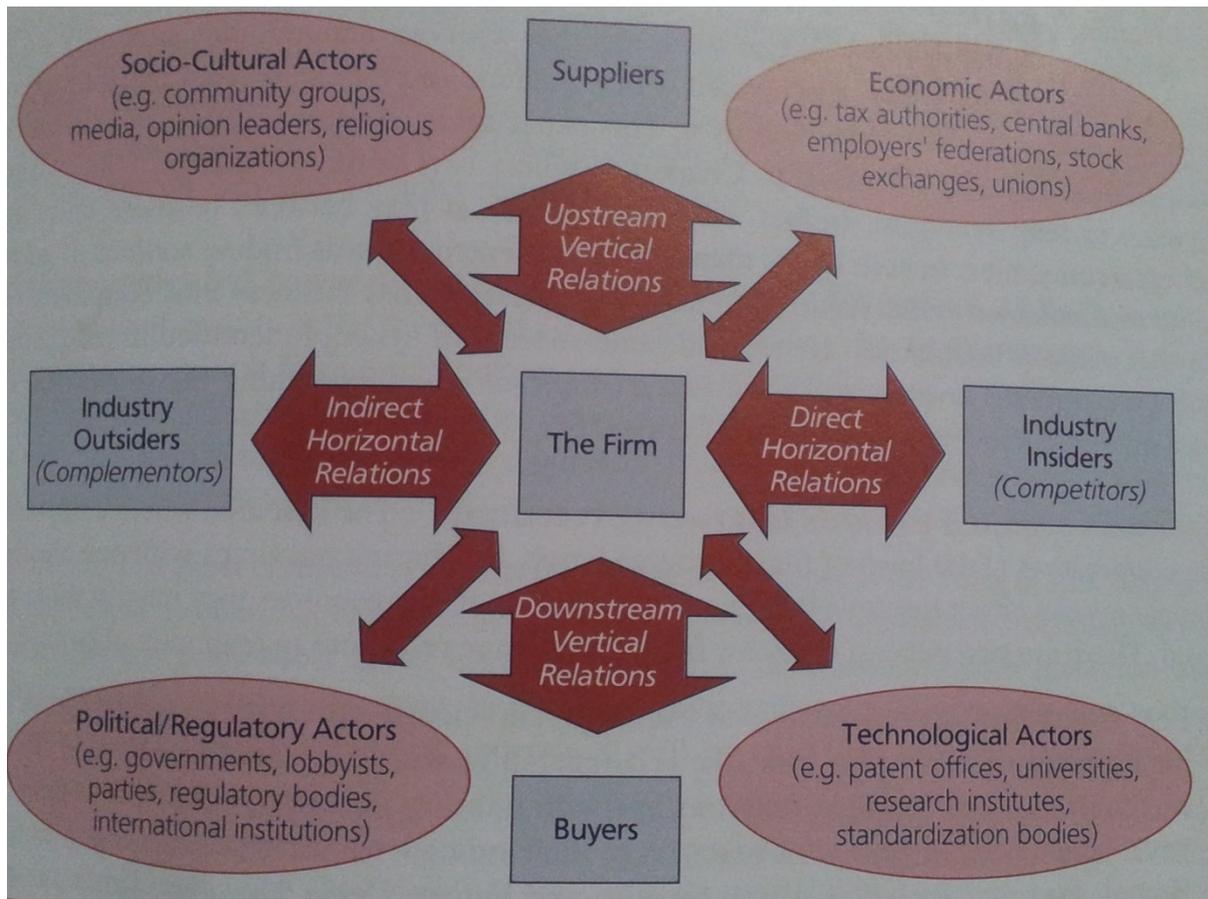


Figure 2: The firm and its web of relational actors – (De Wit, Meyer Strategy Synthesis (Page 155))

Rick Kash and David Calhoun call this new model of collaborative organisation the “demand chain”. They indicate that this model is a counterpoint to the traditional supply chain, with its information flowing in the opposite direction with results driving capabilities rather than the other way round.⁵²

De Wit and Meyer also point out that collaborative alliance is not only about working together towards a common interest, but that one must be assertive about one’s own interests. Alliances are both cooperative and competitive by nature⁵³. Competitive relations can be openly antagonistic on the one hand, but can also be more subtle where organisations’ objectives are less at odds. Cooperative behaviour will be exhibited by organisations where they need each other to succeed. In some instances, alliances could be occasional and in other instances, tightly-knit long-term virtual integration could develop. De Wit and Meyer point

⁵² KASH AND CALHOUN, *How Companies Win*. 2010. Page 196.

⁵³ DE WIT AND MEYER. *Strategy Synthesis*. 2005. Page 163

out that the creating of conditions leading to long-term, shared commitment between firms overcomes the short-term temptation by some to cheat their partners. To be willing to commit to high levels of inter-dependence, they say that parties need to *trust* the intentions and actions of their partners. In Nowak's terms, the collective mechanisms of cooperation yielding a favourable cost-to-benefit ratio must be strong enough to provide reasonable assurance that defection is an unlikely strategy. De Wit and Meyer indicate that highly cooperative behaviour is likely to obtain in situations where firms face a joint challenge that can only be resolved through mutual commitment. More restrained behaviour, on the other hand is more likely when the levels of dependency are low and parties seek to optimise their own return to the detriment of others. In cases where a high level of commitment is required, coordination and conflict-resolution mechanisms will need to be put in place to solve evolving problems that may emanate from the relationships as a consequence of the conflict between cooperation and competition.⁵⁴

1.7. The Rise of Collaborative Organisation

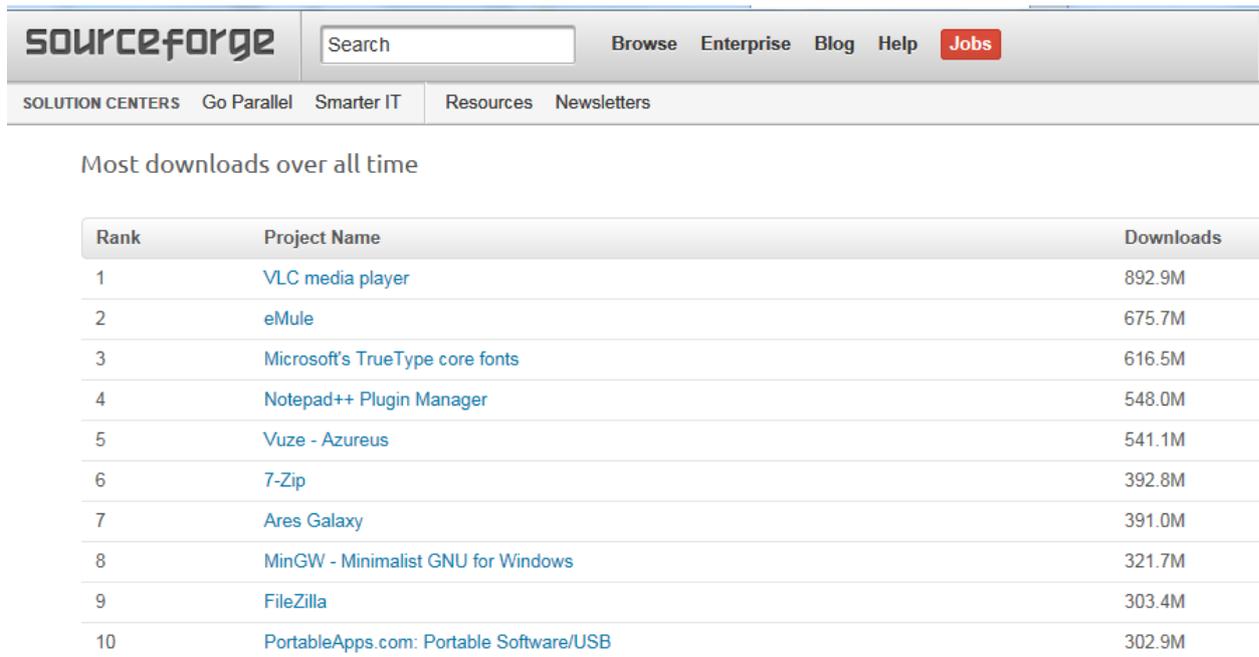
Communities of practice and Networked Organisations have mushroomed in the knowledge society, enabled by the ubiquitous capability of the internet converging with other communication technologies that provides the foundation for collaboration and fast-tracking of relentless innovation that would otherwise not have been possible. CoP of mammoth proportions have developed among individuals, interest groups, institutions of learning, and companies, both large and small, transcending geographic and other boundaries. This has given rise to accelerated shared product development, strategic outsourcing, and benefits achieved by economies of scale and economies of scope. Two examples that demonstrate the unprecedented scale of collaboration are provided below:

1.7.1. Open Source Collaboration

SourceForge is a centralized source code repository, accessible through its website (<http://sourceforge.net>) that allows software developers across the globe to work in partnership to develop software applications. According to its website as at 30 August 2013, 3.7 million developers were involved in collaborations in more than 430,000 projects. More than 41.8 million consumers downloaded applications from SourceForge and more than

⁵⁴ DE WIT AND MEYER. Strategy Synthesis. 2005. Page 165

480,000 downloads occur per day⁵⁵. The table below shows the top 10 downloads of all time which provides compelling evidence that CoP and network organisations work and are highly prevalent in today's knowledge society.



Rank	Project Name	Downloads
1	VLC media player	892.9M
2	eMule	675.7M
3	Microsoft's TrueType core fonts	616.5M
4	Notepad++ Plugin Manager	548.0M
5	Vuze - Azureus	541.1M
6	7-Zip	392.8M
7	Ares Galaxy	391.0M
8	MinGW - Minimalist GNU for Windows	321.7M
9	FileZilla	303.4M
10	PortableApps.com: Portable Software/USB	302.9M

Figure 3: <http://sourceforge.net/top> – 31/10/2014

1.7.2. Open Content Collaboration

Jimmy Wales, the co-founder of and promoter of Wikipedia a revolutionary open-content encyclopedia, outlined the vision as follows in a 2004 interview with Slashdot. “Imagine a world in which every single person on the planet is given free access to the sum of all human knowledge”⁵⁶. According to Wikipedia’s website⁵⁷ as at October 2014, Wikipedia has 33.7 million articles in 287 languages. The English Wikipedia has over 2.6 billion words, more than 100 times as many as the next largest English-language encyclopaedia, Encyclopaedia Britannica. Koch and Lockwood provide a compelling comparison of the construction of Denis Diderot’s *Encyclopédie*, compiled between 1750 and 1772 against the construction of Wikipedia⁵⁸. They explain that Diderot was commissioned to provide a translation of Chambers *Cyclopaedia* into French. Diderot’s project started well and attracted a number of contributors as well as four thousand subscribers. But then the French authorities found the

⁵⁵ <http://sourceforge.net/about>. Accessed 31/10/2014

⁵⁶ SANGEETH VARGESE. *Open Source Leader*. 2010. Page 20.

⁵⁷ http://en.wikipedia.org/wiki/Wikipedia:Size_comparisons

⁵⁸ KOCH AND LOCKWOOD. *Superconnect*. 2010. Pages 75-78

encyclopaedia's tone to be too subversive, showing too much respect for common folk and too little for established traditions, the monarchy the aristocracy and the Church. A number of the collaborators fell away and Diderot was pressurised to write hundreds of articles himself. He personally supervised the printing, corrected proofs amidst mounting pressure and constant police interference. He completed the work after 22 years in 1772. Diderot then discovered that his publisher removed or revised many parts of the encyclopaedia that was found to be politically sensitive. Koch and Lockwood point out that, despite the immense difficulties experienced, *Encyclopédie* was a great practical and intellectual achievement but the cost was enormous and the objective of making all available knowledge to all people was not achieved. Koch and Lockwood quote David Weinberger, fellow of Harvard's Berkman Centre for Internet and Society who highlights the "epically important" lesson that can be learned from Wikipedia. It has "really proved something...we now know without a doubt that some immense and complex works can be created by removing most of the elements of control". Koch and Lockwood highlight two telling contrasts between Diderot's and Wales' work. The first is the scale and achievement of the projects. Diderot initially had more than one hundred collaborators whom he needed to cajole and pay. As political pressure mounted, a number of his fellow collaborators abandoned the project. *Encyclopédie* reached a few thousand users. As at October 2014, the Wikipedia website reports over 49 million contributors (called Wikipedians). Wikipedia reaches hundreds of millions of people. The second contrast is the relative ease at which the projects were achieved. Koch and Lockwood point out the stark contrasts between the two projects.

Diderot toiled slavishly on his own for two decades. Wales worked part-time on Wikipedia and it was hugely successful in twelve months Diderot poured his life energy into Encyclopédie and it wore him out. Wales' life was immeasurably enhanced by Wikipedia. Diderot was persecuted by the establishment. Wales was welcomed into it. Time magazine named him as one of the hundred most influential people in the world.

Jimmy Wales describes the building of Wikipedia using the "piranha effect" metaphor⁵⁹. Piranhas are small innocuous-looking carnivorous fish that singularly might give one a nasty bite. But collectively, they can devour a cow in a feeding frenzy in a very short space of time. The piranhas work as a team and each one is attracted by the activity of another. Likewise,

⁵⁹ ANDREW LIH. *The Wikipedia Revolution*. 2009. Page 83

Wikipedia depended on a rich culture of online users who were accustomed to collaboration and group behaviour.

The above examples clearly indicate unprecedented levels of cooperation between individuals and business organisations. There is clear evidence of the power of cooperation through indirect reciprocity for the benefit of the public good. The examples also provide some insight into how networked structure can promote cooperative behaviour that can produce advanced work spontaneously without rigorous regimental and hierarchical management and organisation that was prevalent in the industrial economy. Friedman quotes Joel Cawley, the head of IBM's strategic planning unit: "What we are seeing in so many different fields is that the next layers of innovation involve the intersection of very advanced specialities.

1.8. Network Characteristics

Networks, be it social or organisational, are characterised by 3 crucial elements, viz. Strong Links, Weak Links and Hubs. According to Koch and Lockwood⁶⁰,

- Strong links typify the lasting relationships we have with individuals around us such as family, friends and work associates. Strong links are important for our emotional well-being but can be dangerous if there is too much reliance on them. They point out that Sociologists have proved that those people that are too reliant on strong links tend to be isolated, deprived of much valuable information, and are unable to improve their lives.
- Weak Links are among the most powerful and creative forces. These are the links that we have with people who are more acquaintances than friends or even strangers that we happen to meet. These links require little or no time or no effort to maintain and yet can result in enormous dividends.
- Hubs comprise groups of people collaborating for some common purpose including families, businesses, social circles, schools, churches, clubs and nations. Individuals can belong to many hubs. Hubs are greater than the sum of the people that participate in them. They have lives and characters of their own and are shaped by particular scientific laws. Unlike our forbearers, we are able to participate in many more hubs

⁶⁰ KOCH AND LOCKWOOD, *Superconnect*. 2010. Pages 8-12

during our lives. Our degree of fulfilment depends to a large extent on the hubs we select and how adept we are at changing from one hub to another. Our characters, successes and failures are not purely individually determined. Rather, the hubs we choose or find ourselves in have much to do with who we are as individuals.

1.8.1. Network effects of convergence / rising and falling stars

Koch and Lockwood argue that there is a tendency for networks to concentrate around only a few hubs. The more connected our world becomes, the more we will experience an ever-increasing concentrated world in most categories. They cite an experiment performed by a physicist, Albert-László Barabási, and one of his students, Réka Albert, that constructed maps of linkages of websites with other hubs and users on the Internet. The pattern indicated that a few hubs had a tremendous number of links whilst, on the other hand, the great majority in any system had few linkages. Another regular pattern discovered was that every time the number of links doubled within a small area of inspection, the number of links to other hubs in the same area declined by roughly five times. This is called the *power law distribution*, where a few hubs nearly hog all the links⁶¹. A number of examples of the power law distribution are evident in society today. On the internet, for example, Google (search engine), eBay (buy and sell), Facebook (Social Networking), Twitter (Social Networking).

Koch and Lockwood point out that this convergence towards commonality in an increasingly super-connected world is not a new phenomenon. They cite Michael Kraus, one of the first academics to investigate “language death”, who estimated that there were about 15 thousand human languages ten thousand years ago, formed as people began to migrate across continents and lived in isolation over long periods of time. Today, Kraus says, there are only six thousand languages ten thousand years ago, formed as people began to migrate across continents and lived in isolation over long periods of time. Given the extent to which people today increasingly communicate across the globe, Kraus predicts that in another hundred years, there will only be six hundred languages. Nowak states that it was indirect reciprocity that propelled the development of human language. Language is the medium through which people interact with one another, exchanging ideas, sharing their thoughts and ideas. In this way, Nowak says that language is intimately linked with cooperation. Nowak calls indirect reciprocity the “midwife of language”. He says that language had to evolve with cooperation

⁶¹ KOCH AND LOCKWOOD, *Superconnect*. 2010. Pages 183/184.

because individuals will not bother learning new ways of communication unless they are already working together to some extent⁶². This argument provides credence to the “language death” studies that suggests that the more global we become in our need to communicate, the more convergent we will be in our communication mechanisms.

The examples provided by Koch and Lockwood are in support their argument that in an increasingly networked society, we are more likely to see more dominant stars than in less network-reliant markets. Whilst the network seemingly levels the playing field, it is often the case that the networked society is dominated by a few hubs. This suggests that in a highly connected world, the winner-takes-all concept prevails. This convergence towards commonality within a highly connected world has a tremendous impact on how innovative businesses position and organise themselves to be able to build products and services that enable them to compete favourably, both globally and locally.

⁶² NOWAK M. 2011. *Super Cooperators*. Page 173.

Chapter 2

2.1. Remodeling Regional Economies to prosper and survive

Many regions across the world have re-organised themselves economically by developing adaptive approaches to navigate rapidly changing environments and thereby maintaining and growing their economic strengths that they have become known for. Regional economies including firms, sectorial bodies and governments continually need to contemplate all four of Boisot's strategic processes, straddling immediate to long term decision making (see Chapter 1 - page 9) to respond to the threats that they face, and to find novel and innovative ways to create a climate for growth and prosperity within their region. Charles Hampden Taylor⁶³ points out that when one is uncertain of the future state, it is difficult to derive a good strategy. He advocates scenario construction as an effective means of examining alternative futures from which strategies can be derived. He suggests the following three guidelines for scenario construction:

- Generate Models because they help to recognise meaningful patterns in the world.
- Most scenarios will be wrong. Painting different scenarios allows us to notice their refutations.
- We should not stake our future on any one preferred outcome. The key is to prosper and survive across potential futures, however foreign they might be.

In KwaZulu-Natal, for example, there are a number of companies that have a variety of innovations, some of which are in similar or connected domains. When considering how best to engender and support organisational networks that will derive the *best* economic value for the region, it is prudent to examine a number of possible futures. This also involves one of Weick's seven properties of sensemaking he terms as "grounded in identity construction". One of the key activities would be to project organisations and their perceived organisational networks onto the global environment within which they operate. In turn, this allows for organisations to act or model themselves individually and collectively in relation to their

⁶³ Bob Garratt. *Developing Strategic Thought*. 2003. Page 122.

environment such that it leads to greater preparedness, predictability and more certain, positive futures.⁶⁴

Hampden Taylor paints scenarios three different forms of capitalism practiced by North America, Greater Europe and Japan were deployed to build strong economies in these geographical regions. The key points that identify the master strategies of the regions are provided below. This is followed by a summary of the salient common and critical factors that lead to greater regional global competitiveness.

2.1.1. North America's successes

- North America moved away from an individualistic and self-indulgent culture into a more creative and global focus. America is known for its leading edge in business scholarship and began to seriously study different cultures of competitive advantage and chose the best from each nation.
- The country maintained its dominance in superconductivity, biotechnology and nanotechnology through native creativity, ingenuity and innovation. It forged itself into an impregnable position in telecommunications because of its huge investment in satellites making it virtually impossible for alternative systems to compete.
- The inclusion of women into higher ranks of executives contributed to the emphasis of relationships and Japanese women joined American companies.
- America used its political leadership to create an unassailable competitive position while systematically raising standards of quality and benchmarking.

2.1.2. Greater Europe's cooperative era

- Hampden Taylor makes the observation that countries such as Germany and Japan that have suffered severe losses through war and adversity have developed economically faster than the winners such as Britain. This is an enactment of an inbuilt survival instinct of identifying and leveraging cooperative 'attractors' in

⁶⁴ KARL E. WEICK. *Sensemaking in Organisations*. 1995. Page 22/23.

chaotic environments, resulting in patterns of aligned forces directed in this case towards building success as espoused by complexity theorists.

- Germany placed Rhenish capitalism at the heart of Europe. At the heart of this economic philosophy is the conviction that disputes about wealth distribution had to cease in the interest of consensual wealth creation. A nation could not develop by taking away from its workers or its entrepreneurs. The Social Charter, adopted in 1961, emphasised the importance of economic development through mass upgrading of skills, the proper remuneration of employees, the encouragement of entrepreneurship and cooperative development across nations.
- Greater Europe's economic development arose from its institution building. The European Economic Community, for example, was, according to Hampden Taylor, "built brick-by-brick into a social market that represents 292 million people, the largest market of properly educated and developed people on earth"⁶⁵.
- Greater Europe encouraged worker and employer co-determination as well as cross-organisational cooperation. It also encouraged European -wide clusters of cooperating partners to complete in skills, but not to lower wages.
- In Europe, corporations were not competing head-to-head but began to form semi-partnership links of reciprocal support.
- Rhenish capitalism developed a bias in favour of engineering, manufacturing and production against large money markets and dominance by financial institutions.
- Hampden Taylor describes the English-speaking world as being too distrustful and too intellectual and too posturing. Yet as a consequence of the turbulent economy and the realisation that it needed to collaborate with her neighbours so as not to drift into the economic wilderness, Britain signed the Social Charter in 1997, 36 years after implementation.

⁶⁵ Bob Garratt. *Developing Strategic Thought*. 2003. Page 128.

2.1.3. Collaborative wholes of the East

Keiretsu (consortia) is a typical practice of Japanese business and strongly aligned to their culture. Much has been written about how Japan and indeed other eastern countries, unlike the west, thought in wholes and not in parts. Their strategic thinking is inclusive, lateral, multi-dimensional and mutual. Gibson, et al, describes one form of Japanese Keiretsu as follows⁶⁶:

Keiretsu involves a very large financial institution, a very large industrial conglomerate, and smaller firms in a network of relationships that enable the large firm to produce the product and the smaller firms to supply components, do research and design, and perhaps distribute and market. The participating bank provides the financial requirements to support the network of cooperative relationships. This form of inter-organisational network has enabled the Japanese industry to grow without bottlenecks of supply and damaging competition from domestic firms.

Hampden Taylor makes the following key points about the Japanese model of developing networked organisation:

- In the consortium, who ‘makes’ money and who ‘loses’ money is irrelevant. It is the relationship that makes money more so than could be made separately by the parts. A great deal of cross-subsidisation takes place in order to gain competitive advantage. The gaining of market share (what you put in), and not a pure profiteering (what you get out) is a key focus of the Japanese Keiretsu.
- Japanese firms have developed an obligation to each other forming tight co-operating consortia that are mutually dependant. Companies develop a strong convergent strategy that generate creative innovation deliberately cross-fertilization building dense skills and knowledge.
- Japan targeted meta-technologies (tools that make tools), also referred to as horizontal technologies, because hundreds of vertical technologies benefited from them.

⁶⁶ GIBSON, IVANCEVICH, DONNELLY, KONOPASKE. *Organisations: Behaviour, structure, processes*. 2003. Page 402.

Examples such as industrial robots used in manufacturing and microchips used for in computer equipment and artificial intelligence machines across multiple domains are cited.

- In 1992, it had been pointed out that the rate of economic development correlated positively with the number of engineers, but negatively with the number of MBA's. By 1995 there were over 1000 Institutes of Mechatronics in Japan. These were dedicated to the proposition that a large number of future processes in manufacturing would fuse electrical engineering with mechanical engineering.
- By analysing the customer's latent needs, Japanese companies could also cross-fertilise the developing knowledge of the customer with the developing knowledge of its own technologies.

The 3 scenarios painted by Hampden Taylor, whilst containing divergent approaches, illumine a number of common key pointers that underpin the development of a viable economic model for regions. These include:

- Build on and leverage the strengths that exist within the region.
- Focus on skills development, especially in areas of science and engineering. There is a positive correlation between economic development and these skill-sets.
- Develop learning environments that produce the requisite variety of supporting skills. These skills should largely be concentrated in areas of regional strengths and economic focus.
- Create an enabling environment that supports organisational knowledge-diffusion networks. The supporting environment could incorporate financial institutions, institutions of learning, government's local economic development, building infrastructure, etc.
- Align economic activity with cultural norms and values that promote the public good. Within a South African perspective, this includes Broad-based Black Economic Empowerment, women empowerment, employer-employee co-determination and cross-organisational cooperative practices that reduce head-to-head competition.
- Foster political leadership to develop policies that support local innovation.

Hampden Taylor's observation that countries ravaged by war such as Germany and Japan have developed economically faster than winning nations is a particular encouraging point for South Africa, given our dark history of 300 years of colonialism and Apartheid. The galvanising spirit of nation-building can be a strong motivating force for spurring cooperative development.

2.2. Regional Collaborative Networks

2.2.1. Complexity theory in action – The Humberside TEC

Michael Jackson provides a case study of the Humberside Training and Enterprise Council (TEC) that was established by the UK government by privatising the civil service to promote local economic development. This case study is provided as an example of complexity theory in action within a region⁶⁷. The TEC comprised seventy private companies. The role of the TEC was to ensure appropriate education, training and development, advice counselling, provide help in finding training solutions to business problems, and increase competitiveness and growth in Humberside's economy. According to Jackson, the MD, Peter Fryer, pushed the TEC to the edge of chaos and described his role as: "explore the environment, share feedback, clear pathways, give oceans of support and bugger things up!" Three principles of organisation that the TEC adopted were: 'make connections', 'learn continuously', and 'make processes ongoing'. Regular learning and networking conferences were held for all staff. Informality and accessibility to all levels became the norm. Many learning approaches and activities were adopted and staff completed a monthly activity sheet indicating what they had learned. The concept of making process on-going was to emphasise the need to self-organise within changing environments. TEC policies were changed to be outcomes-based rather than the specification of rigid processes and procedures.

Peter Fryer describes how he used the principles of complexity theory to transform the TEC into an efficient and adaptable organisation⁶⁸. Complexity theory encourages a shift from a command and control style of management. It challenges the idea that an organisation should strive for equilibrium and recommends that they should operate at the edge of chaos. The

⁶⁷ MICHAEL JACKSON 2003. *Systems Thinking. Creative Holism for Managers.* (Page 125-128)

⁶⁸ GEOFFREY HIGGS 2003. Seminar notes on 'Intra Organisational Network Development, The Humberside TEC experience. Presented by Peter Fryer (<http://www.trojanmice.com/humberside.htm>)

TEC was formed by privatising part of the civil service that dealt with training and business support and comprised of seventy private companies that employed about two hundred staff and had an annual turnover of about 35 million pounds. He states that the TEC associated itself with the London School of Economics and this association laid down the theoretical principles of complexity that explained why some of the principles that they had already started doing practically were working. Fryer describes the TEC as a “complex evolving system” which he says raises the questions and answers thereto and consequently what opportunities arise that may be exploited. Learning environments are continually engaged in feedback loops that can deal with the challenges of a turbulent world. According to Morgan⁶⁹, most organisations are proficient at single-loop learning, developing an ability to scan the environment, set objectives and then monitoring the system according to these objectives. Double-loop learning involves an additional step of questioning the relevance of the operating norms and this was what Fryer tried to inculcate in the TEC. The TEC adopted a network systems model originally produced by Chris Langton and Fryer describes the basis of the model as follows:

“It’s a very simple model that assumes there are a number of agents that are connected. We cannot predict or dictate what is going to happen, but from those connections, regularities and patterns form which then feed back into the system. And that simple model enabled us to ask a whole host of new questions. What were the boundaries of our system? Who were the agents and how were they connected? What were the patterns forming? What were the mechanisms of feedback that we had. Those questions by themselves brought about change because we would never have dreamed of asking them before”

This description is clearly aligned to the “Organisations as brains” metaphor as described by Morgan⁷⁰. Morgan uses this metaphor to examine the possibility of distributing holographic capacities for intelligence and control throughout the organisation so that the system can self-organise as emerging opportunities and challenges present themselves. Fryer saw the organisation as a learning organisation and a cybernetic approach is evident in his portrayal of the TEC. According to Morgan, cybernetics suggests that learning organisations must allow them to do the following:

- *Scan and anticipate change in the wider environment to detect significant changes.*

⁶⁹ GARETH MORGAN 2006. *Images of Organisation*. Chapter 4. Pages 84-87.

⁷⁰ GARETH MORGAN 2006. *Images of Organisation*. Chapter 4.

- *Develop an ability to question, challenge and change the operating norms and assumptions.*
- *Allow appropriate strategic direction and pattern to emerge.*

Also, in achieving these aims, they must

- *Evolve designs that allow them to become skilled in double-loop learning, to avoid getting trapped in single-loop processes, especially those created by traditional management control systems and the defensive routines of organisational members.*

Fryer points out that the organisational interaction in the TEC was made up of three things, viz.

- Objects such as computers and hardware devices.
- Closed systems such as electricity supply and health and safety checks.
- Open systems such as those involving relationships and conversations with people and networks within and without the organisation, creativity activities being carried out, etc.

Fryer states that in most organisations, people treat open systems as closed systems and that the government, in particular never fully understood the concept of open systems. One of the main tasks of the TEC was to identify which systems should be treated as closed and which should be treated as open. This, he says, had a tremendous impact on the functioning of the organisation.

Fryer makes a pertinent point that we often view a network as a clinical entity that can be cleanly picked out. All our networks, he says, is interspersed with other networks and they all affect each other. Fryer portrays the TEC as a network of networks and part of a community which itself is a network of networks. The TEC is part of all the training and support network provider networks, part of the learning infrastructure network and the national TEC's network and so on. Fryer identifies five critical aspects of building effective organisation within network complexity that were practiced by the TEC. These are autonomy, connectivity, feedback, community and leadership and Fryer's suggestions are briefly summarised below.

1. Autonomy.

The principle is that people know what to do and thus there is no need for policing and reminding them about their responsibility. People should be treated as responsible adults and be trusted. This, Fryer says, places moral responsibility on them. When

mistakes happen as they invariably do, it places one in an unexpected position. Learning takes place when mistakes happen. Fryer states the TEC sought to remove 'stabilisers' that actually obstruct the learning and development process. He uses the analogy of teaching a child to ride a bike. Initially, two extra wheels are placed alongside the back wheel that acts as stabilisers. Once the child has mastered how to ride the bike, the stabilisers are removed. Some business stabilisers that Fryer identifies are signing in and out, filling in of timesheets, rules, procedures, processes and systems that tend to force people into line rather than allowing a culture of taking responsibility. Fryer also sought to remove formal hierarchy, formal job descriptions, budgets that tended to wrongly focus on the money rather than the activity. The most expensive activities is 'managing' and 'checking'. Fryer says that they told each person that they are their own manager and they saved a fortune.

2. Connectivity.

Fryer notes that connectivity is a critical aspect of networking and that the nature of the dialog and communication amongst connections are fundamental. The TEC placed emphasis on ideas and knowledge sharing. They brought communication experts in to assist with converting the initial argumentative winner-takes-all conversation to a more collaborative, sharing and development of ideas. Persons who went to meetings to represent a team were given the power to commit on behalf of their team. This ensured that reliable persons who could be trusted to were selected and this improved connectivity and got the job done. There was recognition that the real business of the organisation took place at the interface between the staff member and the client or stakeholder. The more staff were capacitated to inter-connect with clients and empowered to take decisions on behalf of the TEC, the better the standards and efficiencies of service that could be provided. This approach also encouraged people to be more creative, to feel a valued part of the organisation and consequently to work smarter. According to Fryer, there was a time that they ran out of meeting rooms. In order to improve communication, they established a coffee shop in a busy area of the building. Free coffee and tea were provided and the open plan had the advantage that people who were passing by often joined in on the conversation. He states that meetings lasted only as long as they needed, whereas meetings in meeting rooms lasted as long as the time the room was booked.

3. Feedback.

Like complexity, Fryer says that feedback is happening around us all the time. He expresses the importance of both external and internal feedback and the TEC provided training to their staff to pick up and give feedback verbally. Learning and emergent forms of organisation place considerable emphasis on double loop learning to transcend the constraints of single-loop processes and defensive routines that tie an organisation to the past⁷¹. The TEC philosophy resembles Morgan's learning organisation and a culture of learning to learn was a key priority for the TEC.

4. Community.

The TEC functioned like a community where people felt a sense of belonging. This, Fryer says is an aspect of networking. He says that people would be engaged long beyond the call of duty. The only rule was that people must act in the best interests of the organisation.

5. Leadership.

Fryer says that it was important to have lots of skills and talent to be adaptable and to spot patterns as they emerged or even before. It meant that people needed to be given the space to try things out, to "hold" leadership and to create the space of possibilities. This style of dispersing leadership throughout the organisation allowed Fryer as the CEO to

1. Explore the environment by being very well connected both internally and externally.
2. Exploit networks constantly as patterns emerged and then to encourage the formation of communities of practice to maximise the knowledge and information that the organisation had.
3. Clear pathways by finding the "stabilisers" that seemed to be good ideas but was stifling the culture of self-responsibility and accountability and thereby impeding efficiency.
4. Feed information to others more directly, provide support and help them grow their connectivity.

⁷¹ GARETH MORGAN 2006. *Images of Organisation*. Page 97.

Michael Jackson states that if organisations are pushed away from equilibrium towards the edge of chaos, self-organisation occurs naturally and organisations become capable of infinite variety and more responsive to more flexibly to changing, turbulent environments. He contends that this is essential because, as with fitness landscapes in biology, only flexible organisations are able to take “adaptive” walks to “higher fitness points”⁷².

2.2.2. Lessons from the Flat Panel Display Industry

The flat panel display (FPD) research done by Jennifer Spencer is provided to demonstrate the power of how regional strategies of developing convergent, knowledge-diffusion networks can be so powerful that it can result in the total domination of the global market. Spencer’s work provides important insights into network structure that consists of central firms, network density between participating firms. Her study also highlights the importance of knowledge diffusion within regional collaborative networked organisations as well as how knowledge inflow from and knowledge outflow to the outside world are effectively managed and controlled through gateway and representative companies of the regional network.

Jennifer Spencer conducted a longitudinal analysis of patterns of knowledge diffusion networks spanning 20 years in the Flat Panel Display (FPD) industry at national, regional and global levels. FPDs are thin displays used in devices such as televisions and portable computers. Her study supports the notion that new knowledge is rarely appropriated by a single innovator. Instead, advancement in knowledge diffuses to other organisations through formal and informal knowledge-diffusion networks. Spencer argues that knowledge diffusion networks are important competitive sources for firms, yet the significance of the network is often overlooked. She believes that attention must be given to understanding the structure of these networks. There needs to be a deeper understanding of the patterns of interaction in national, regional and global networks. Spencer makes the profound point that knowledge diffusion networks may well influence the evolution of a country or region’s industries and the competitiveness of its innovation firms. Spencer’s study identifies patterns of knowledge diffusion among North American, Japanese and European firms from the earliest published technological breakthroughs until the beginning of large-scale manufacturing of FPD portable computers.

⁷² MICHAEL C. JACKSON. *Systems Approaches to Management*. 2000. Page 197.

The technological cycle from innovation to discontinuity as a consequence of a new innovation described by Spencer is completely in line with complexity theory. The cycle begins with a rare, unpredictable product innovation that offers significant cost, performance and quality advantages. An era of ferment follows where competition grows between new product designs and between rival approaches to the new product. During this period, a considerable amount of ambiguity and uncertainty ensues and competing firms begin to disperse along different technological trajectories. This is a turbulent period for business and firms initially tend to back their own product designs to win early competition. The era of ferment ends when a single technology emerges as the winner. What starts out as a single fluctuation becomes so powerful that it completely shatters the pre-existing order and a new, higher level dissipative order arises. This is the bifurcation point. An era of incremental change will persist until another technological discontinuity will launch another subsequent era of ferment.

According to Spencer, the FPD innovation caused a technological discontinuity in the display industry in the 1960's and opened competition between the Cathode Ray Tube, Light emitting diodes and other display technologies. Most FPD technologies were initially invented in US laboratories. A group called RCA was responsible for some of the most noted innovations and they kept their technical advances secret until the end of the decade. Once RCA announced its accomplishments, worldwide excitement occurred overnight. Competition emerged between FPDs and other display technologies in devices such as computers, airplane cockpits, digital watches and calculators. During the era of ferment, firms developed displays using a variety of approaches including electroluminescent, plasma, liquid crystal and several other technologies. Initially, some firms such as Exxon and IBM adopted more than one technology. The enormous cost of Research Development (R&D) made it impossible for all firms to pursue all technologies and most firms adopted a single approach. During 1973 and 1974, there was intense competition between firms' designs. In the 1983-1984 period, gradual convergence of designs began to emerge and ultimately in 1989, the era of ferment ended when the LCD emerged as the winner. 100% of portable computers produced after 1989 contained an LCD and almost all the manufacturing took place in Asia.

Spencer studied the different strategies of firms in North America, Europe and Japan from the early competition in the 1960's through to gradual convergence of Liquid Crystal Displays (LCD's) as the dominant design in 1983-1984. During the period of ferment, she found that Japanese companies exhibited a later accumulation of entries into the market and a less

pronounced exodus of firms in relation to the west. Exits from the market tend to occur when firms do not adopt a dominant innovation early and stick to their initial designs, or because barriers to entry are raised by the innovation and profit margins decrease making it difficult for least efficient firms to survive.

Spencer found a number of different approaches between the various regions during the various stages of the technological cycle. Spencer contrasts North America, where firms pursued at least 8 different approaches against the Japanese whose firms pursued only 4. Japanese firms clustered around LCD's and as convergence to the dominant design developed, American and European technologies were unable to compete. Japanese companies commercialised displays in basic applications such as calculators and watches in the early stages whereas the Americans and the Europeans kept their efforts in the laboratory. This early commercialisation strategy enabled Japanese firms to develop process competencies that strengthened their ever-increasing dominance in the market. These dominant trends continued beyond the bifurcation point and Japanese firms held the majority of market share in the FPD industry once large-scale manufacturing began.

Spencer explored the knowledge-diffusion networks that arose during the era of ferment. Knowledge diffusion in the FPD industry took place through a number of structures. The Society for Information Display hosted a number of technical conferences in the 1970's between North America, Japan and Europe. The forums led to knowledge diffusion and an accelerated pace of technical advancement. Physics journals were published and researches reported that their most important source of technical information came from articles written by corporate scientists rather than university publications. This prompted Spencer to explore knowledge-diffusion networks from university and industrial resources. 3448 articles written by researchers in FPD firms were used to construct knowledge-diffusion networks and 34,802 citations were aggregated to the firm level. Spencer explored the standard network constructs of network density, centralisation, Euclidean distance, adjacency and reachability through citations and examined their significance in striving for global dominance. These constructs are described as follows:

1. *Density* reflects the proportion of potential ties between firms that have been completed. Density represents the active ties of participating firms in the network that facilitate cross-fertilisation and deep collaboration of knowledge and skills that catalyses innovation and market growth.

2. *Centralisation* indicates the degree to which a small number of firms hold prominent network positions.
3. *Euclidean distance* reveals which actors are ‘close’ to one another based on the number of ties between them.
4. *Adjacency* reflects the percentage of firms that maintained at least one direct citation tie.
5. *Reachability* indicates the percentage of domestic and foreign firms connected through a series of ties.

Spencer also analysed regional and global networks. Regional networks included only firms whose headquarters were in the same region. Her analysis of these networks covered three distinct periods, viz.

- the 1969-1973 period that spans the initial FPD breakthroughs to the early phase of commercialisation
- the 1974-1983 period that saw an increasing number of entries into the industry.
- the 1984-1988 period that saw a decline of FPD firms and the emergence of LCD as the dominant design.

The figure below shows the number of firms that were active in the FPD industry in each of the regions during the 3 periods described above.

		<i>Europe</i>	<i>Japan</i>	<i>North America</i>
Period 1	1969–1973	6	15	24
Period 2	1974–1978	8	20	30
	1979–1983	11	25	37
Period 3	1984–1988	11	25	39

Figure 4: FPD firms

All the firms in Asia were Japanese. Firms in Europe came from Finland, France, Germany, Italy, the Netherlands, Switzerland and the UK. Two of the North American firms were from Canada and the rest were from the US.

Spencer found that there were no clear trends in the global density (density across regions) of the network. Linkages across regions remained fairly static. European density was higher in the 1970s than the 1980s. In North America, density levels declined over time, with about 10% of potential ties bridged in Period 1 whereas in Period 2, only 4% of ties were bridged. In contrast, density in Japan increased from 0% in period 1 to 15% in period 3. North American networks showed the highest centralisation in the first two periods and the lowest in Period 3. Japan showed the opposite trend with higher centralisation in the third period. As LCD dominated the market, Japan's network density in the FPD industry increased.

The study showed that Euclidean distance and adjacency was much higher with companies in their home region. Firms did not maintain as many ties with foreign firms as they did with firms in their home region and there appeared to be an indirect connection to firms from other regions. The implication is that knowledge flows from one region to another are via indirect paths of knowledge diffusion networks.

Spencer also identifies gatekeepers and representatives (the network links) as knowledge channels that regulate the degree to which knowledge flows from one group to another. Global gatekeepers absorb knowledge from foreign firms and convey it to domestic firms. Representatives absorb knowledge from domestic firms and convey it to foreign firms. Her research shows that firms that act as knowledge brokers hold positive implications for their future position. The findings indicate that of the firms ranking in the top 10% of gatekeeper status during Period 3, 67% went on to become the largest FPD producers within the next 2 years. In contrast, only 9% of gate-keeper firms and 5% of representative firms became top-10 manufactures by 1990.

Spencer's empirical findings show that North American and Japanese industries displayed their greatest competitiveness when their regional knowledge-diffusion networks exhibited the highest density and centralisation. When firms are connected to a technological community, the cooperative forces increase internal research, builds an industry infrastructure, tracks and shapes an institutional, clustered environment evolving in the environment and provides the platform for external advances. Spencer does warn, however,

that the building of regional clusters around a small number of central firms gives a few firms the opportunity to strongly influence the development of their industry technology. This influence may have both positive or negative industry outcomes based on the technical viability and eventually commercial acceptance of those central firms' technologies.

Spencer uses her findings on knowledge-diffusion patterns to offer six propositions of how to exploit network constructs to increase the competitiveness of regional and national firms in science-based industries. These propositions are summarised below.

- 1. Relatively high levels of density in a national or regional network will associate with higher global competitiveness for that region's industry.*

Spencer's research shows that Japanese firms' network density increased over the 20 year period whereas North American and European firms' network density declined during the same period. Her study could find no clear trends in the density of the global network. Dense networks (especially locally based) can facilitate the knowledge diffusion across firms and can help build consensus, facilitate convergent approaches and communicate the standards and accelerate the design speed and progress towards commercialising viable products. Increased investments in technology results from inter-firm learning and increases the chances that the technology will win the dominant design. Convergent technological approaches attract investment and allow innovators to speak more loudly and influentially when the network support is dense. Early convergence and commitment by participating firms on a dominant design may increase the barrier to entry for rivals. At the same time, early convergence can limit technical options and reduce research on promising alternatives.

- 2. National or regional networks that exhibit high levels of centralisation and density will be more likely to facilitate convergence on a dominant design than networks with low levels of centralisation and density.*

Spencer states that countries with corporatist systems (prevalent in the east) are characterised by more enduring national interest groups that participate in the decision-making structure of state, whereas countries with pluralist systems (prevalent in western societies) house more independent groups that arise to target specific issues and then disappear. Spencer highlights the importance of the how the establishment of strong and

viable industry associations and research and development consortia in corporatist countries increase the density of knowledge diffusion. She also mentions how the Japanese government pursued policies to bring FPD industry firms together in research consortia to hasten the development of LCDs, plasma displays, VLSI circuits and other technologies. Another pertinent point that Spencer raises, is the inculcation of an ideology that supports knowledge sharing. Spencer's research showed that throughout the time period of 20 years, Japan's peak network density levels was about 50% higher than North America's network density levels at their peak. Spencer gives an example of how American companies who belonged to the SEMATECH (Semiconductor Manufacturing Technology) consortium resisted divulging technological knowledge to one another whereas the Japanese network saw increasing density over time. Pluralist systems that do not have a prevalence of social institutions and that support independence and competition among business organisations reduces the firms' incentives to form dense knowledge-diffusion networks and this is likely to impede the development and sustainability of dominant designs and global competitiveness.

3. *Corporatist countries are likely to display denser knowledge diffusion networks than pluralist countries.*

Spencer states that labour market mobility, common suppliers and customers, participation in regional institutions, and informal interaction among scientists contribute to the diffusion of knowledge in cities, regions and countries. Her research found that, in the FPD industry, the direct transfer of published scientific knowledge occurred more readily within countries and regions rather than between countries.

4. *Early in the era of ferment, generic qualities such as firm size will act as important determinants of a firm's status as a global knowledge broker. Later, attributes of a firm's investment in the technology will become important determinants of the firm's status as a global knowledge broker.*

When competition grows between new product designs, firms with cross-border strategies and reach are the most likely to be strong gatekeepers and representatives for knowledge flow.

5. *Throughout industry emergence, the multi-nationality of a firm's technology strategy will influence its status as a global knowledge broker.*

When a knowledge broker bridges firms with different and supporting innovations, they may profit from their strategic positions. Knowledge brokers hold access to unique sources of knowledge and may frame information such that innovating firms they bridge align their environments to suit the knowledge broker's own technologies. This could contribute to a firm's competitiveness or have a negative effect.

6. *Global gatekeepers and representatives are more likely to sustain their investment and capture market share after a dominant design has emerged in their industry.*

Spencer concludes that institutional structures, corporatism and government policies clearly influence the competitiveness of a country's firms. Her research suggests that policy makers should devise mechanisms to empower knowledge diffusion networks that arise among innovating firms. Institutional structures and government policies that target specific innovators or discourage firms from pursuing global strategies can affect the density and centralisation of industry networks and the emergence of firms acting as knowledge brokers. The configuration of the knowledge-diffusion network structure incorporating network density and centralisation is also deemed to be extremely important. Network density and centralisation enabled Japanese innovators to rapidly converge in developing a dominant design that saw a virtual 'take over' of manufacturing of LCD's. The role of firms that play a central role in the knowledge network is further elucidated in the next section.

2.3. Knowledge diffusion networks - guided by a strategic centre

Spencer's point of centralisation within knowledge networks is also strongly advocated by Lorenzoni and Baden Fuller who state that networks that are not guided by a 'strategic centre' will in all likelihood not meet the challenges of today's markets⁷³. Lorenzoni and Baden Fuller identify three dimensions of a strategic centre:

⁷³ GIANNI LORENZONI AND CHARLES BADEN FULLER. *Creating a strategic centre to manage a web of partners*. (Article found in DE WIT B. AND MEYER R 2001. *Strategy Synthesis*. Reading 7.2 Pg 373-383)

- a creator of value for its partners. Strategic centres recognise the importance of knowledge diffusion across the partnerships that make the whole.
- as leader, rule setter and capability builder. The central firm facilitates the development of core skills and competitive. Expertise s shared across the network.
- as simultaneously structuring and strategizing. Strategic centres create the vision in which partners play a critical role. They build a strong brand image and build effective systems and support partners. They create an atmosphere of trust and reciprocity. They develop mechanisms for attracting and selecting partners.

Lorenzoni and Baden Fuller provide examples of central firms and their activities, some of which are shown in the following reference table.

Name of Company and its Industry	Activities of Strategic Centre	Activities of the Network
Apple (computers)	<ul style="list-style-type: none"> • Hardware Design • Software Design • Distribution 	<ul style="list-style-type: none"> • Principal subcontractors • Manufacture • 3000 software developers
Benetton (apparel)	<ul style="list-style-type: none"> • Designing collections • Selected Production • Developing new technology system 	<ul style="list-style-type: none"> • 6000 shops • 4000 subcontractors in production • Principal joint ventures in Japan, Egypt, India, and others
Nintendo (video Games)	<ul style="list-style-type: none"> • Design • Prototyping • Marketing 	<ul style="list-style-type: none"> • 30 principal hardware subcontractors • 150 software developers
Toyota (automobiles)	<ul style="list-style-type: none"> • Design • Assembly • Marketing 	<ul style="list-style-type: none"> • Principal subcontractors for complex components • Second tier for other components • Network agents for distribution

Lorenzoni and Baden Fuller underscore the conception that the strategic web of partners extends beyond joint venture and subcontractor typed relationships. Partners are seen as an integral part of the central organisation. Strategic centres have a network view of governing a whole system. Lorenzoni and Baden Fuller identify the main features of the strategic centre's role as

- Strategically outsourcing more than traditional firms. Co-collaborators are themselves encouraged to be problem solvers and initiators.
- Partner capability development. Strategic centres assist in the development of core skills of partners to make them more competitive. They compel partners to share their expertise with others in the network including the central firm.
- Technology development through borrowing of ideas. This is seen as critical in creating and mastering new technologies.
- Encouraging competition between value chains and networks. The strategic centre encourages rivalry between firms inside the network in a positive manner.

The vision of strategic centres studied by Lorenzoni and Baden Fuller was not just considered to be the focus of the central firm. Their findings were that their visions dynamically emerged over time and changed as the network grew and as the environmental conditions changed. Successful networks were guided by a clearly formulated vision that was shared and embraced by participating firms. Central firms also retained key activities such as branding and systems that integrate the network. Central also play a critical role in developing trust and reciprocity within the network. According to Lorenzoni and Baden Fuller, the Benetton franchising system that they studied is an extreme form of a trust-based system. In the continent of Europe, Benetton does not use legal contracts but relies on unwritten agreements. The company claims that it focuses attention on making intentions clear. It also saves a great deal of time and expense.

Central firms that were studied pointed out that the partner selection must be done with great care. Collaborations between large companies will require careful consideration of matching capabilities and resources as well as considerations of competition. In the case of a large company partnering with many smaller companies, the centre acts as a developer of the community. Lorenzoni and Baden Fuller state that the strategic centres that they studies reject

the idea of doing everything themselves. Instead, mechanisms are found to determine how best to utilise the network to develop innovative responses to requirements.

This chapter provides a number of insights on how the regions that were studied have responded to complexity through the development of economic structure incorporating knowledge diffusion networks to bolster their competitive positions within a global market. Case studies show the importance of building cooperative and collaborative relationships among stakeholders. Regions that engender collaborative relations between business, labour and government and align cultural aspects that serve the public good are more likely to contribute to the diffusion of knowledge within the regions. Regions with dense knowledge networks that exhibit high levels of centralisation are more likely to develop strong economies that can withstand the rigours of the turbulent global environment.

The first two chapters provide a platform upon which to examine the KZN ICTE Cluster forum and to determine the extent to which the KZN region is positioned in relation to its vision to make KwaZulu-Natal a vibrant, fully inclusive knowledge economy with a strong ICT and electronics brand that speaks to local and global challenges.

Chapter 3

A case study of the KZN ICTE Cluster forum

3.1. Background

The formation of an Information and Communications and Electronics (ICTE) Cluster Forum in KwaZulu-Natal (KZN) to facilitate the formation of knowledge diffusion networks was initiated by the KwaZulu-Natal Department of Economic Development and Tourism (KZN-DEDT). The Provincial government adopted an economic strategy that recognised the need for developing clustered organisation in key economic sectors of the province that included the ICTE sector. In 2005, the KZN-DEDT commissioned a situational analysis study⁷⁴ undertaken by Kaiser and Associates to develop a provincial ICTE cluster strategy to achieve the following key objectives:

- To develop a strategic framework to define and channel provincial support to the sector for the coming three years,
- To define and develop a set of priority initiatives to support existing projects and programmes and /or initiate needed cross-cutting interventions in the ICTE sector,
- To determine the potential for establishing a provincial ICTE industry forum.

The Kaiser and Associates study arrived at, amongst others, the following conclusions:

- KwaZulu Natal has the third largest ICTE sector in South Africa, with a size well below that of Gauteng and the Western Cape. The largest concentration of firms is in Durban and Pietermaritzburg.
- An electronics sub-cluster exists in the Durban area, where there is a specific security / access control cluster node.
- The ICT subsector however, which is mostly service driven and concentrated in the Durban area, is more indicative of a typical urban business services

⁷⁴ KAISER AND ASSOCIATES: *Situational Analysis Report*. May 2005

agglomeration than of real ICT clustering. Although there is rapid growth in the number of ICT firms, the lack of specialisation in the subsector, and the absence of knowledge creating anchor firms are holding back the development of the cluster.

- The KZN ICTE sector is characterised by SMME firms, with close to 80% of firms classified as “small” or “micro”. There are very few medium sized firms in the cluster; this is particularly true on the ICT side. There also appears to be few large “anchor firms” on the ICT side, with the largest employers operating as vendors or general IT solution providers. This implies an even greater need for collaboration in order for the cluster’s ICT firms to compete effectively. In the electronics sector, there is a stronger mix of medium-sized companies, and several fairly large firms that could serve as cluster “anchors”.
- Black Economic Empowerment (BEE) is a problem throughout the sector. Levels of black ownership and professional staff are extremely low. This suggests the need for a strong focus on supporting start-ups, as this is likely to be one of the key mechanisms to promote increased equity in the cluster.
- The provincial ICTE cluster is growing solidly, but as a whole remains without a clearly specialised focus on which to build sustainable competitiveness. Again, the established electronics subsector appears to offer an existing source of global competitiveness. The ICT sector on the other hand offers dynamism, but remains small, locally focussed and lacking in global competitiveness, with the exception of some specific pockets of success. Overall, the cluster struggles with a lack of sufficient “anchor firms”, and with the fact that global ICTE firms and their key customers tend to establish their head offices (and therefore research bases) in Gauteng, leaving KZN with sales outposts. Therefore, KZN ICTE firms tend to be more generalised and trading focussed rather than specialised and development or integration focussed.
- Several key market trends suggest some opportunities exist for KZN to leverage territorialised sources of competitive advantage in order to develop and grow a specialised, globally competitive ICTE cluster. Amongst the key sources of advantage are:

- Established skills base in microprocessors and radio-based systems, in particular in defence / military, telecommunications, automotive, and power sectors
- Customisation and integration capabilities
- Developing expertise in rural telecommunications and Human Computer Interaction.
- Transport hub for Southern Africa (Posts, Dube Tradeport and Cyberport).
- Strong manufacturing base, in particular competitive base in automotive, paper, and food processing (and potentially in aerospace).
- Growing financial services, business services and retail sector
- Relatively skilled, low-cost, loyal workforce (low attrition)
- Quality of Life (climate)
- Progressive, active, well financed government.

Kaiser and Associates' strategy document points out that a number of potential areas of specialisation exist in KZN and that these themes could serve as the basis for a vision that could drive the province towards enhancing their regional capability and global competitiveness. The strong sets of advanced skills, especially concentrated in the electronics industry, combined with a good supply of graduates, competitive labour costs, high labour retention and an entrepreneurial spirit, are factors that provide a source for competitive advantage for the sector. The study contends that building towards the convergence of these forces is not being fully exploited. The challenges include the "brain drain" mainly to Johannesburg and to a lesser extent Cape Town, the perception that KZN is "not the place to be" for ICTE graduates, that professional development is lacking as well as that limited project management, business management and entrepreneurial skills are lacking. A number of opportunities that can spur ICT development exist, particularly within the triangular belt with the apexes at Durban, Pietermaritzburg and Richards Bay. This zone includes the Dube Trade Port which is considered to be one of South Africa's top 10 investment opportunities. The Dube trade port comprises the King Shaka International airport with passenger and freight terminals, a trade zone that is positioned for warehousing, manufacturing, assembling

and more, the ‘Dube City’ that offers hospitality space, an agrizone, as well as the Dube iConnect which is a dedicated IT and telecommunications provider.⁷⁵

Kaiser and Associates cite telecommunication costs, broadband access outside the metropolitan areas and the lack of IT/Science parks as infrastructure elements that are needed to drive KZN towards building knowledge networks that trend in the knowledge economy. In the area of research and innovation, they point out that KZN has a number of research institutions capable of producing cutting edge research, but lack in the creation of new knowledge and innovation. Their research suggests that only pockets of innovation exist particularly in the electronics sector and that the ICTE sector is more geared towards servicing and trading. The strategy document argues that diffusion of knowledge is where the heart of the problem lies and have identified that a clear disconnect exists between universities and industry in terms of research and collaboration. Industry, they say, does not consider current university research to be relevant and that much of this research is not being commercialised. Industry relies almost exclusively on the research that happens within the organisation. This lack of collaboration between universities and industry leads to a decline in knowledge creation and that large companies or innovative ideas may eventually take root in more conducive environments elsewhere.

The situational analysis report provided the necessary foundation upon which the DEDT could bring key stakeholders together in 2005 to consider the establishment of forum that would facilitate organisational networks. The KZN ICTE Cluster Forum was established in 2006 and received support from a number of organisations including the KZN-DEDT, the Electronics Association, the Black IT Forum, the Computer Society of South Africa, the SmartXchange ICT Hub and Higher Educational Institutions that include the University of KwaZulu Natal, Durban University of Technology, Mangosuthu University of technology and the University of Zululand. The forum outlined its vision as follows:

“to make KwaZulu-Natal a vibrant, innovative, fully inclusive knowledge society with a strong ICT and electronics brand that speaks of innovative approaches to local and global challenges”.

⁷⁵ <http://www.dubetradeport.co.za/Pages/Company-Profile/Overview> . Accessed 29/10/2014.

Cluster Model – a proposed structure to enable clustering

Kaiser and associates recommended that a structural framework be devised that enables the formation of innovation-driven clustering. They provide a cluster model outlined in the following diagram⁷⁶:

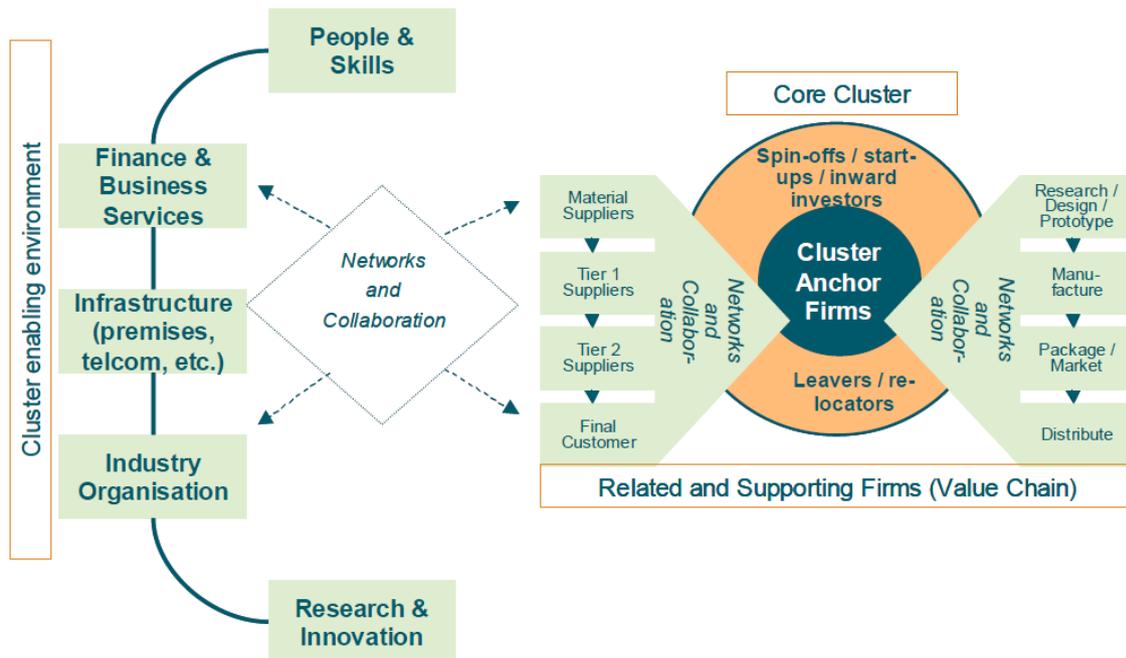


Figure 5: Cluster Model Diagram

The model depicts a “core cluster” with an anchor firm (or firms) at the centre collaborating with other firms to achieve a common set of goals. Kaiser And Associates’ concept of “Anchor Firms” can be likened to Lorenzoni and Baden-Fuller’s concept of a *strategic centre* within a web of partners⁷⁷. Clustered activity in KZN is largely considered to be centred on locally-based innovative product development. Collaborative activities were envisaged to span the entire product development life-cycle, ranging from ideas through research and design, prototyping, manufacture, packaging, marketing and distribution. The diagram also shows related and supporting firms that may support the clustered organisation or benefit

⁷⁶ KAISER AND ASSOCIATES: *Situational Analysis Report*. May 2005

⁷⁷ GIANNI LORENZONI AND CHARLES BADEN FULLER. *Creating a strategic centre to manage a web of partners*. (Article found in DE WIT B. AND MEYER R 2001. *Strategy Synthesis*. Reading 7.2 Pg 373-383)

therefrom. Suppliers of various secondary products and services could potentially be sourced locally to benefit the cluster, similar to what happens in Japanese Keiretsu. The principle of self-organisation as a result of changing environments can be extrapolated from the diagram as the possible spin-offs, start-ups and inward investors on the one hand with leavers and re-locators on the other. This is also reflective of an environment that facilitates continuous learning, a fundamental principle for a knowledge diffusion network.

The model shows the need for the creation of an enabling environment that included

- the creation of a pipeline of skills development.

This involves establishing strong networks between the cluster and tertiary institutions and other skills development agencies. The development of dense skills, dense networks and the cross-fertilisation of knowledge within the consortium are imperative for the overall success of the consortium.

- the involvement of finance and business services.

The forum considered establishing strong ties with government funding programmes including the KZN growth fund, the department of Trade and Industries Support Programme for Industrial Innovation and the Technology Innovation agency. Trade and Investment KwaZulu-Natal (TIKZN), an agency to promote the province as an investment destination, was also identified as an important strategic partner engaged in the cluster.

- the establishment/building of a Technology Park that would serve as a geographic node that would potentially stimulate innovation through collaboration because of the density of similar or complementary skills.
- obtaining buy-in from industry organisations that included tertiary institutions, the KZN electronics cluster, the Black IT Forum, the Computer Society of South Africa, government and business.

A number of KZN-based firms, most notably in the electronics sector, could have played (and can still play) the role of strategic centres of formidable regional knowledge diffusion networks by virtue of the global success of their products. For example, in 2005, Delca Research conducted research on behalf of the Embizeni Innovation Support Centre and

identified the following companies and key business activities in the KZN electronics sector⁷⁸:

Firms surveyed in the KZN electronics sector

PR Electronics	Procon Electronics	Inhep Electronics	Electrowave
Antronic	Conlog	Nortech International	Flowmetrix
Emcom Africa	Production Logix	Shurlok	Powertron
Omniflex	Bandit	UEC Technologies	Ultitec
Thorough Technologies	Autotronix - Automation & Control		

Table 1: KZN electronics companies surveyed by Delca Research

Business activities of firms surveyed in the KZN electronics sector

Business Activities	Electronics	
	No of Firms	Percent
Access control systems	4	12
Automotive equipment	1	3
Automated parking devices	2	6
Measuring & metering equipment	3	9
Domestic/industrial equipment	2	6
Data communication equipment	1	3
Telecommunication equipment & components	2	6
Process controllers	3	9
Electronic components	1	3
Electronic security equipment	3	9
Simulators	1	3
Vehicle detection systems	1	3
Data acquisition systems	1	3
Contract manufacture	4	12

⁷⁸ DELCA RESEARCH: *Survey of ICT & Electronics organizations in KwaZulu-Natal*: June 2005.

Electronic counting systems	1	3
Process automation & control systems	2	6
Fleet management/vehicle tracking systems	1	3
Total	33	100

Table 2: Principal business activities of electronics companies in KZN surveyed by Delca Research

When one combines the findings of Delca’s survey with Kaiser and Associates’ research, it is apparent that the electronics sector has a significant base of innovation and skills that can play anchor roles in clustered, innovation networks. One of the conclusions of the Kaiser and Associates study was that “The ICTE cluster is growing solidly, but as a whole remains without a specialised focus on which to build sustainable competitiveness”. At the time of the report however, the KZN ICTE cluster activity and alternatively, clustering in the ICTE sector has been virtually non-existent. This has been highlighted in the same report as follows:

*“The ICT subsector however, which is mostly service driven and in the Durban area, is more indicative of a typical urban business services agglomeration than of real ICT cluster”.*⁷⁹

Kaiser and Associates point out that there is a lacking of specialised focus in the ICT sub-sector but point to some specific pockets of success. Generally, they argue that the potential for developing regional knowledge diffusion networks that leverage the specialisations of globally successful companies based in KwaZulu-Natal has not been sufficiently exploited.

3.2. Recommended Cluster Strategy and Action Plan for the KZN ICTE cluster

In July 2005, Kaiser and Associates delivered a strategic framework for the development of an ICTE cluster forum in KZN as commissioned by the KZN Department of Economic

⁷⁹ KAISER AND ASSOCIATES: *Situational Analysis Report*. May 2005

Development⁸⁰. According to the document, the Cluster Strategy and Action Plan document was informed by the Situational Analysis study as well as “best-in-class initiatives and programmes adopted in a wide range of ICTE clusters around the world”.

Kaiser and Associates identified a number of key areas of competitive advantage around which cluster activity could be built. They specifically highlight the electronics sector that includes several large export-oriented firms around which a cluster could anchor, including UEC Technologies, Shurlok International, Nortech International, Conlog and PFK Electronics. They also mention that a number of smaller technology-intensive firms exist around which networks could form.

Altech UEC SA (Pty) Ltd, for example, is a highly successful global company that originates from KwaZulu Natal. Formerly called UEC Technologies (Pty) Ltd, the company prides itself in securing a number of notable world firsts including the very first DVB-compliant set-top box ever produced and the first STB incorporating Open TV middleware and the first NDS XTV PVR to be deployed.⁸¹ According to its website, Altech UEC SA (Pty) Ltd is the largest developer and manufacturer of set-top boxes in Africa and produced the 20-millionth set-top box in February 2014⁸². Altech UEC exports its products to four continents and has offices in Durban, Australia, India and Hong Kong⁸³.

Impro Technologies is another company that participated in the formation of the KZN ICTE cluster forum. Impro Technologies specialises in Access Control and product identification systems. The company was established in 1987 and its initial focus was Image Processing. During the founding stages, the company realised the potential of Radio Frequency Identification (RFID) technology and became one of the first companies in the world to get involved in RFID. Impro’s range of products are designed, developed and built in its

⁸⁰ KAISER AND ASSOCIATES: *Development of an Information and Communications Technology and Electronics (ICTE) Cluster Strategy for KZN, Cluster Strategy and Action Plan: Draft Summary*: July 2005.

⁸¹ <http://www.uec.co.za/> - accessed 12 April 2014

⁸² <http://www.uec.co.za/news-events> - accessed 12 April 2014

⁸³ <http://www.uec.co.za/contact-details> - accessed 12 April 2014

Durban-based factory and are now exporters to over 60 countries worldwide, including Europe, Japan, the Middle East and the United States of America⁸⁴.

The achievements of Altech UEC SA and Impro Technologies illustrate the tremendous potential from which strong regional knowledge diffusion can be leveraged. Hampden Taylor highlights the importance of harnessing existing regional strengths in order to build strong, densely skilled networks to achieve global competitiveness. As was expounded in chapter 2, Japan targeted meta-technologies, North America maintained its dominance in superconductivity, biotechnology and nanotechnology and Rhenish capitalism in greater Europe developed a bias in favour of engineering, manufacturing and production.

Kaiser and Associates' state that, whilst there is huge potential for clusters to develop, relationship-building endeavours that give rise to clusters have been limited in KZN. They point out that KZN has functional industry organisations as well as hubs and incubators such as the Innovation Support Centre and the SmartXchange ICT hub and incubator. However, they indicate that

- there was poor communication and collaboration between industry and Higher Educational Institutions,
- there were limited levels of inter-firm collaboration, especially in Research and Development,
- there were relatively low levels of industry trust.

The following strengths and weaknesses in development an enabling environment for clustering were summarised:

⁸⁴ <http://www.impro.net/index.php/about/about-impro/521-about-impro-company-history.html> accessed 12 April 2014

	Strengths	Weaknesses
People & Skills	<ul style="list-style-type: none"> ▶ Relatively good supply of graduates ▶ Pool of advanced skills in electronics ▶ Competitive labour costs and high labour retention 	<ul style="list-style-type: none"> ▶ Brain drain ▶ Quality of graduate skills insufficient - limited project management and business management skills ▶ Weak paths to employment
Location & Infrastructure	<ul style="list-style-type: none"> ▶ Logistics and manufacturing hub ▶ Cost of living and operating a business ▶ Quality of life 	<ul style="list-style-type: none"> ▶ Telecommunications costs ▶ Patchy broadband access outside of major metros ▶ No IT/Science Parks
Research & Innovation	<ul style="list-style-type: none"> ▶ Internationally recognised research institutions with strength in key areas like RFID, AI, HCI, and rural telecommunications ▶ Relatively high levels of investment in R&D by firms 	<ul style="list-style-type: none"> ▶ Lack of sufficient research staff and budgets at universities ▶ Very weak university-industry research links ▶ Large corporates (ICTE and their suppliers) generally not conducting research in KZN
Finance & Business Services	<ul style="list-style-type: none"> ▶ Active provincial and local government initiatives to support start-ups ▶ Fairly strong business services environment in Durban metro area ▶ Embizeni ISC and SmartXchange providing wide range of business support services to start-ups 	<ul style="list-style-type: none"> ▶ Virtually no venture capital funding or angel networks ▶ Limited FDI ▶ Limited access to business services outside of Durban
Industry Organisation	<ul style="list-style-type: none"> ▶ Current trust/faith in industry organisations ▶ Substantial recent activity (e.g. Digital Coast, EIA) 	<ul style="list-style-type: none"> ▶ Sustainable funding not yet established ▶ Clear roles/responsibilities not yet defined

Table 3: KZN ICTE Cluster Enabling Environment – Strengths and Weaknesses⁸⁵

The establishment of a cluster forum requires an intervention strategy that will focus the sector in harness its strengths and address the identified weaknesses in order to place the sector on a growth path that optimises economic development and international competitiveness. Kaiser and Associates developed the following strategic framework around which a cluster development strategy can be devised:

⁸⁵ KAISER AND ASSOCIATES: *Development of an Information and Communications Technology and Electronics (ICTE) Cluster Strategy for KZN, Cluster Strategy and Action Plan: Draft Summary*: July 2005.

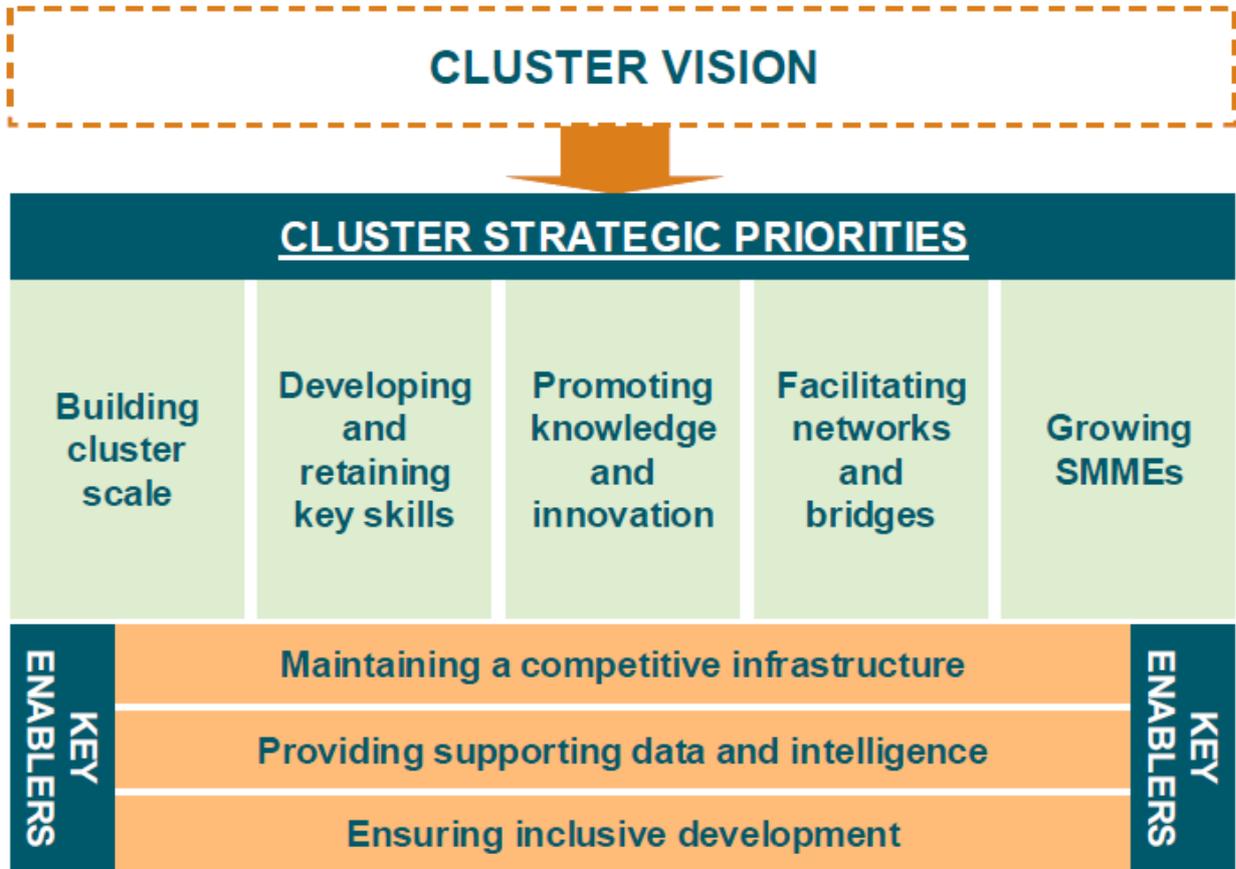


Figure 6: Cluster Strategic Framework for the KZN ICTE Cluster Forum⁸⁶

Kaiser and Associates state that a Cluster Vision is the first step in that it will provide the necessary focus for the cluster to be effective. The Vision will define where the cluster wants to be through the building of networked organisation around sources that will provide competitive advantage and sustainability to the sector. Once the Vision is established, five strategic priorities will need to be developed⁸⁷. These priorities are stated in the document as follows:

1. Building cluster scale:

⁸⁶ KAISER AND ASSOCIATES: *Development of an Information and Communications Technology and Electronics (ICTE) Cluster Strategy for KZN, Cluster Strategy and Action Plan: Draft Summary*: July 2005.

⁸⁷ KAISER AND ASSOCIATES: *Development of an Information and Communications Technology and Electronics (ICTE) Cluster Strategy for KZN, Cluster Strategy and Action Plan: Draft Summary*: July 2005.

This will involve identifying and engaging large, “anchor” firms and institutions around which the cluster can develop. The scale of the cluster refers to the number of participating firms and individuals that make up the cluster. Kaiser and Associates point out that KZN lacks highly active firms with corporate and research functions that provide a basis for SMME collaborations, research programmes, etc. Their recommendations include:

- The establishment of a technology park that will serve as a focal point for attracting investment.
- Marketing the cluster – firstly inwardly targeting the local industry and graduates, then eventually externally for investment and exports.

Kaiser and Associates state that the building of cluster scale will rely on collaborative efforts between the various stakeholders including government, industry players and higher institutions of learning.

2. Developing and retaining key skills:

This will involve improving the quantity and quality of ICTE skills in the province, to support the growth of the cluster.

Kaiser and Associates point out that for the region to be competitive, the skills base consisting of well-qualified, flexible labour in highly specialised areas is critical. According to the document, there is a brain-drain of graduates to Gauteng, the Western Cape and abroad.

They recommend the following initiatives to be considered:

- Launch a pilot programme in at least one of the areas of specialisation.
- Develop a skills development and employment programme and a research apprenticeship programme involving universities and anchor firms within the selected areas of specialisation.

- Build a database of skill-sets and match these against the selected areas of specialisation.

3. Promoting knowledge and innovation:

This will involve increasing the amount of knowledge created in the province and promoting increased levels of knowledge transfer with the aim of improving overall innovation levels.

Kaiser and Associates point out that knowledge creation and diffusion across the sector is necessary for the development of successful clusters. Their research found the levels of collaboration to be very low in the province. They recommend the following initiatives:

- Establish what the science base should be for the cluster to remain competitive in the future and to develop research and development programmes that will provide strategic direction to selected areas of specialisation.
- Establish a pilot “centre of excellence” programme that conducts leading-edge research, receives funding for research, plays a key role in commercialisation of products and promotes linkages between the cluster and key stakeholders.
- Establish a fund that would be accessible to part-fund research required by the cluster.
- Compile information on all public and private research ongoing in the province. This would assist firms to publicise their research needs and support knowledge diffusion and match-making.

4. Facilitating networks and bridges:

This will involve increasing the quantity and quality of collaboration amongst stakeholders within the cluster, as well as bridging outside of the immediate cluster.

According to Kaiser and Associates, high levels of both formal and informal collaboration and networks must exist between institutions and firms for clusters to be successful. Their findings are that KZN firms and institutions are not strongly engaged in collaborative activity.

They suggest that the institutionalisation of the KZN ICTE Cluster forum will facilitate the implementation of cluster initiatives throughout the province. This forum will play a facilitating or brokering role in developing networked organisation and will bring together all ICTE organisations and institutions in the province.

5. Growing SMMEs:

This will involve ensuring that the cluster thrives in the future by creating a dynamic and supportive start-up and growth environment.

Kaiser and Associates state that the development and support of SMME companies are pivotal to successful clusters. They point out that KZN appears to have a dynamic start-up environment but that SMME growth and development will thrive better within a dynamic, networked, collaborative environment.

The three key enablers that serve as a foundation for building an effective cluster are specified as follows:

1. Maintaining a competitive infrastructure: this will involve local and provincial government doing what it can to ensure that the costs of doing business, from telecommunications costs, to transport costs to office space availability and costs, are as competitive as possible.
2. Providing supporting data and intelligence: this will involve ensuring that sufficient information is available on the cluster to support strategic decisions and to monitor progress against the cluster strategy.
3. Ensuring inclusive development: this will involve ensuring that the cluster develops in such a way as to ensure the appropriate levels of inclusion on racial, gender, and geographical levels.

The document points out that in order for the cluster to develop through the building of networked organisation, key stakeholders such as government, ICTE sector organisations and

Higher Educational institutions will need to play significant roles in driving key initiatives in the areas of strategic focus.

3.3. Vision, Mission and Strategic Goals

In 2007, Dr Zweli Mkize, the Premier of the KwaZulu-Natal province stated the Provincial Government's vision for the ICTE sector as follows:

Our vision is to make KwaZulu Natal a vibrant, innovative, fully inclusive knowledge society with a strong ICT and electronics brand that speaks of innovative approaches to local and global challenges. KwaZulu Natal must be an example of an environment where ICT and Electronic-based innovation flourishes with social entrepreneurs from historically disadvantaged population groups, remote communities and the knowledge intensive industry benefitting and contributing to the well-being and quality of life of our citizens.

The vision, mission and strategic objectives of the forum outlined in the constitution of the cluster forum were ultimately adopted in 2010 as follows:

Vision

The organisation's vision is to create an inclusive, vibrant, ICTE community in KwaZulu Natal, where the KZN ICTE sector is collectively recognized as a thriving knowledge economy that is underpinned by a diverse, sustainable and growing ICTE economy, centres of excellence and skilled human capital resources.

Mission

The organisation's mission is to bring together all relevant stakeholders in ICT&E in the province under an umbrella body so that, we collectively represent the ICTE knowledge economy. We will become the de-facto ICTE organization that will lobby,

represent, co-ordinate and implement aligned strategic initiatives to benefit the ICTE sector in KZN.

Strategic Objectives

1. Build a brand that is easily recognized, respected and that is synonymous with KZN ICTE.
2. To build a community where members have a collective identity, pride and loyalty to ICTE in KZN.
3. To promote KZN as an ICTE destination in order to attract skills and investment.
4. To actively create awareness and promote skills, technologies and products of members to potential investors and venture capitalists.
5. Identify, initiate and co-ordinate initiatives that results in the diversification of skills within the sector.
6. Identify, initiate and co-ordinate initiatives to address historical barriers of entry of specific ICTE sectors. These initiatives will specifically target the disabled, historically disadvantaged individuals, women and black owned companies.
7. Identify, initiate and co-ordinate initiatives that are aligned with addressing the international decline in quality and ICTE skills.
8. Collect, analyse and provide sector based research and survey information.
9. Build a knowledge repository of technical skills, research and data that will support the transition and roll out of high level strategies into detailed implementation focused initiatives.

In the analysis of the above, the mission and strategic objectives appear to be disconnected from the initial ideas outlining the concept of clustering as outlined in the Kaiser model. The objectives are mostly about branding and promotion of the ICTE sector. These objectives are largely in the domain of the Trade and Investment KwaZulu-Natal (TIKZN) organisation that was also established by the KZN department of economic development. The organisation's website describes its principle activity as follows:

Trade & Investment KwaZulu-Natal is a South African trade and inward investment promotion agency, established to promote the province of KwaZulu-Natal as an investment destination and to facilitate trade by assisting local companies to access international markets. The organisation identifies, develops and packages investment opportunities in KwaZulu- Natal; provides a professional service to all clientele; brands and markets KwaZulu-Natal as an investment destination; retains and expands trade and export activities and links opportunities to the developmental needs of the KwaZulu-Natal community.⁸⁸

The objectives as outlined in the 2010 constitution do not speak to the leveraging of regional ICTE strengths to cultivate regional knowledge diffusion networks that will result in higher global competitiveness. In the final report that outlines the cluster's programmes for the 2008/2009 financial year, the following strategic priorities are outlined:

1. The building of cluster scale: this involves the marketing of the cluster and its initiatives to ensure increased participation and support by all stakeholder groupings.
2. The development and retaining of key skills: this involves improving the quantity, quality and availability of ICTE skills in KZN.
3. Promoting knowledge and innovation: this involves increasing the amount of knowledge created in the province and promoting increased levels of knowledge transfer with the aim of improving overall innovation levels.
4. Facilitating networks and bridges: this involves increasing the quantity and quality of collaboration amongst stakeholders within the cluster, as well as bridging outside of the immediate cluster.
5. Growing SMME's: this involves ensuring that a dynamic and supportive start-up and growth environment existed within KZN so as to increase the number of viable SMME's within the province.

⁸⁸ <http://www.tikzn.co.za/Home.aspx>

The first strategic priority, “building of cluster scale”, provides a very different scope of this objective as outlined in the 2005 Cluster Action Plan Summary. In the 2005 plan, the action is stated as follows:

“Building of cluster scale: this will involve identifying and engaging large, “anchor” firms and institutions around which the cluster can develop”.

The description of what “building of cluster scale” is about in the 2005 document corresponds with the cluster model as depicted in *Figure 5: Cluster Model Diagram*. The strategic objective as originally described is core to what the initial concept of Clustering is about. It is fundamental to how the ICTE community was envisaged to galvanise and grow networked organisation through a well-defined, structured model. The priority, as redefined in the 2010 constitution, changes this focus completely. The emphasis shifts to “marketing the cluster and its initiatives”. It also is unclear if “the cluster” refers to the cluster forum as a whole or a cluster that may have formed under the auspices of the forum as per the 2005 model.

The fourth and fifth priorities above identified in 2009 are not adequately covered in the *objectives* stated in the 2010 constitution. In particular, the fourth priority that is the central basis of the forum has been omitted from the constitution. Whilst it may be argued that these points are implied in the document, it is necessary to align the mission statement, strategic priorities and the objectives such that they provide a very clear focus and direction for the forum. The central proposition of the cluster forum to facilitate regional collaborative organisational networks as a catalyst for economic growth *must* surely be clearly articulated in the objectives as a measurable outcome in the objectives of the organisation.

3.4. Clustering Road Map Development

In 2008, the KwaZulu-Natal Department of Economic development commissioned a number of “road maps” to be developed in identified domains within which the province could

develop economic capability, growth and sustainability. The purpose of these studies were generally to identify the potential in the market, identify regional strengths, identify technology and resource gaps that impede development, and to formulate processes, target actions and set time frames to implement programmes to meet specific goals.

Some of the key road maps developed were:

- Advanced ICT Skills Development Strategy – May 2008
- Embedded Systems Technology Road Map – May 2009
- The KZN Software Engineering Road Map – March 2009
- The eLearning Technology Roadmap – May 2009
- Broadband – The KZN Market 2009 Licensing Landscape. – March 2009

The purpose and salient intentions and recommendations of each of the road maps are provided below.

3.4.1. Advanced ICT Skills Development Strategy

The “Advanced ICT Skills Development Strategy” document was developed for the KZN DEDT for the benefit of the ICTE Cluster Forum by a company called Lindon Corporation. The document highlights the lack of ICTE skills in KZN, and points out that in South Africa, we are faced with huge challenges bridging the digital divide. The more profound challenge that South Africa faces in educating, training and integrating the majority of the population, more so than other emerging societies, is compounded by the fact that the majority of the population were subjected to an apartheid system that deliberately denied them access to decent education for centuries. The document also states that In the Global Competitiveness Index for many years, South African Corporates have consistently been voted as poor investors in the development of their workforce. This document references the South African IT industry strategy noting that human resource development is the most critical area that South Africa faces in the development of its ICT sector.

The Advanced ICT Skills Development Strategy document makes four recommendations and interventions that the advanced skills development strategy should focus on, viz.

1. encourage youngsters to enter the targeted fields of study by choosing the appropriate subjects at school;
2. make it financially possible for them to undertake their studies in a comfortable manner without financial worries and with the required institutional support;
3. ensure that there is a good quality and cutting edge academic programmes with sufficiently qualified staff to teach them;
4. Support the growth and sustainability of the local ICTE sector to absorb as many qualified people as possible.

The Advanced ICT skills roadmap recommendations target the attraction of mainly new entrants into the ICT sector, especially individuals. The roadmap was commissioned on behalf of ICTE Cluster Forum but unfortunately, the potential for developing advanced skills within a clustered, networked environment was not adequately considered. The Advanced ICT Skills Development road map does not reference the Kaiser strategy and planning documents that were to form the basis for a formation of clusters in KZN. This disconnect indicates an insufficient degree of using building-blocks necessary for the development of cohesive cluster organisation and development.

As mentioned previously, the Cluster Model resembles the “strategic centre” model of Lorenzoni and Baden Fuller as well as the Japanese Keiretsu model. Chapter 2 of this thesis provides details of the importance of the role of strategic centres in developing the core skills of partners to make them more effective and competitive. The building of knowledge diffusion networks in the identified specialised areas is another key aspect omitted from the document. These are critical structures that will facilitate the development of advanced ICT skills.

3.4.2. Embedded Software Roadmap

The roadmap states that embedded software development is a core activity of most businesses in the electronics industry prevalent in KwaZulu-Natal that manufacture or produce new products. According to the report, international research in developed countries indicate that up to 50 embedded systems exist in every home and that the use of embedded technology is expanding on an on-going basis with solutions becoming more integrated and more mobile. The report also points out that South Africa faces increased competition from international businesses that are capable of delivering fully integrated solutions using the latest technologies. It states that skills are in short supply in KwaZulu-Natal and that the quality of graduate resources produced by local higher educational institutions does not meet the standards required by the industry. These factors, it argues, necessitate the need for the development of a collaborative approach to building the necessary skills required to bolster the potential of the electronics sector.

The development of the roadmap included a workshop with number of industry players. The key domains of interest to industry and academia were identified as well as the challenges that that need to be confronted. These are summarised in the following table:

Domain	Definition	Challenges
Embedded Systems Solutions	Technology categories consisting of key product type areas:- i. Small scale embedded solutions – vertical markets ii. Integrated System on Chip Connectivity, real world sensing iii. Interconnected solutions – Mobile, set top boxes, PC embedded, and next generation, interoperable and inter-connected solutions. Technologies to engineer embedded solutions - Development platforms and programming languages. Technologies for sensing real world data. Technologies for data signal processing. Power technologies to support rural solutions.	Skills resources and skills levels don't meet market demands. Closer alliance between Industry and Academia. Development platforms for new learners. Shortage of skills. Resources drawn to higher salaries in other regions. Political understanding and approach affect market opportunities. Late formulation of Cluster – Not a unified approach to market opportunities.
Infrastructure Technologies	Supporting infrastructure such as network connectivity & Interoperability frameworks. Protocols and standards for Interoperability. Security & IP Protection Power supply infrastructure.	Not a strategic area of focus. Understanding of other programs and leveraging opportunities Political influences affect market opportunities.
Engineering Technologies	Technologies to support the development of embedded solutions. Software development systems. System Engineering. Modelling methodologies.	Skills resources and skills levels don't meet market demands. Life Cycle Management and System Engineering skills required. Common platforms are needed to assist in education of students and learners.
Content Management Technologies	Security technologies including network transport and storage Protection of IP and Licensing of technologies. Secure Access Technologies	Still needs further investigation by the cluster.

Table 4: Technology Domains⁸⁹

The challenge “late formulation of the cluster...” identified in the “Embedded Systems Solutions” domain is an indication of the pressure that the sector feels and the underlying implication that, unless there is a concerted effort to collaborate effectively, it will become increasingly difficult for local innovation to grow, be sustainable and remain globally competitive.

⁸⁹ KWA-ZULU DEPARTMENT OF ECONOMIC DEVELOPMENT: *Embedded Systems Technology Road Map*. 4 March 2009. Page 5

In the following diagram, the Embedded Solutions Domain is further subdivided into core technology segments that regional players are engaged in and specifies some of the key characteristics (labelled as “definition” in the diagram) of each segment.

Technology Categories	Definition
Microprocessors – General Use	Majority of current product solutions support vertical markets. Dedicated Solutions on low to medium integration micro-processors Single Solution – Single platform Real world sensing and DSP processing. Low level of system integration and connectivity
System on Chip Solutions	Medium level of integration. Higher levels of Signal Processing. Integrated solutions to first tier information gathering systems. Connectivity to immediate hosts. Service vertical markets. More Complex Development platforms and Design tools.
Mobile Inter Operable Solutions	Technology in this area is mobile, active, changing and follows international trends of connectivity and functionality. Strong level of Inter-operability and Connectivity. Open Source Development platforms. Network ready – Supporting commons communication standards. One Platform – Many possible solutions. Develop on PC – Deploy on Target Real World Sensing and DSP, Video, Voice and Human Interfaces. Strong focus on added service for third parties. Strong Protocol, Security and Interface definitions using common standards. Includes development in C, C++, Python, Open AT and scripting. Operating Systems include Windows, CE, Linux and various RTOS frameworks. Home Automation and Content Delivery opportunities. Also Set top box platform technology capable.
Set Top Box and Embedded PC	Content delivery, Gaming and Entertainment. Highly integrated and standardised solutions. Operating Systems include Windows, Linux, RTOS types. Using common platforms- PC104 motherboards etc. Develop on PC – Deploy on Target. Home Automation and Content Delivery opportunities.

Table 5: Embedded Systems Solution Segments⁹⁰

The roadmap points out that most of the South Africa’s product technology innovations lie in the application engineering approach that innovates by using existing tools and technologies to provide new market solutions rather than pioneering new technologies. It states that the electronics sector in KwaZulu-Natal produces products of varying complexity and utilises embedded software extensively to provide new products and services.

⁹⁰ KWA-ZULU DEPARTMENT OF ECONOMIC DEVELOPMENT: *Embedded Systems Technology Road Map*.

4 March 2009. Page 7

The roadmap makes the following statement that again underscores the potential for developing stronger regional networked organisation.

“Embedded PC solutions and set top box opportunities are not being exploited by the industry. It is apparent that the industry has not identified market opportunities in this area. The province does however have world leaders in paid television services, internet gaming solutions and transaction management services. These services are marketed internationally and enjoy a high level of success in their targeted market regions.”

It is clear from the roadmap document that the scope and opportunity for building strong networked organisation exists. Whilst the emphasis of the document is around skills development, it would be judicious to use the Kaiser model or something similar as the structural foundation for this proposed venture. This would be in line with Lorenzoni and Baden Fuller’s assertion that networked organisation works best when guided by a strategic centre. Skills development needs must support the successes of the local industry and thus the key industry leaders should be at the forefront of the developmental requirements that lead to adequate skills density and deeper and broader knowledge that enables innovation and lessens the cost burden thereof. The roadmap proposes that a ‘specialist skills intervention’ workshop be convened by the KZN ICTE Cluster forum to bring together role players from schools, universities and government. The importance of skills development as articulated in the roadmap corroborates Jennifer Spencer’s proposition that relatively high levels of density in a national or regional network will associate with higher global competitiveness for that region’s industry. Unfortunately no follow up programme ensued subsequent to this roadmap.

3.4.3. The eLearning Road Map

Preliminary investigations done by the Cluster Forum indicated that a number of eLearning initiatives were already taking place in KwaZulu-Natal. This information, coupled with the importance and prominence that eLearning was gaining universally, prompted the KZN Department of Economic development to commission a study to examine the potential for

developing clustered activity around eLearning. This research project also involved two workshops that brought together practitioners within the eLearning sector. Three main areas of activity were investigated, viz. eLearning Content Development, Learning Management Systems and Mobile Learning as expounded below.

eLearning Content Development

The research showed that the development of eLearning content was the area in which most of the activity took place.

The Durban University of Technology (DUT) and University of KwaZulu-Natal (UKZN) embarked on a number of content development initiatives covering a broad range of learning areas. The document also identifies KZN-based companies that have developed eLearning content targeting a number of different learning requirements in business. International companies such as NIIT also established offices in Durban and offer eLearning solutions various to KZN-based organisations.

The eLearning Road Map advocates for collective knowledge generation, cooperation and collaboration between different sectors and also within the private sector.

Learning Management Systems (LMS)

The road map investigation found that Moodle and WebCT were the most widely used LMS's that were being used. Significantly, it found that at least one company in KZN called Avnon Consulting, developed its own SCORM⁹¹ compliant LMS.

Mobile Learning

⁹¹ SCORM (Sharable Content Object Reference Model) is a set of technical standards for e-learning software products. Specifically, SCORM governs how online learning content and Learning Management Systems (LMSs) communicate with each other. SCORM is a specification of the Advanced Distributed Learning (ADL) Initiative from the Office of the United States Secretary of Defense. (See <http://scorm.com/scorm-explained/> ; <http://en.wikipedia.org/wiki/SCORM>)

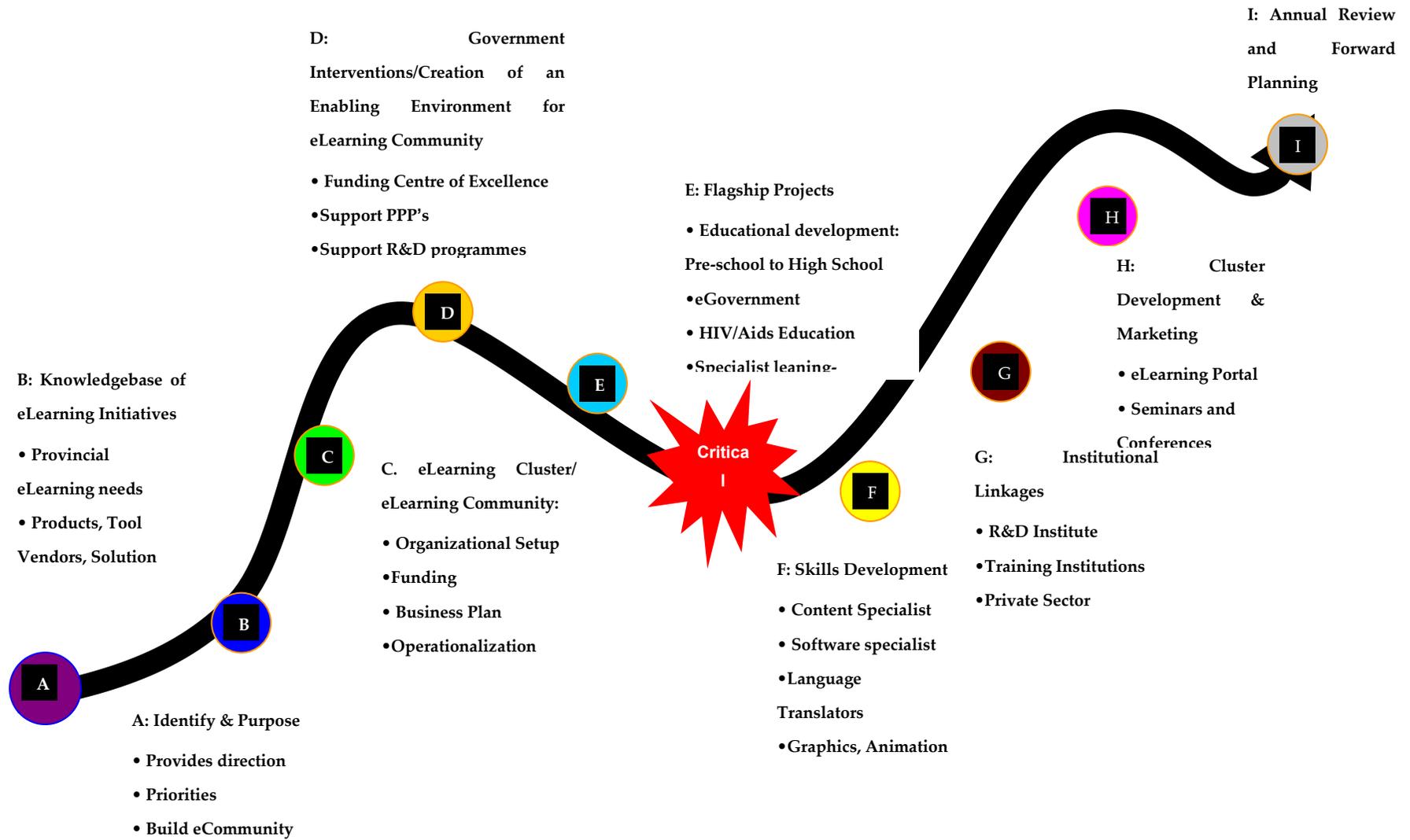
The eLearning Road Map identifies Kumaras Pillay, a Mathematics teacher at Burnwood Secondary School based in KZN, won a prestigious international award for developing a product called M Learner that provided Maths and Science interactive content on WAP-enabled cell phones.

The eLearning Road Map clearly articulates the business case for the development of an eLearning Cluster. Given the involvement of both business and tertiary institutions in the area of content development, it argues that it makes sense to network. The key aspect mentioned is that, despite the cross-cutting nature and pervasiveness of ICT and even within the eLearning segment, the eLearning Cluster to be established “must be known for something that gives it the cutting edge”.

Some of the projects mentioned above were identified as potential flagship projects (strategic centres) around which clustered activity could have been formed. The road map also proposes a process through which projects could be adopted by the ICTE Cluster forum that would then assist in the formation of clustered activity. The project selection process put forward involves the following steps:

1. Invitations to present project proposals
2. Project impact assessment
3. Project Adoption
4. Engagement of enablers including funding institutions, industry partners, skills development programmes, etc.
5. Project extension planning, resources, milestones, etc

The different stages of the road map are outlined in the diagram below.



The eLearning roadmap document lists the following benefits of developing collaborative learning networks.

- *Raising and Sustaining Local Research and Development.*

Innovative eLearning content and tools are already being developed and by harnessing the power that collaborative activity can provide the current initiatives, the quality of products should increase and project development will be more rapid.

- *Improved Commercialisation.*

The high competitiveness, high research and development costs and the rapidity of product life-cycles make it difficult for companies to go it alone. By linking universities, business and other partnerships, commercial models must be developed to make the cluster viable.

- *Increased e-Literacy.*

Today's society places tremendous demand on the need for immediate access to the right knowledge.

- *Rapid Training and Development*

Clusters provide for the opportunity to be less of a self-contained, closed system to a more interactive, open system. The knowledge economy has given rise to more collaborative partner relationships with organisations traditionally thought to be outside the organisation such as customers, suppliers and even competitors.

3.5. Timeline of KZN ICTE Cluster Activity

The following table is provided to summarise of the key milestones achieved by the forum.

Year	Activity
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2005	<ul style="list-style-type: none"> • Conceptualised Forum initiated by the DTI • Kaiser and Associates Situational Analysis Study of <ul style="list-style-type: none"> ○ KZN ICTE business environment and exploring the possibilities for Clustering. ○ Cluster Model • Workshop with ICTE stakeholders including business, Higher Educational Institutions and the KZN DTI. • Kaiser and Associates – Development of a Cluster Action Plan and Action Plan. • Establishment of a cluster interim board.
2006	Establishment of the ICTE Cluster – Set up as a legal section 21 company
2007	Official Launch of the Cluster
2008	Development of Advanced ICT&E Skills Development Strategy – May 2008
2009	Development of Road Maps <ul style="list-style-type: none"> • Embedded Systems Technology Road Map – May 2009 • The KZN Software Engineering Road Map – March 2009 • Broadband – The KZN Market 2009 Licensing Landscape. – March 2009 • The eLearning Technology Roadmap – May 2009 •
2010	Draft and Final adoption of the ICTE Cluster Forum Constitution The appointment of Lindon as Cluster management
2011	-
2012	No cluster activity

It is clear from this timeline that the ICTE cluster forum has fallen far short of its vision and strategic goals. The KZN ICTE Cluster Forum was formed to potentially exploit the potential of developing clusters around very significant innovation prevalent in the electronics sector but regrettably, the forum did not live up to its expectations and is currently not operational at all. The impact of this failure to establish an ICTE Cluster Forum in KZN to develop an

environment that is conducive for clustering has a negative impact on the ICTE sector as a whole. The following Chapter provides a 20-year synopsis of MicroVision Software, a KZN-based company that I established in 1993. This journey should demonstrate the need for companies such as MicroVision to be engaged in collaborative organisation and knowledge diffusion networks to withstand the treacherous turbulent environment.

Chapter 4

MicroVision Software – Case Study

4.1. The Establishment of MicroVision

This chapter involves participatory research in a company called MicroVision Software c.c. that I established in 1993. I resigned from the Tongaat-Hulett Group (Pty) Ltd to form the company after working as an analyst programmer for six years since 1988. I initially worked for the Group Information Services (GIS) department as part of a team of software developers. GIS developed a number of mission-critical applications for the group and its subsidiary companies. The period from 1988-1992 was characterised by many exciting innovative initiatives. I was the chief developer in two major projects, viz.

- the Brick ‘n Tile Point of Sale system that was installed at twenty one Brick ‘n Tile centres that mainly sold Corobrik products.
- the Cascade Planning System that used Materials Resources Planning and Operations Research optimisation methodologies to plan factory production for two months based on expected demand patterns.

At the time, Corobrik (Pty) Ltd was a subsidiary company of the Tongaat Hulett Group and Brick ‘n Tile was a sales division of Corobrik. During the early 1990s, a number of companies underwent a restructuring process of “down-sizing” and “right-sizing” and the Tongaat Hulett Group decided to close the GIS department on the basis that software development was not its core business. Most of the software developers were retrenched but, because I was considered key to maintaining the Brick ‘n Tile and Cascade systems, I was offered a transfer to Corobrik and I accepted. The in-house GIS-developed software was quickly phased out at Corobrik and replaced by the American-developed J.D. Edwards Enterprise Resource Planning system. I was the only software developer at Corobrik at the time and, because the environment was no longer suitable for a career I wished to pursue in software development, I departed and to establish MicroVision Software.

Corobrik became one of MicroVision's first clients. Both the Brick ' Tile and Cascade planning systems were core systems for Corobrik and the dependency on my knowledge resulted in work that spanned four years from 1994 to 1997. This work anchored MicroVision during that period and allowed me the time and funding to develop the first version of our schools management system called MasterC.

4.2. Core development focus - Schools Management Systems

MasterC was completely re-developed twice as a result of the dramatic changes in technology as well as in the educational environment. The approximate life-cycle of each of the versions of MasterC has been approximately 7 years. The initial version, released in 1994, was a text-based application developed in a language called Clipper, and used a database called dBase and operated on Microsoft's MS-DOS operating system. Our first clients were mostly schools in the Austerville area. This was the community that I was living in. I was also a Mathematics teacher in this area for four years prior to my joining the Tongaat-Hulett group. Clearly, the strong ties with the community were strong motivational forces for MicroVision to target local schools and for them to purchase the product after, of course, assessing its value in facilitating schools' management and reducing the administrative workload of teachers. The sale of MasterC to schools outside the area was largely influenced by the network linking stronger ties to weaker ties. It is no coincidence that sales initially spread to schools in areas that had historical ties to Austerville. My brother was a school teacher in the Western Cape and we leveraged his connections to sell to surrounding schools there.

In the mid 1990's, Microsoft Windows was the dominant operating system for personal computers and we felt the desire and the pressure to re-develop MasterC to have a graphical user interface and to be compatible with the Microsoft Windows operating system. We started the development in 1998 and in 2000, we released MasterC for Windows. In 2006, the interactive web had already taken root and the idea of developing a web-based MasterC was driven by the same pressure and desire to remain competitive. The stakes were much higher at the time because the National Department of Education released their windows-based schools management system called SASAMS and provided the system free of charge to schools. The development of the web-based version of MasterC was partially funded by a

SPII (Support Programme for Industrial Innovation) grant that is offered by the Industrial Development Corporation (IDC) for the development of innovative technology products and/or processes. MicroVision received SPII funding in September 2006 in a 50-50 matching scheme that covered the entire systems development lifecycle, from the initial product concept to the point at which the product was ready for market. The development took about two and a half years to complete and we released the web-version in January 2009. When we applied for funding, we under-estimated the time it would take to develop the application by at least six months. As a consequence, the development cost was much higher than anticipated and this had a significant impact on our cash-flow.

Interestingly, and perhaps inevitably, the older version of the application also competed against the newer version. Parallel versions existed for at least two years until we stabilised the web-based application and announced that we would no longer support the older Windows-based system. This period was particularly difficult because the Department of Education specified a number of changes and reports and we had to enhance and support two different versions.

The company won two SPII awards as a result of the successes it achieved from this venture, viz.

- 3rd place in the Small Companies Category in 2010.
- The winner in the Emerging BEE category in 2011.

Over time, we were able to expand our user base and currently, MasterC is used by approximately 200 schools, mainly in KwaZulu-Natal and in the Western Cape. Approximately 120 schools access the application via the web.

During the past 20 years of its existence, MicroVision lived on the edge of chaos in a rapidly changing environment. The sustainability of MicroVision over this period has been extremely difficult. The following have been factors:

- It took 2-3 years to develop each version of MasterC. The return on the investment happened after 2 years of the product being on the market. The time it took to reach the break-even point from the start of the development has thus been approximately 5 years.

- Virtually all of our profits were ploughed back in the business because of the costly systems development and re-development.
- We lost key resources at critical times during MicroVision's existence. All the software developers we employed started with no experience. Our experience has shown that it takes at least one year for developers to obtain a fair degree of proficiency after completing their university studies. The average time that our developers worked for MicroVision is 5 years. Beyond that point, we have been unable to compete with larger companies with respect to salaries.
- We were constrained by limited resources to build the business. We had very little capacity to build a marketing and sales team.
- The revenue that we received from MasterC has not fully sustained the company. We needed to supplement our income and got involved in other ventures, including bespoke development for a number of companies to fund the development of our own products. Our resources were thus spread very thinly.
- It has been extremely difficult to compete in an environment where the department provides a "free" system called SASAMS to schools. We have been able to maintain and marginally expand our schools base because of significant offerings in our application that is not available in SASAMS. The department has, however, put pressure on schools to use the SASAMS system and this poses a huge threat to us.

4.3. Network linkages and Cluster Potential

The network ties that we built over the years were the key sources for securing business opportunity. MicroVision's first client, Corobrik, was the company I worked for and who required my services. The schools we initially sold MasterC to were schools in my neighbourhood. Most of the other schools that purchased the system are in concentrated geographical areas where the network influence of one school was an encouragement for other schools to purchase the system.

The Shell and BP refinery (Pty) Ltd (SAPREF) was a client of ours for approximately 12 years. In 1995, I was introduced to SAPREF by Mark Russell-Boulton whom I worked with

at Corobrik. He supported a number of systems at the refinery, but was emigrating to the United Kingdom. MicroVision took over Mark's projects and also developed a number of systems for SAPREF. In 2002, SAPREF changed their security access system and used Impro Technologies' products. At the time, Impro Technologies' software was primarily security-focused with access control management being completely in the domain of security personnel. SAPREF, however, required that various business units be allowed to manage access to the refinery via an on-line, automated system. There was a high volume of permanent and temporary contractors (approximately 2500 during a shut-down period), permanent and temporary staff as well as visitors who accessed the refinery on a daily basis. It was critical for the process of allowing people onto the site to undergo a stringent process that included:

- A request for the person to access the site. Contractors needed to be linked to a firm and the job function of the person had to be specified.
- The approval of the person by an authorised approver.
- An induction and training process. Contractors had to undergo induction and training specific to SAPREF's health, safety and environmental requirements.
- The activation of the person for a specified period.

SAPREF also wanted to integrate the access control system with their business systems including human resource (including contractor) management and time-management systems. They also wanted to use web-enabled technology because of the scale of access as well as the need for on-site and off-site access and management. MicroVision was tasked with building the system and this required a high degree of interaction with SAPREF's various business units, Impro Technologies technical personnel, as well as technical resources from other systems we needed to integrate with. This experience necessitated the formation of a Community of Practice comprising of multi-disciplinary skills, all directed to play a part in solving the problem at hand.

The successful implementation of this system resulted in us working closely on other major projects that integrated Impro Technologies' products. These projects include

- the Island View Storage Security and Logistics System (SLOCS). Island View Storage were experiencing a high degree of theft of their products. We developed a site access logistics management system that integrated access control systems incorporating RFID and digital video recording systems with business systems.
- the Cutler Complex access Management System. The Cutler Complex is a national key point in terms of the National Key Point Act (Act 102 of 1980) as amended. The complex located at Island View / Fynnland area of the Bluff and is part of the Port of Durban. It covers an area of 116 hectare and is developed as a major bulk storage and handling facility for chemical and petroleum products in both liquid and gas⁹². We developed the access management system that worked on a similar basis of access as SAPREF's system.
- the development of a module for parking garage management for Amano Japan.

We were introduced to these new projects through the network and business ties of SAPREF and Impro. These experiences provided a strong indication of the massive potential for networked organisation. After successfully completing these ventures and engendering a good working relationship, MicroVision, together with Impro Technologies, conceptualised the development of a security and logistics cluster. In 2007, we developed a concept document that described the potential for what we called the SELOTEC Cluster, and hoped to have this cluster adopted by the KZN ICTE Cluster Forum. Unfortunately the forum never reached the point of inviting proposals for cluster development. MicroVision is a small business and we were tremendously constrained by a need for sustainability. We did not have the resources to engage in the further research and development required for building products to augment Impro Technologies' products without being in an environment that supported the SELOTEC Cluster.

We felt quite isolated as a company in the software development industry and felt a strong desire to network. We were convinced through our own experience that we would never be able to grow our business unless we were plugged into a network of resource pooling and searching for joint opportunity. In the early 2000's I joined the Black IT Forum (BITF), an

⁹² <http://cutlermanagementboard.co.za/> - Accessed on 01/10/2014.

organisation that was established to address the historical imbalances of black representation in the ICT industry. The vast majority of black businesses in the ICT sector were experiencing the same difficulties that we were experiencing and this lobby group mainly targeted government to transform the industry and to provide opportunities for small to medium-sized business to grow.

In 2005, MicroVision joined the SmartXchange ICT Hub. SmartXchange was established in 2004 through a consortium led by the Ethekewini Municipality. According to the Annual Review Report of 2013/14⁹³, the mandate of SmartXchange is as follows:

- Identify and assist in developing a quality SMME (Small, Micro and Medium Enterprises) base in Kwa-Zulu Natal.
- Vehicle for public and private organisations to work together to realise the vision of KwaZulu-Natal becoming Africa's ICT hub.
- Build a pool of skilled ICT workers that will enable KwaZulu-Natal ICT business to flourish
- Support initiatives that work to bridge the digital divide.

MicroVision won 2 awards during our 3-year period at SmartXchange, viz.

- First prize for ICT Company of the year – 2006
- Second prize for ICT Company of the year – 2007

SmartXchange's key focus was on business incubation at the time of our participation. Most of the programmes were focused on business support such as "how to run your business", financial management, etc. The development of business collaboration initiatives was not central to the SmartXchange programme and, consequently, a strong alliance should have existed between SmartXchange and the KZN ICTE Cluster Forum, but unfortunately this never materialised.

⁹³ SMARTXCHANGE 10th Year Commemorative Brochure and 2013/14 Annual Review Report

4.4. Myobuzz - MicroVision's latest innovative product

MicroVision's involvement in educational management and education in general prompted the idea of building tools for greater interaction with the entire school community including learners, staff members, the school governing body, the department of education, alumni and a host of service providers, etc. The building of strong communication channels between schools and their stakeholders is extremely necessary in the creation of functional and conducive educational environments. MicroVision's initial idea, conceived in 2011, was to build a web-based application conceptualised as a "School-Buzz" that provided the functionality needed to facilitate social and learning networks. This cloud-based application was conceived to contain

- a social networking component that allows the school, staff, learners and parents to upload news and information.
- an e-Learning component that allows staff to upload learning material, lessons and exercises within the framework of their curriculum.
- an events management module that provides a calendar view of events planned at the school.
- a module that integrates with our schools management system, MasterC, that provides parents with information relating to their child's performance, incidents, attendance and school fees.

As the idea began to germinate, it became more and more apparent that it is not only schools that require the constructs that facilitate social networking and learning. We were convinced that the initial concept could be extended to cater for the many communities of practice we engage in throughout our lives. The notion of a single platform that allows people to engage in dialogue and learning with all their communities through common, core constructs was born and the product to be developed was named Myobuzz (my-your-buzz).

We envisioned Myobuzz to be an on-line platform that provides the constructs needed for people to create and/or connect with all their communities and community members in a uniform way to learn together and collaborate. One of the metaphors we used to describe the product is that it is "the virtual fireplace around which a community will congregate to share stories, exchange information and learn from each other". Myobuzz was conceptualised to

facilitate the creation of networked, self-sustaining communities where members can keep abreast of the latest community developments and contribute to the well-being of the community. Myobuzz was perceived to be the fusion of global knowledge embodied in different types of communities, including geographical communities, business communities, inter-connected organisations and communities of practise.

4.5. Myobuzz System Overview

Figure 7 and Figure 8 below are screen shots from Myobuzz that show the community affiliations of two different persons.

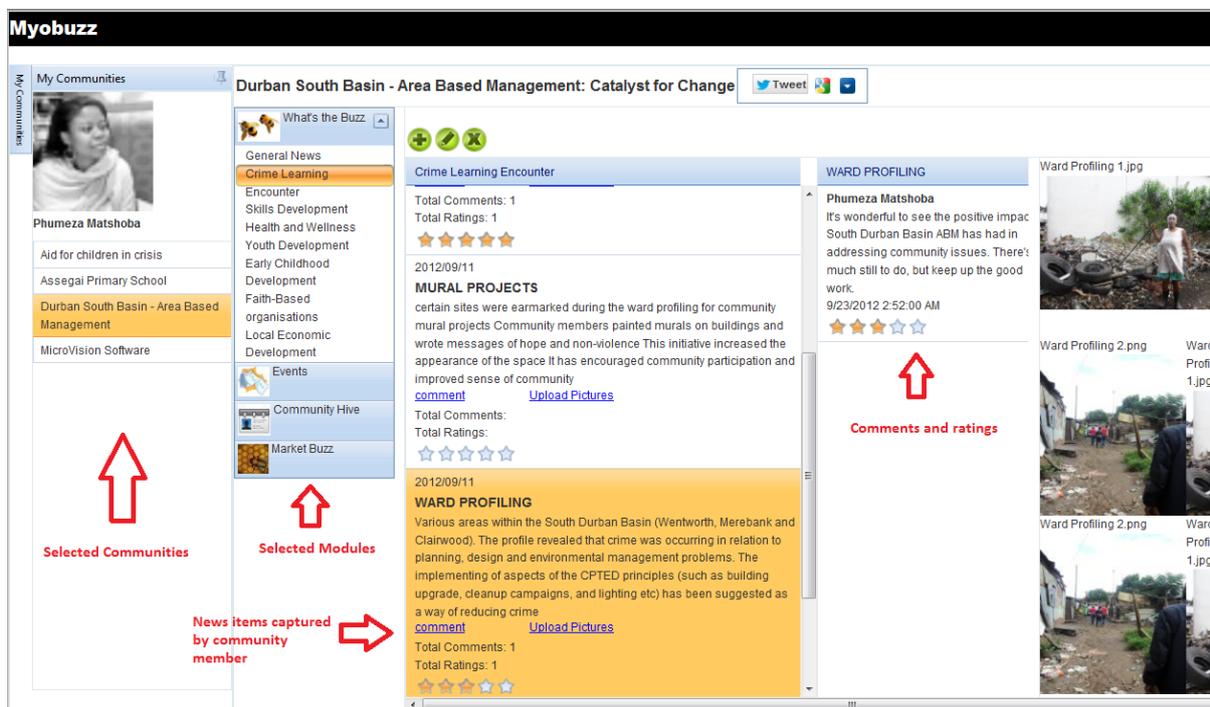


Figure 7

Figure 8

Users may create their own communities or select the communities that they wish to belong to. All the communities that an individual is connected to is visible in a list and, by clicking on the community name in the list, the community gateway is accessed and the user is able to interact electronically within the community and its members.

Myobuzz provides basic core constructs that are applicable to virtually all communities. These include the following modules:

- **What's the buzz.** This module allows members to capture news, upload multimedia items and for others to give comments and feedback. Figure 7 is an example of news items that have been written by various members. Communities may also create news categories in order to structure content. This is illustrated in comparing the “What's the buzz” categories in Figure 7 and Figure 8.
- **Events.** This provides daily, weekly, monthly and timeline calendar view of community events. The events of all selected communities or a filtered list of selected communities can be displayed.

- **Community Profile.** This module allows for community administrators to set up or specify
 - what the community is about,
 - the geographic location of the community,
 - the community's affiliation to other communities,
 - the various community roles that people can register for. For example, a school community comprises of learners, educators, parents, a governing body, educational officials, etc.
 - the Myobuzz modules that are relevant to the community.
 - the curriculum and learning course structure.

- **Community History.** Many communities have rich histories and the system provides for the chronicling of past events and experiences that can be captured in various multi-media formats.
- **eLearning.** A learning curriculum can be structured and multi-media learning material can be uploaded.
- **Market buzz.** This section allows local businesses to advertise their products and services within the local community at a nominal fee. This module is expected to generate revenue for MicroVision.

Communities are inter-connected with other communities and MicroVision has made a distinction between three types of linkages, namely embedded, affiliated and associated communities.

Embedded Communities

An embedded community is contained within a hierarchical structure and is 'owned' by the parent community. For example, a government school, from an organisational perspective, is embedded within a circuit structure, which is embedded in a regional structure which is embedded in a provincial department which is embedded in the national department. Myobuzz makes the following provisions for embedded communities:

1. Information can be shared from the parent community to siblings and vice versa. When a news item is posted, the author can specify the communities that the item can be shared with – across the hierarchical chain.
2. Business intelligence can be derived across the global structure.

The integration of Myobuzz with the MasterC schools management system provides immense extended capability to derive business intelligence for education organised within an embedded form and MicroVision intends to harness this potential.

Affiliated Communities

Communities affiliate to a coordinating body, which itself is a community, in order to engage in a common practice. For example, a school can affiliate to a schools sports organisation that manages sporting activities on behalf of participating teams. A business can affiliate to a business forum for the purpose of networking or creating an environment conducive for business. Affiliated communities could be autonomous and interconnect by choice.

The organisation of sport is an example where both affiliated and embedded types of communities can be prevalent. A soccer club can be embedded in a soccer league because this is the key focus. A school on the other hand that is embedded in an educational circuit, can be affiliated to a sports organisation of which soccer is one of the sporting codes. Sports communities are one of the targeted types of communities of Mobuzz and the system will contain features for league management. The controlling body will have the functionality to create leagues, competitions, teams, set up fixtures and capture results. Affiliated or embedded communities will be able to link their communities to teams and view fixtures, results of matches and the log. Affiliated communities will also be able to upload multi-media articles relating to the event.

The affiliation of schools to a community that manages a common curriculum is another example of affiliated communities of practice. The common curriculum can be managed by a controlling body responsible for the management thereof on behalf of its affiliated organisations.

Associated Communities

Associated communities are linked for any reason that may be of some mutual benefit. For example, communities may associate because of geographic proximity. Businesses, religious organisations, schools, etc. may associate themselves with a geographic community. The association is not necessarily because of a common practice. Rather, the link may be established for purposes of common expediency.

Myobuzz is another example of how the web is being rebuilt around people. Paul Adams, widely recognised as one of the leading thinkers on the social web and currently working as the Global Brand experience manager at Facebook, argues that this people-centred web is a fundamental re-architecture of the internet as opposed to just a small change⁹⁴. He identifies four major shifts that are shaping our world. The first is the rise in accessible information. There is an exponential increase in the store of information digitally. Hundreds of millions of people are posting information online every day. Secondly, the web is moving away from a document-linked web to a web where social behaviour is the key feature. Thirdly, the tremendous amount of stored interactions gives the ability to mine data examining social patterns that gives insight into how trends develop and this will change the way in which business is done. The fourth shift is the dramatic increase in our understanding of how we make decisions. Adams says that have previously over-emphasised rational thought and greatly underestimated the power of the non-conscious brain. Myobuzz fits into this re-architecture of providing individuals with the ability to engage with inter-woven communities and we are passionately driven by the potential of owning this kind of software. We anticipate the ability to collect and mine massive amounts of data and hope to examine the patterns of individuals as they interact within their communities at a social and learning level.

4.6. The need for co-operative development

We strongly believe that the success of the project is highly dependent on the ability of MicroVision to cultivate intertwined communities of practice and establish co-operative business relationships in the areas of software development, community creation, e-learning content development and business development. MicroVision has a staff compliment of only six persons and thus the company's in-house resources are far from sufficient to be able to successfully deliver a project of this envisioned magnitude and complexity.

⁹⁴ PAUL ADAMS: *Grouped New Riders*. 2012. Page 7

Community engagement in the systems development phase

MicroVision initially decided to target four different types of communities during the development phase, namely, schools, geographic communities, sports organisations and religious institutions. The selection of a variety of community types is important in ensuring that the system design is flexible enough to cater for different audiences. These organisations also contain the inter-linkages that MicroVision deems an important differentiating feature to virtually all other social networking applications and community-based systems. MicroVision has begun to establish a number of co-operative relationships in each of the community types.

Engagement with schools

The company aims to leverage the established relationships built with schools over 20 years. An initial 3 schools that use MasterC on the internet have been chosen to be part of the development phase. These schools have offered to assist in the testing of the application by capturing their school news, events, history and providing input on design features such as information layout, ease of use, and additional expectations. The work to integrate Myobuzz with MasterC is extensive and the feedback from schools to communicate personalised information to learners and parents through Myobuzz is critical.

Engagement with Educators participating in the population of e-learning material

The Myobuzz model aims towards building a collaborative network of contributors of e-learning content bound by a common ethos of sharing their knowledge within their domain of expertise for the betterment of all. E-learning content will be ‘owned’ by a community and other communities who wish to use the content can affiliate to this community responsible for managing the content. For example, a Myobuzz community called the ‘SA Schools Curriculum’ will be established that will cover e-Learning content for all grades and for all subjects. Persons, largely educators, wishing to contribute to curriculum content will need to register with this community of practice as contributors. South African Schools will be able to affiliate to this community and will thereby have access to the e-Learning content created by this community. Communities who own content and allow affiliation from others can specify three possible relationships with a contributor, namely, by invitation only, through an application and approval mechanism or by allowing no restriction whatsoever.

Whilst there are many sites that provide e-learning material for the targeted South African school community, MicroVision's research indicate that they are largely subject-specific. This means that, generally, a learner will need to navigate through different sites to obtain material. Furthermore, e-learning content on many sites are not structured in accordance with the South African curriculum. Myobuzz provides for the delivery of content for all subjects in a common format and ability to structure content as per the curriculum required. Importantly, Myobuzz will make provision for open collaborative exchange of knowledge from practitioners themselves. The company believes that providing any educator with the ability to upload content toward a global distillation of knowledge could provide a competitive advantage in the long term. Of course, people must be willing to contribute freely. Andrew Lih suggests that millions of Wikipedians contribute freely to Wikipedia for amongst others, the following reasons⁹⁵:

- the thrill of contributing something that thousands, if not millions, of people will read.
- satisfaction of helping further the recording of human knowledge.
- It is social. You never know who you will meet. Every article has an associated discussion page to encourage debate and to exchange ideas with others in the community.

The "open editing" model adopted by Wikipedia is an important consideration in the light that, despite the threat that uncontrollable chaos and absolute disaster could have arisen, Wikipedia is a highly popular and highly regarded reference and serves as an integral part of the Internet's fabric of knowledge.⁹⁶ A case of a disastrous situation happened in 2005, when someone edited the Wikipedia biography of journalist John Seigenthaler, falsely implicating him in the assassinations of John F. Kennedy and Robert Kennedy.⁹⁷ Seigenthaler rebuked Wikipedia and what it stood for and described his inability to track the perpetrator down. A number of controls have subsequently been put in place in Wikipedia to obviate this type of situation. Myobuzz will attempt to avoid this type of problem by

⁹⁵ Andrew Lih. *The Wikipedia Revolution*. Page 7.

⁹⁶ Andrew Lih. *The Wikipedia Revolution*. Page 4.

⁹⁷ Andrew Lih. *The Wikipedia Revolution*. Page 10.

- Initially allowing contributors to join by invitation only. This invitation may be extended to others by contributors themselves.
- Like Wikipedia, a chronological log of every change will be saved, allowing for unwanted changes to be easily undone.
- Changes to content will be broadcast to the community, allowing inspection, endorsement, challenge and rating.

MicroVision is currently working with approximately 10 educators from schools using MasterC who have committed themselves freely and voluntarily to uploading lessons and providing feedback and input that will assist in the development of the e-learning module. As the development of the module matures, more and more educators will be invited and will hopefully participate.

MicroVision hopes that, much like Wikipedians, the community will self-organise in a distributed, decentralised way. Like ants at work, there are no instructions from the top or middle-managers directing others⁹⁸. The building of the curriculum will result from individual contributions working collectively towards incrementally building an end-product for the benefit of all. The “piranha effect” is a metaphor that Jimmy Wales uses to describe the Wikipedian operation: “You start with a little tiny article and it’s not quite good enough so people are picking at it and sort of a feeding frenzy and articles grow”.⁹⁹ Lih states that the piranha effect took effect with Wikipedia almost overnight and relied on an online culture of collaboration and group behaviour.

Engagement with Geographic Communities

The South Durban Basin Area Based Management (SDB ABM) structure is embedded in the Ethekewini Municipality and is responsible for local economic development and co-ordination of municipal services containing one of the most important industrial hubs in South Africa. It contains two petro-chemical refineries, a large paper mill, motor manufacturers and at least

⁹⁸ Andrew Lih. *The Wikipedia Revolution*. Page 82.

⁹⁹ Andrew Lih. *The Wikipedia Revolution*. Page 83.

5,000 businesses, 22,000 households and 200,000 residents in 6 residential areas.¹⁰⁰ The SDB ABM coordinates many programmes within the region in the areas of crime learning, skills development, health and wellness, youth development and local economic development. The SDB ABM management has agreed to work with MicroVision to assist in tailoring Myobuzz to be a medium of communication through which the organisation can communicate with residents and stakeholders. Each residential area can establish its own community within Myobuzz that can, for example, be managed by leadership from the rate payers association. These residential communities can then affiliate to the SDB AMB for deeper, interactive communication and participation.

MicroVision's vision is that Myobuzz become the interactive communication tool of choice to enable e-Government and if the system works for the South Durban Basin region, it will work for any geographic region.

4.7. Gauteng Department of Education – Pilot project

In 2011, we made application to the Technology Innovation Agency (TIA) for funding when Myobuzz was still in a conceptual phase but our application for funding was turned down. This, however, did not deter us and we started building the application at our own cost. After developing the application to fair degree that enabled us to showcase some of the features, we embarked on a road-show to search for potential investors and funders. The KZN ICTE Cluster Forum would have been the perfect vehicle for us to pitch to. eLearning was one of the key focus areas of the forum but, unfortunately, the organisation was no longer functional. From 2012, I approached a number of institutions and individuals in the hope that we could develop a collaborative network that would assist in the co-development of Myobuzz. In all cases, we were encouraged by the levels of interest in what we were doing. However, it proved very difficult to obtain the funding and the engagement required to augment the development team.

During my search for collaborative partnership, I was fortunate that Sibonelo Ngubane, whom I had known since 1995, had taken keen interest in Myobuzz. He was one of the

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http://www.durban.gov.za/City_Government/Administration/Area_Based_Management/South_Durban_Basin/Pages/default.aspx

persons high up on my contact list because of his ICT knowledge, experience and business contacts. Ngubane had his own company, STN Technologies in the 1990s. He subsequently joined Microsoft South Africa and was responsible for building Government business for Microsoft. He currently works for the Sizwe Group (Pty) Ltd who does business with amongst others, the Gauteng Department of Education (GDE). The Sizwe Group became aware of the GDE's request for a quotation for an eLearning platform that would be used in a "proof-of-concept" project to deliver eLearning to schools in Gauteng. Ngubane recognised that Myobuzz was able to meet the requirements of the GDE and we agreed to respond to the quotation under the banner of the Sizwe Group. Our quotation was accepted and Myobuzz is currently used in the GDE eLearning project as the eLearning Management System. The GDE delivered 88,000 tablets to approximately 2,200 schools and learners in Grades 4 to 9 are able to access eLearning content from these devices via the Myobuzz platform. As a result of the success of the project, MicroVision entered Myobuzz for the "MTN Business App of the Year 2014 Awards" and we were delighted that Myobuzz was chosen as a finalist in the "Best use of Microsoft Cloud Services" section¹⁰¹.

In August 2014, the GDE released a tender for the "Provision of Sustainable end-to-end e-Content Solution Model for all the GDE Schools, and Model the 21st Century e-Classroom". This opportunity prompted MicroVision, Sizwe and Nasou Via Afrika (Pty) Ltd trading as Via Afrika to form a consortium to respond to the tender. The intriguing aspect of this association was how quickly we came to agree to work together. Our initial engagement with Sizwe had a high degree of risk associated with the relationship. We have never worked with Sizwe in the past. Their core business is more focused in IT Infrastructure than in delivering software solutions. Myobuzz was not a tested product at the time and much of the proof-of-concept was experimental and there was no absolute guarantee that the system would deliver acceptably, especially given such a large user base. MicroVision and Sizwe never had any previous business relationship with Via Africa. Yet, in the space of three weeks, the three entities agreed to work together and bind each other in a consortium agreement that would govern our working relationship for the next three years if we are successful in the tender bid. The key value propositions of each entity that are necessary requirements for this tender are as follows:

¹⁰¹ <http://www.appoftheyear.co.za/search-results/?category=11#.VCm6JvmSx9U>

MicroVision

- are the developers of Myobuzz, the platform required for delivering eLearning content, providing communication capability amongst stakeholders, and delivering business intelligence and analyses such as portal usage and learner performance evaluation.

Via Afrika

- is a content developer and educational publisher working in the digital and printed textbook markets in South Africa since 1949.
- has a track record of excellent materials to meet the curriculum needs of learners and educators.
- have highly skilled educational experts with substantial experience in digital content development.

Sizwe

- is an IT infrastructure company with the capacity to host the cloud-based solution and to provide hardware and infrastructure to schools.
- has extensive experience in managing projects of a similar nature in Gauteng.

In our determination of whether we enter into a joint venture or not, the prisoner's dilemma would have come into play up until the point of signing the agreement. A question that would have been asked is: "Do we cooperate with this group or do we defect?" Each entity would have had to make a determination of their ability to deliver the total solution and whether or not perhaps to go it alone or align with different players. Our survival instincts were brought to the fore. Each would have examined the cost/benefit analyses and would have pondered the paradox of self-interest versus the collective good as examined in Chapter 1. Each entity would have undergone a sense-making process at some level and considered various plausible options that would increase its individual probability of success. Ultimately, the consortium agreement was signed even though some important details still needed to be ratified. A high degree of cooperative behaviour occurred in the preparation of the tender in order to give the consortium the best chance of success.

The achievements that we have had with Myobuzz thus far encourage our belief that Myobuzz has the potential to become a dominant design in community-based social networking and learning. Myobuzz, by virtue of its features and structural elements that give communities of all types the building blocks to engage with their members, and the ability to inter-connect with other communities, has global appeal. Myobuzz can aspire to such dominance if it is one of the first applications on the market that allow people to engage with all their inter-connected communities through a single portal that combine communication and learning. Being the first of such applications in the market will give us immense competitive advantage in

- attracting people and communities globally,
- building a strong global brand
- adding more and more innovative features for multiple and interconnected communities making it difficult for competitors to catch up.

The success of achieving dominance will depend on the extent to which knowledge networks can be built or naturally form around the product. We are utterly convinced that a formation much like the KZN ICTE Cluster forum was envisioned to be, would facilitate our need for clustered, collaborative organisation that would create the environment for Myobuzz to achieve global competitiveness.

Chapter 5

Conclusions

This chapter highlights some of the lessons and points raised to lay a foundation for the re-invigoration of the ICTE Cluster Forum that will fulfil the initial intent of building an environment that will make KwaZulu-Natal a vibrant, innovative, fully inclusive knowledge society that contains collaborative organisation and dense knowledge networks.

5.1. Survival in tough conditions demands collaboration

In chapter 1, the turbulence of the global environment was examined. The graph in Figure 1: *Degree of competitiveness in selected industries*, provides a clear illustration of how tough the global environment is for business to attain and maintain profitability in the knowledge economy. This is especially the case when multiple convergence of disruptive innovation dramatically reshapes the way in which the knowledge-based socio-economic world works as we have experienced over the past 30 years. The industry effect during first 20 years of the knowledge economy in selected industries including the ICTE sector is examined by Cynthia Montgomery and quantifies the relatively low levels of profitability that business experienced in many sectors during this period.

The rise of collaborative organisation at a global scale has been unprecedented than at any other time in the existence of humankind. This need for collaboration has been triggered by extreme complexity, heightened turbulence, accelerated pace of change and global competitiveness that we are experiencing in the global economy. Edward Lorenz's "butterfly effect" is an apt metaphor for the way in which new technologies that took root in the early 1990s ultimately triggered massive disruption of the industrial era and, in many instances, completely shattered the pre-existing order. The turbulent environment resulting from the flipping of the economy from an industrial era to a knowledge economy compels business to explore different models to those than were prevalent in the 300 years of the industrial era. The old order of mechanistic, hierarchical organisation where strategic and tactical decisions were made at the top and filtered down to the bottom through many layers of hierarchy needed to make way for much more open, decentralised and flat-structured approaches. We now live in an era it is virtually impossible for many organisations in highly competitive and

complex industries to solve large problems on their own. A strategic synthesis between the opposite poles of competition and cooperation that combines the advantages of both needs to be sought and this is no easy journey for any business.

Examples of mass-scale collaboration have been provided indicating the unprecedented scale of collaboration that exists in today's society. There are many striking aspects of this cooperative behaviour. People collaborate with others producing complex work with others that they do not know, crossing all boundaries of geography, race, religion, creed, and so on. The benefits derived through this cooperative behaviour have been immense and far-reaching. For example, the relatively small sacrifice of many millions of contributors produced the largest encyclopaedia, Wikipedia in a relatively short space of time. Immensely complex works have been produced without traditional elements of managerial control.

It is in this context that the resolve to form an ICTE Cluster forum in KwaZulu-Natal to bolster regional probability of success in the ICTE industry was an important initiative. The KZN ICTE Cluster Forum experienced great difficulty in achieving its objectives. One of the main reasons put forward for the failure to establish the forum is that a lack of trust exists between participating stakeholders. This initiative transpires during a period when South Africa is in a process of rebuilding itself into a democracy after an extremely difficult period of 300 years of systematic exploitation and deliberate under-development of the majority of the South African people. This history has resulted in huge disparities in economic ownership and opportunity and we face an enormous challenge of poverty, inequality, unemployment and under-employment. At the kick-off meeting of the cluster at which I was present, tension between participating parties was palpable. During the meeting, the Black IT Forum complained that they were marginalised by organisers and the Kaiser and Associates researchers in the initial build-up. There was also unhappiness that a Cape Town-based company, Kaiser and Associates, was selected to formulate the Cluster strategy whilst it was felt that there were competent KZN-based skills. Competitive and argumentative stances strongly permeated from the stakeholders present. The prisoner's dilemma of cooperation or defection comes into focus. In this scenario, if trust is a pre-condition for cooperation and collaboration, then the formation of a cluster forum would have been a non-starter. The

overall consensus though, was that the establishment of a forum that encourages clustering must be pursued.

Whilst it is apparent that we do not live in a cooperative utopia, we have no option but to evolve. The birth of our new South African democracy came about as a result of the alignment of cooperative, sacrificial forces for the benefit of the entire nation. It is critical that this same resolve that built democracy which itself is founded on a bottom-up cooperative framework be extended into building an economic framework where cooperation can flourish. Without fostering regional cooperation, we will struggle to compete favourably in a world where cooperation is ingrained in the socio-economic culture of many regions.

5.2. Clustering is a stated strategic pillar for KZN Economic Development

The Provincial Growth and Development Plan 2011-2030 (PGDP) for KwaZulu-Natal has been formulated to drive and direct growth and development in the province to the year 2030.¹⁰² The document emphasises a clustered developmental approach to economic development. This includes building industrial hubs or clusters of activity within each district. Intervention 1.5.b is about the establishment of regional innovation and technology hubs that stimulates synergies between organisations. The document states that the intervention seeks to promote the development of technology parks, innovation hubs and/or any other sectorial knowledge clusters in an attempt to boost effectiveness of research and development of institutions and stimulate the development of new products in the Province. It is stated that 4 technology hubs will be established in 4 regions in the province and that awareness around the concept has already been established and that interested private investor investors have already been mobilised.

It is very encouraging that the KZN provincial government has continued to promote a clustering strategy that includes the ICTE sector. A corporatist approach should be considered between

¹⁰² PROVINCIAL PLANNING COMMISSION. Province of KwaZulu-Natal. *Provincial Growth and Development Plan 2011-2030*. September 2013 revision

government, the private sector and institutions of learning. As Spencer's studies found, this contributes to the diffusion of knowledge in cities, regions and countries. A revitalised ICTE cluster forum will empower knowledge diffusion networks and provide a framework for local innovations to develop into dominant design. The European Economic Community that encouraged co-determination amongst workers and employees and inter-organisational collaboration is another example of the benefits that can be derived through adopting corporatist approaches even in plural societies and across nations within a region (see paragraph 2.1.2 that deals with Greater Europe's cooperative era).

5.3. Leverage regional strengths

The way in which regions have responded to economic complexity has also been deliberated upon in chapter 2. Firms, governments and institutions of learning have rallied together within the regions studied by Charles Hampden Taylor to focus on their areas of strength, building strong collaborative frameworks and densely linked knowledge networks. In so doing, the regions have been able to maintain their global dominance in their selected domains. Spencer's case study of the Flat Panel display industry gives a clear indication of how regional convergent networks can completely disrupt another region that may have leading knowledge but insufficient knowledge depth and openness to compete effectively in a global environment. Her studies show that North American and Japanese industries were most competitive when their regional knowledge-diffusion networks exhibited the highest density and centralisation. This study makes a convincing case for the re-invigoration of the KZN ICTE Cluster that can be an effective vehicle for creating an enabling environment for clustering in the region. The formation of regional networked organisation guided by strategic centres and the support, monitoring and evaluation thereof are critical for regional firms to favourably compete within an international economy.

5.4. We need to exploit mechanisms that give rise to cooperation

Martin Nowak argued that the construction and complexity in evolution is the consequence of cooperation. Whilst cooperation involves a sacrifice and "hurts our fitness", it is the "master architect of evolution". Cooperation is a necessary requirement for taming turbulence. From a chaos theory perspective, order will spontaneously arise from chaos through a process of self-organisation of elements (alignment of cooperative forces) within the system itself. Nowak

says that cooperation arises out of competition and we are continually placed in a dilemma of cooperating or choosing the natural selection of self-interest. Natural selection always favours defection and he suggests that natural selection needs help in seeing the advantages of cooperation. Nowak's five mechanisms of direct reciprocity, indirect reciprocity, spatial selection, group selection and kin selection that give rise to cooperation are based on a cost-benefit determination. According to Nowak, cost and benefit are measured in terms of *fitness* which is the rate of reproduction, be it genetic or cultural or economic.

Direct Reciprocity favours a regional context because of the proximity of individuals or groups that allows for reciprocation of an altruistic act to be enacted. Like in the prisoner's dilemma when the game is played repeatedly, it makes no sense to defect if the balance of forces is such that cooperation will lead to better fitness levels for everyone and including the self. A favourable climate for direct reciprocity is needed and can be catalysed in KwaZulu-Natal if forums exist that allow for people and organisations in related industries to interact. We can only scratch each other's back if we know one another and can see the value in performing altruistic, reciprocating acts. The absence of the ICTE Cluster forum, that should provide a platform for organising the sector and that encourages stakeholder linkages, results in a disjointed sector that make it very difficult to grow partnerships organically. The initial stated objective of the cluster in building cluster scale is to market the cluster inwardly. This involves popularising the purpose of the cluster, creating platforms for companies to showcase their capability and to provide environments such as technology parks and technology hubs that allow companies to be visible and that foster learning environments. The creation of new and innovative technologies can be a long and arduous process that requires tremendous sacrifice and risk. Investment of time, money and effort are some of the key ingredients in this type of venture. Another key factor in developing competitive products is to understand one's limitations and how and where to effectively leverage knowledge and skills from other sources that are not available within one's own organisation. Lorenzoni and Baden Fuller's studies of central firms within a network found that they reject the idea of doing everything themselves (See section 2.3 of this thesis). Rather, they determine how best to utilise the network to develop innovative responses to requirements. Performing functions that collectively lead to product development require a significant amount of cooperation and it is important for participating parties to feel the individual and collective benefit of working

together. As a fledgling partnership that understood the dependencies of standing a chance of winning the Gauteng Department of Education's tender to deliver eLearning to approximately 2.2 million learners across all schools in the province and the immense benefits that would arise, MicroVision, Sizwe and Via Africa performed a number of reciprocating cooperative actions, each scratching the others' backs enthusiastically.

Indirect reciprocity involves harnessing the power of reputation. Whilst MicroVision, Sizwe and Via Africa did not have previous business engagements prior to the GDE bid, the decision to participate in the consortium was not a completely blind one. The power of the reputation of each of the companies was an important factor in the decision to engage. The first few meetings were crucial in finally deciding whether or not to pursue the tender together and, within one week, as we engaged further and understood the benefits of pooling our resources, the levels of comfort increased sufficiently so to pursue a tender that would bind us for at least three years.

A number of organisations that affiliated to the ICTE cluster forum have very strong legacies that span many years of business excellence including international experience. The power of these reputations must be exploited and leveraged to build strong foundations upon which knowledge networks can grow. It is vital for a region to exploit these organisational strengths. The innovations in RFID, set-top box development and manufacturing, access control and the many innovations that have been developed and exported worldwide are important platforms for developing cluster scale. There is a great need to foster an environment that will excite forces that will cultivate regional inter-firm network density and cause multi-disciplinary skills to converge to solve large problems. These forces include building knowledge networks, organisational networks, communities of practice and learning environments involving higher institutions of learning, small business, government, financial institutions, anchor clients and other stakeholders. The starting point will be to encourage and incentivise successful KZN-based innovation-driven firms to become the strategic centres of clusters that will fulfil functions as outlined by Lorenzoni and Baden Fuller (See page 51 of this thesis). Strategic centres have the responsibility of creating value for their partners, facilitating the development of core skills, knowledge diffusion within the cluster and fostering an atmosphere of trust and reciprocity.

Spatial selection. As indicated by Nowak's chess-board analogy, each square on a chess board does not touch all the other squares on the board. In business too, there are eco-systems of neighbourhoods within which the game is played that also connects through to other eco-systems. Spencer's studies in the FPD industry showed that gatekeeper and representative organisations play important bridges between their regions and other regions in the rest of the world. The establishment of an effective ICTE cluster forum comprising of business, government, promotion agencies, investment organisations, higher institutions of learning and other stakeholders are important in creating an environment that will set the climate for international engagement that protects regional industry initiatives as well as exploit international opportunities. The Kaiser and Associates' Cluster Model (Figure 5: Cluster Model Diagram) provides a framework for how a cluster can be structured and this can still form the basis for re-establishing the Cluster Forum.

Equally the cluster forum, though collective knowledge and wisdom, should also be alive to the demands, threats and opportunities that international engagements can bring. It is expected that within a regional cluster, a number of primary and secondary business opportunities can emanate from a cluster built around a strategic centre. It would be important for a cluster to explore the opportunities that could be harnessed by other local businesses. Potential network linkages will need to be examined with a specific goal of building network density and inter-dependency within the region.

Group Selection. According to Nowak, the cooperative mechanism works well if there are many small groups and not so well if there are few large groups. The Kaiser and Associates cluster strategy document indicated that 80% of businesses in KwaZulu-Natal are made up of small enterprises (see chapter 3) and this part of the sector needs to be energised. A body such as the KZN ICTE Cluster Forum can build immense opportunity for small business through fostering cluster formations. The original stated objective of the forum was to "build cluster scale" where anchor firms would engage smaller firms to supply knowledge, components and resources needed by the cluster. Lorenzoni and Baden Fuller's studies identify that firms occupying central positions are responsible for partner selection and that

this needs to be done with great care.¹⁰³ A convergent strategy will need to be adopted that would enable cross-fertilisation of knowledge and skills diffused across the cluster. It was pointed out in Chapter 2 of this thesis that this type of clustering has worked effectively in the Japanese Keiretsu. In Chapter 2, Spencer's FPD studies showed Japan's increase in regional network density as FPD became the dominant design whereas the opposite happened in North America and Western Europe. This is ascribed to the way in which the Japanese organised themselves cooperatively into tight, mutually dependant consortia. It was also pointed out that KwaZulu-Natal has many potential anchor firms with innovative products that compete and can compete favourably in the international market. Chapters 3 and 4 show that tremendous potential exists for developing clusters that include small business around these "strategic centre" firms prevalent in KwaZulu-Natal.

Kin Selection

Nowak points out that that the network of a few close friends has the propensity to promote cooperation even in the absence of direct and indirect reciprocity. When direct and indirect reciprocity are included, the potency of cooperation networks of close friends is much higher than smart co-operators within a well-mixed population that contains co-operators and defectors. When things get tough, those closest to you are the most likely to come to your rescue¹⁰⁴. Nowak warns, though, that we should not be too narrowly focused in this regard when building cluster formations. We need to step out of the narrow confines of kin selection that favours our own kind. Nepotism is counter-productive in situations when cultivating cooperation in the wider society. This is particularly the case within a South African context where we need to vigorously break down the vestiges of Apartheid and racism.

5.5. We must pay special attention to network structure.

The ICTE cluster forum will need to facilitate networked structures that will amplify the chances of innovative products developed within the region to reach their tipping points and

¹⁰³ GIANNI LORENZONI AND CHARLES BADEN FULLER. *Creating a strategic centre to manage a web of partners*. (Article found in DE WIT B. AND MEYER R 2001. *Strategy Synthesis*. Reading 7.2 Pg 373-383)

¹⁰⁴ NOWAK M. 2011. *Super Cooperators*. Page 251-252.

achieve local and global market success. Martin Nowak, together with Erez Lieberman and Christoph Hauert, studied network structures and found that they can either act as amplifiers or suppressors of selection of advantageous mutants.¹⁰⁵ From a commercial perspective, mutants would be akin to the creation of new or improved innovative products or services. Their studies have shown that suppressor networks tend to be organised in hierarchies. In such structures, there is a good chance that innovations can be overlooked. Amplifier networks, on the other hand, augment chances of innovation to thrive and take root. They identify two types of amplifier network structures, namely, star-like and funnel network structures. The World Wide Web is an example of a star-like structure where individuals and groups are highly connected to hubs. In an ICTE cluster forum context, these will be the strategic centres or the anchor firms of clusters. In a funnel network, one node (the anchor firm) is connected to three, then to nine more and so on until the funnel wraps to back to the first node. It is expected that the forum will facilitate communication and networks and it is important to ensure that brilliant ideas need to trickle throughout the population such that regional strengths can be harnessed and channelled towards cluster formation.

Nowak also points out that there is a link between cooperation and the structure of a network. His experiments have shown that it is easier for co-operators if each individual is connected to a few others¹⁰⁶. Fewer people means less management and the larger the number, the less spontaneous the team members will be. This can be linked to the trend of engaging smaller, specialised business entities or communities of practice within a cluster. Clusters connected to the forum will need to examine optimum structures of organisation that promote cooperation.

5.6. Build on common values to foster a culture of cooperation and cohesion

¹⁰⁵ NOWAK M. 2011. *Super Cooperators*. Page 246.

¹⁰⁶ NOWAK M. 2011. *Super Cooperators*. Page 250.

The Keiretsu network that emphasises the inter-connected nature of different inter-locking business is strongly aligned to Japanese culture. Ethnically, the Japan is the most homogeneous nation in the world where only 15% of the land is capable of agriculture, the rest being mountainous terrain¹⁰⁷. According to Alston and Takei, the Japanese were forced to develop standards of behaviour that de-emphasised the individual while emphasising the importance of conformity within the group. Alston and Takei state that in Japanese culture, the logic of “winning the game, but losing the fight” is part of their cultural attitude. These cultural principles and values are also practiced in business and Japanese business successes through Keiretsu formations have been widely documented.

South Africa, on the other hand, is a nation made up of diverse race, cultures and religions. We come from a divided past and this makes it much more difficult to foster homogeneous relationships across the many divides. As a nation, however, we have been able to traverse extremely difficult terrain and in 2004, have experienced the birth of a new democracy. Despite the diversity that exists, there is much commonality that we can build on that encourages cooperation. Nowak argues that the science of cooperation that structured humanity over 4 billion years of evolution harmonises with the teachings of the great world religions that have provided coping mechanisms to ameliorate suffering and sadness. The tenets of common teachings are based on love, hope and forgiveness and unselfishness¹⁰⁸. These are the same principles that form the basis for cooperation. The spirit of cooperation has been driven for millennia. It can also be seen in traditional ideas and teachings such as “one good turn deserves another”, “do unto others as you would them do unto you”, and so on. Reuel J Khosa advocates for the African philosophy of *Ubuntu* to help the world to take a better view of the continent and to show the world a better way to develop its human potential. Khosa states the following about Ubuntu:

“At the heart of every society is a predominant philosophical value system, which in our case is Ubuntu. This is captured in the Zulu expression Umuntu ngumuntu ngabantu, or ‘I am

¹⁰⁷ J P Alston and I Takei, *Japanese Business Culture and Practices: a Guide to Twenty-First Century Japanese Business* (iUniverse, 2005).

¹⁰⁸ NOWAK M. 2011. *Super Cooperators*. Page 253.

because you are, you are because we are'. The Swazis say: Izandla ziyagezana, meaning 'The hands wash the other'; and the Tsonga put it rather humorously in the phrase: Rinitho rinwe a ri musihove, or 'On finger cannot pick up a grain'. Throughout Africa, similar sentiments are expressed in equally pithy terms. The value of Ubuntu is widely embraced in black Africa and forms the basis for the Pan-African philosophy that seeks to unite peoples across national boundaries. It is a value system with echoes in other cultures and continents too. Ubuntu can be understood as a universal idea, but it so happens that we in Africa gave it pre-eminence. It implies that we have a coherent, indigenous and legitimate set of principles upon which to construct a new self-confident African identity.'¹⁰⁹

We have no choice but to evolve. Cooperation, as it was since the beginning, is the driving force.

¹⁰⁹ KHOSA R J. 2006. *Let Africa Lead. African Transformational Leadership for 21st Century Business*. Page 5.

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