



Design for commercialisation: Enabling innovative product ideas through supportive creative environments.

By

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ABSTRACT

Design as a field of practice is constantly evolving and has predominantly been used to stimulate and facilitate the humanisation of new technologies, so that they are usable and desirable for the capitalist economy (Boehnert, 2013, p. 14). With the evolution of the commercial and economic systems, the role of the designer now needs a shift so that it is able to facilitate new and appropriate interactions (Manzini, 2015, p. 180). This thesis explores what some of those interactions may look like and the role that design may be able to play in assisting them.

Enabling society to be better equipped to communicate and collaborate with industry and academia, and vice versa, may be beneficial. The more society's contributions can be heard, acknowledged and implemented, the better the economy may function. Increasing the transparency and understanding of these systems would potentially allow for less corruption and greater collaboration within and between them, possibly allowing for improved innovation. Once entrepreneurs are better equipped to integrate and take advantage of the institutional structures that are in place, this could drive economic development forward, and more informed and effective decisions might be implemented. Institutionally, through a better understanding of their resources and networks, such research could also lead to the implementation of better management and leadership strategies.

This thesis focuses on the role of design as a catalyst for product development in the Western Cape. The concept of enabling innovative product ideas through design is analysed through an examination of three current case studies being developed in this region. To contextualise this a bit further, what is examined are the processes, developments and relationships, within and across the structures of the university, civil society and the design industry. This is explored to identify how each of these groups may support the design process, and where they may inhibit it.

The primary objective is to provide a foundational road-map to enable innovative ideas from which citizen projects, universities and the design industry may benefit and continue to build upon. In this way, it may be possible to create a more synergetic relationship between universities, the design industry and civil society, or at least to make that relationship more transparent and mutually beneficial.

Keywords

Industry, Civil Society, Academia, Commercialisation, Innovation, Design, Designers, Participation, Entrepreneur, Knowledge and Networks

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DEDICATION

**For my mother, may I repay all the kindness I have received from
her, and more.**

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Glossary

Actor – human or non-human (e.g. books) contributors that play a part in the functioning system.

AMTL – Advanced Manufacturing and Technology Laboratories

CAD – Computer Aided Design

CAM – Computer Aided Manufacturing

CCDI – Cape Craft Design Institute

CPUT – Cape Peninsula University of Technology

FDI – Formula D Interactive

Innovation – Ideas that advance society, technology or the economy.

Innovation ecosystem – The combination of different actors in a system that contribute to the working and progression of that system (Carayannis & Campbell 2012, p.11).

Innovation networks – How the different knowledge clusters are connected through mutually beneficial relationships (Carayannis & Campbell 2012, p.9).

Knowledge clusters – Where groups or individual actors are located (Carayannis & Campbell 2012, p.9)

PLMCC – Product Life-Cycle Management Competency Centre

IP – Intellectual Property

CHAPTER 1: Introduction

This chapter begins by providing understanding of the context of the research problem and the scope of the work explored. After establishing these parameters, a basic introduction into the principal areas of investigation is provided. This includes how the design process has evolved and where it may be heading with regard to civil participation. Finally the nature of commercialisation in relation to product design is outlined, to provide a framework within which the material is examined.

1.1 Society's Ideas

To begin the introduction to this thesis, a short personal exploration identifies the background to why the research was undertaken. The reason for this is that the case identified below was the direct stimulus that initiated the identification of the problem statement and research questions that were subsequently investigated. It therefore seems appropriate to begin with this personal encounter.

The concept for this thesis arose during a Cape Peninsula University of Technology (CPUT) industrial design project in which I participated. Along with three other graduate level industrial design students and under the guidance of our industrial design professor, I was selected to be part of developing a new product range. The aspect of the product that interested me most was that the initial products were conceptualised and produced by a man – Mr Brink – with only one arm, to assist other people in the same situation. Another project which was being initiated and tested by a disabled individual within the university was developing a solution to assist people without hands to be able to drive. The insights and ideas generated by this individual for this project were crucial throughout this development (Coetzee, 2014).

Having got to understand how Mr Brink's products worked and having done research into the other products on the market, I was surprised to find that there seemed to be nothing available anywhere on the Internet, that came near to what these products offered. How could this be? How could there be so many people who desperately

need these objects in order to live more dignified, capable lives – solutions which would so radically assist them with this, and yet there was nothing?

This led me to look into where the product had come from and why it was so innovative. The answer of course was that the individual who was responsible for making the product was the same person who was experiencing the problem. This allowed a deep, integrated understanding of the challenges being faced and the ability to physically build objects that would resolve the problem. All alone and with only one hand!

Not surprisingly, the products themselves had not been built with aesthetics and semantics (meaningfully communicated instruction) in mind, but were purely functional. They had been made with only the materials, resources and tools that were available to him and with the knowledge he embodied. From this point, the idea was that his solution would be improved on through a design intervention to improve its modularity, functionality, usability, feasibility, desirability, viability and manufacturability, so that it could be mass produced and distributed to those who needed it.

Over the course of the project, many questions began to arise about the process of redesigning these objects using the university as a conduit; how ideas that are born outside the parameters of the design industry and that have valuable potential, progress to a point where they can then be produced? Are they able to progress to this point? What structures are in place that support or inhibit such ideas? Through my personal affiliation with the university, the design industry, and now this project, I decided I would explore how the three sectors – civil society, the design industry and the university - each play their specific roles in supporting innovative ideas, and what the roles of each are. The hope is that through a better understanding of these roles, a more effective, interactive and beneficial system can be moved towards.

Three case studies were used to engage in primary contextual research. This allowed for an improved understanding of the underlying networks, with the aim of assisting the commercialisation of future viable products. For both the organisations and individuals involved in these projects, there may be the need for a clear and accessible understanding of how the different networks and actors operate, and what

the most appropriate avenues for development may be. What follows, are the formal questions that directed the research to explore this subject.

1.2 Primary Question

How can innovative product ideas developed out of necessity by individuals be supported for commercialisation in formal creative environments?

1.3 Sub Questions

1.3.1 Question 1

What is the product innovation ecosystem within the Western Cape region?

1.3.2 Question 2

What are the current product design processes within the product innovation ecosystem?

1.3.3 Question 3

How can design thinking support and aid in the commercialisation of promising innovative ideas?

1.4 Design by Civil Society

Due to rapid advances in technology, the barriers to creating new products have been lowered dramatically, allowing ordinary citizens to embark on innovative ventures. Community needs are being met by combining hi-tech mass produced components with locally available and manufactured materials and parts (Walker, 2011, p. 86). Knowledge of how specific tasks can be accomplished – which used to be restricted to specialised groups – is now becoming available for all to benefit from. As a result of these changes, society is evolving to embrace the problems at hand in new ways and on a scale previously unimaginable.

What is design, who does it and why? These questions are explored in detail in Chapter 2: Literature Review, but a brief introduction of participatory design is required at this point.

Participatory design can be described as bringing the to-be end-user into a design process with professional designers, such that they are an integral part of the project, giving feedback and generating ideas (Spinuzzi, 2005, p. 164). Designers explore conditions in which the end users are able to be involved with the decision making processes that lead to the final outcome of a product, service or system, thus resulting in the improved quality of living (Halskov & Hansen, 2015). What this thesis examines is what happens when the project itself, instead of being generated by a collective of designers for commercial and capital gain, is initiated by an individual outside of the design industry. That is to say; the idea which becomes the focus for a design development has itself been initially generated by an individual from civil society. In this way, the model of participatory development shifts from that of trying to define what the end-user wants or needs, to identifying the most effective way of developing the already existing idea (created by the end-user). What will not be explored in detail due to research constraints, but which is likely as important an element, is how the inventors/participants are sustained and promoted to continue developing innovative ideas.

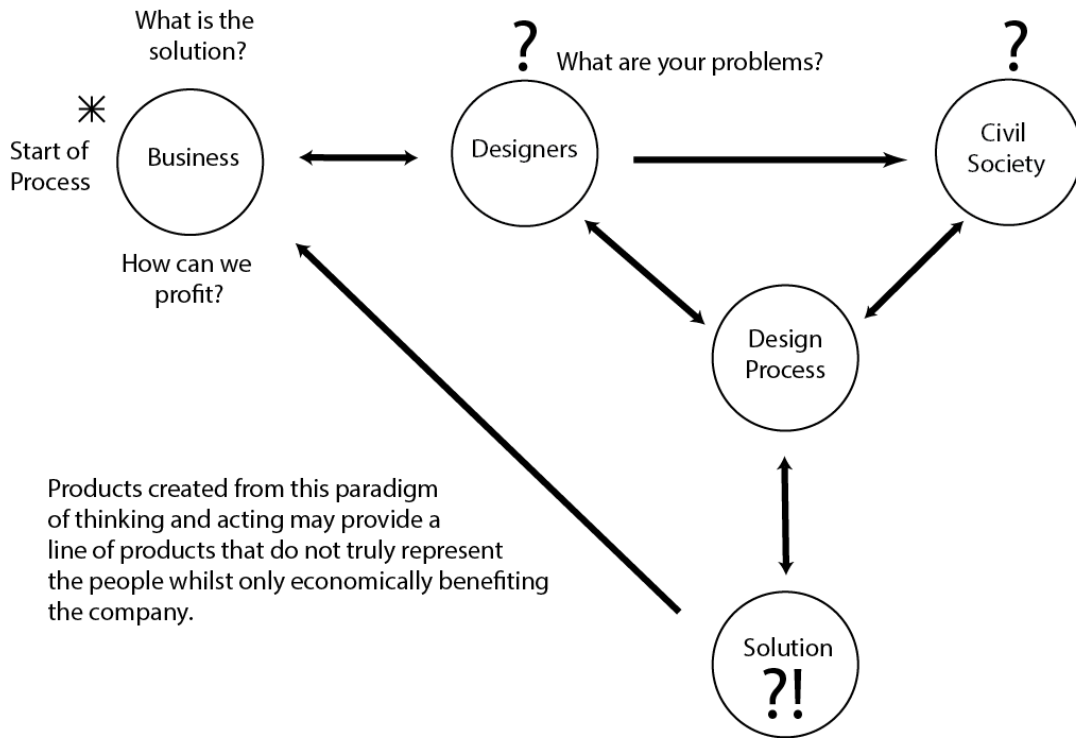
The Illustration below indicates the proposed difference between the traditional participatory model and the above mentioned civil-generated participatory model (fig 1). Although a crude approximation, it highlights the possibility of an important shift towards a more socially responsible model. In the first model, the individual in society is not seen as a designer but as a provider of information and insight. In the second model, the individual is the primary designer, even though they may have no formal design training, because they already have in-depth knowledge of the problem and how to go about solving it. This concept is further elaborated upon within the literature review.

In this system, there is no more need to go out searching for potential and even superficial problems. Rather it is a matter of developing a solution based on an existing and real problem that has already been identified and initiated. Finally, if the primary objective for the creation of ideas is not the profit of a business but rather the development of positive social change, there is potentially a greater possibility for sustainable economic growth. Such an approach may therefore appeal to governments or philanthropists as a viable product design route.

Individuals within civil society in its vast and complex diversity are continually faced with problems that need to be solved, generally to create better standards of living. Some of these individuals arrive at innovative solutions for their own challenges that hold great potential for commercialisation, as well as for assisting numerous other people facing the same or similar difficulties. Often, these people have no formal design training but create objects simply to solve the challenge they are facing.

1

Traditional Participatory design model



2

Civic generated Participatory design model

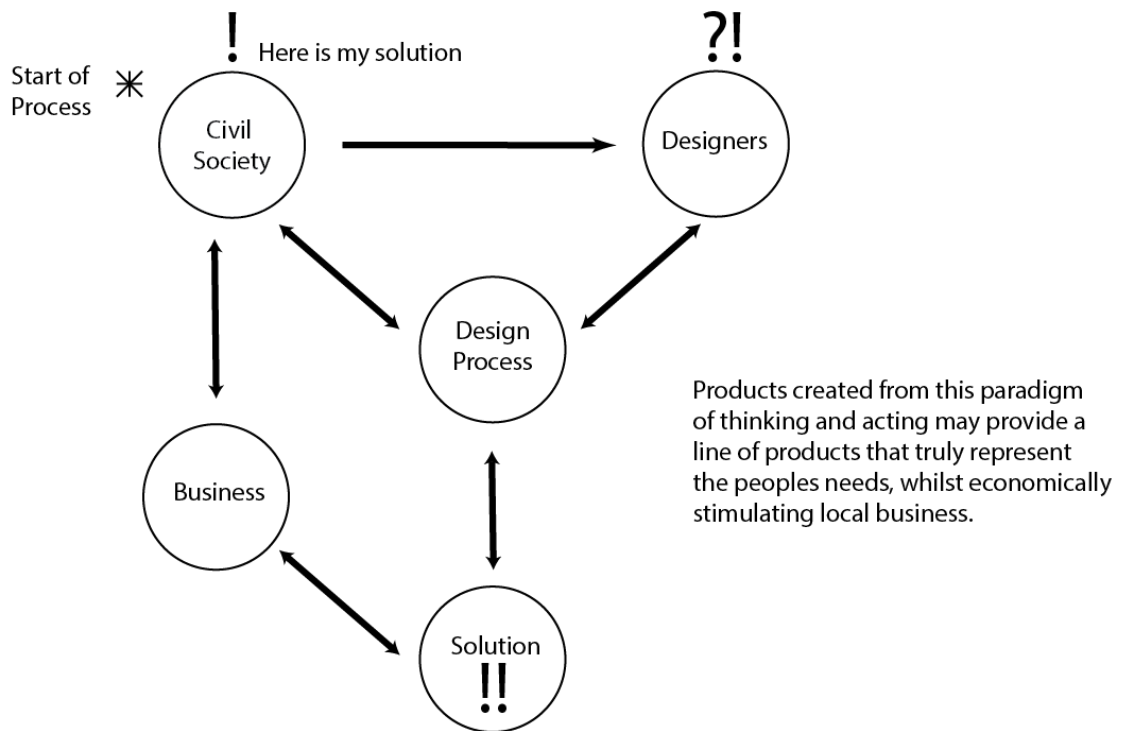


Figure 1: Proposed Participatory Design model
Image by Author

Traditionally, the majority of products appear to have been designed to accommodate the largest market division, primarily in pursuit of profit and often with disregard for the needs of minorities, or those without purchasing power. A portion of society therefore may often be overlooked, having to make do with what has been designed for others, potentially causing both physical and emotional stress. Using the introductory case explored above as an example, because there were no options available to him, the process of preparing food was both difficult and degrading, creating unwanted and unnecessary dependency.

Some of the members of these minorities, such as Mr Brink, are technically adept and devise their own solutions to the problems they experience. Other individuals in society create both innovative objects and innovative ways of producing objects, due to their need to survive, or simply out of personal interest. It is possible that many of these objects and methods would benefit from a supportive creative environment so as to become commercially viable. An opportunity therefore exists for developing support and assistance through the integration of formalised education and design structures for these promising solutions.

1.5 Design with Society

The much larger contextual narrative that this research finds itself within is that of the current economic, social and ecological systems and the sustainability of these structures. At present, there is a major shift taking place all around the world – economically, ecologically, technologically and socially – as a result of an emerging new economic system based on systemic collaboration (Rifkin, 2014, p. 7). These changes are having profound effects on the nature of production for commercialisation as electronic tools and technologies rapidly evolve. As we have progressed from the industrial age into the information age, the industrial age model of business is becoming redundant; moving into the network age, new directions and methods are being adopted in its place (Hughes, 2013; Heimans, 2014). At the heart of these new models lies the entrepreneurial spirit of individuals within civil society. In the quote below, by a leading expert in sustainable development, it becomes evident that facilitating, promoting and stabilising innovative ideas by individuals within society is an important present day requirement:

We are at the end of the first industrial revolution; non-renewable fossil fuels, manufacturing; and all of a sudden, we have systems which are not sustainable. The internal combustion engine is not sustainable. Freon way of maintaining things is not sustainable. What we have to look at is at how we feed, cure, educate, transport, and communicate for seven billion people in a sustainable way. The technologies do not exist to do that. Who is going to invent the technology for the green revolution? Universities? Forget about it! Government? Forget about it! It will be entrepreneurs, and they're doing it now. (Sirolli, 2012)

How does design relate to entrepreneurial activity? This discussion is explored within Chapter 2: Literature Review, but essentially, the field of design holds a practice and culture that is arguably the most capable of facilitating the above mentioned entrepreneurs, to develop and normalise their ideas into sustainable ventures. This is eloquently expressed below by a leading sustainable design academic:

A century ago, a new culture and new practice appeared to deal with technological innovation and industrial development, making them part of everyday life and, more importantly, building a shared vision able to give them meaning. This new culture and practice was industrial design. In my view, something very similar should happen today. Social innovation has the potentiality to change the world, but a new culture and practice is needed. Design could become this new culture and practice, but to do so it must itself change and become a widespread activity, permeating through the multiple nodes of the unprecedented socio-technical networks in which we are all living and operating. Is it possible that this will happen? Can there really be a design culture and practice in this new century able to assume this role toward social innovation and technological innovation? The short answer is: yes, but we have to work on it. (Manzini, 2015, p. 29)

The Western Cape government, together with the Cape Craft Design Institute (CCDI), has recently launched a strategy for design to unlock innovation and drive competitive advantage in the Western Cape (CCDI, 2014). They explain in the strategy summary that there is a need for a design strategy in the Western Cape, “to create an enabling environment that facilitates the optimal use of design to catalyse economic growth and improve quality of life for all in the Western Cape.” (Ibid.).

1.6 Design for Commercialisation

Innovative product solutions developed by individuals in civil society which have the potential to aid many others with the same or similar problems, may not have supportive and creative environments for their structured development in the Western Cape region. Getting an idea to evolve from an initial concept through to a marketable product can be a long and difficult journey that requires the investment of considerable time and resources. As a result, for the idea to be successful in this progression, it must not only hold truly significant and innovative qualities, but these must then also be recognised and supported by structures and environments that are capable of and effective at realising the process.

In general, the development of any one product will vary quite drastically from that of another in terms of resources, skills, investments, partners etc. (see fig 2). What becomes evident is that understanding the structures and environments that are conducive for the development of an idea may be a valuable addition to simply knowing the design process. This understanding can then be used as a platform to replicate, modify and enhance future ideas, regardless of the complexity of the process. *Design for commercialisation* therefore involves incorporating this understanding, so that the process of a product's development may be more effectively managed and executed. It looks at how design can facilitate social change by acting as a catalyst, enabling individuals with innovative ideas that they are passionate about, to be able to act effectively towards achieving them.

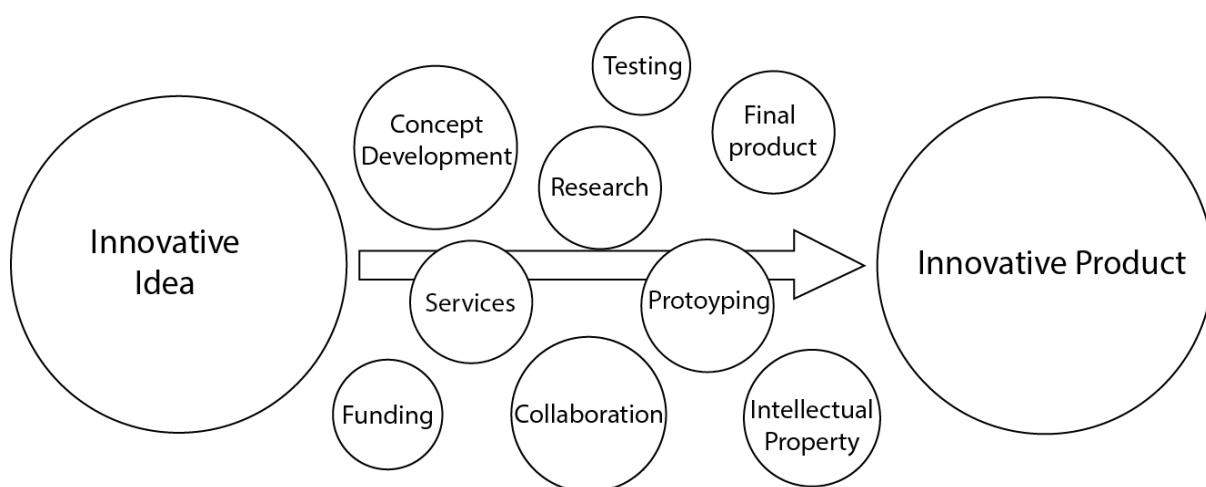


Figure 2: From Idea to product
(Image by Author)

The global economic foundation of commerce has recently transitioned from being based primarily on labour intensive industrial activity, to the ownership and trading of knowledge and information (Smith, 2000; Hughes, 2013). The primary commercial system which has allowed both of these foundations to function has been constructed on the capitalist free-market model. This economic model, which operates on the principles of supply and demand, uses economic growth and profit as the principle measures for its success (McNally, 2013). The 2008 global market crash and financial crisis, coupled with the current ecological crisis, which has itself been exacerbated by the present economic model, has stimulated the potential for new alternatives (Mulgan, 2009). What is truly remarkable is that the capitalist economic era has driven a technological revolution so powerful that it has allowed the possibility and emergence of an entirely new economic system, as well as the commercial platform for it (Rifkin, 2014, p. 65).

The way that global economic power has been held and operated in the past is fundamentally changing. Where the old system relied on hierarchical, centralised, privatised, independent and linear forms of power that have dictated nearly all (if not all) of the preceding economies, the emerging one is evolving to be oriented towards networked, de-centralised, open, collaborative and lateral structures of power (Heimans, 2014). The most important attribute of these characteristics for the new model of power, though, is transparency, since this is what allows for its existence (Ibid.). This notion challenges the entire premise of how economy and commercialisation operate in the current model. The Oxford dictionary defines commerce firstly as, “The activity of buying and selling, especially on a large scale” and secondly, (as a dated definition); ‘Social dealings between people’ (Oxford University Press, 2015). The emerging new economy has been referred to variously as the collaborative commons (Rifkin, 2014, p. 19) and the age of Networks (Manzini, 2015, p. 180).

For centuries, the public has been controlled by misleading media designed to control the masses and fulfil the specific agendas of developing corporate growth, by stimulating individual wants and desires and negating the social and environmental needs and consequences of their practices (The Century of the Self, 2002). Lengthy bureaucratic processes in governments and universities are unable to cope with the expanding needs of populations and, as a result, new systems are being generated

from within society both to cope, and to take advantage of new services and market places (Heimans, 2014). New, open information, tools and technologies are empowering the ability of citizens to allow these possibilities to take place. As a result, locally driven businesses are becoming able to competitively survive alongside large corporate entities. This can be seen especially in the local organic food sector (Ikerd, 2011, p. 53). Globally then, it appears that the monoculture of giant corporate companies is gradually being replaced by more diverse, locally oriented initiatives that acknowledge the ecological and social consequences of their businesses.

Once an innovative idea has been established, in order for commercialisation to take place it is important to support it by providing the correct knowledge and resources at the appropriate stages of its development. Each stage may often involve specific tasks and collaboration of specialised inputs from different parties, which requires a well-managed process to be effective (see fig 3). The rise of structures like incubation hubs, living labs and collaborative working places are representative of the demand for this kind of collaborative approach.

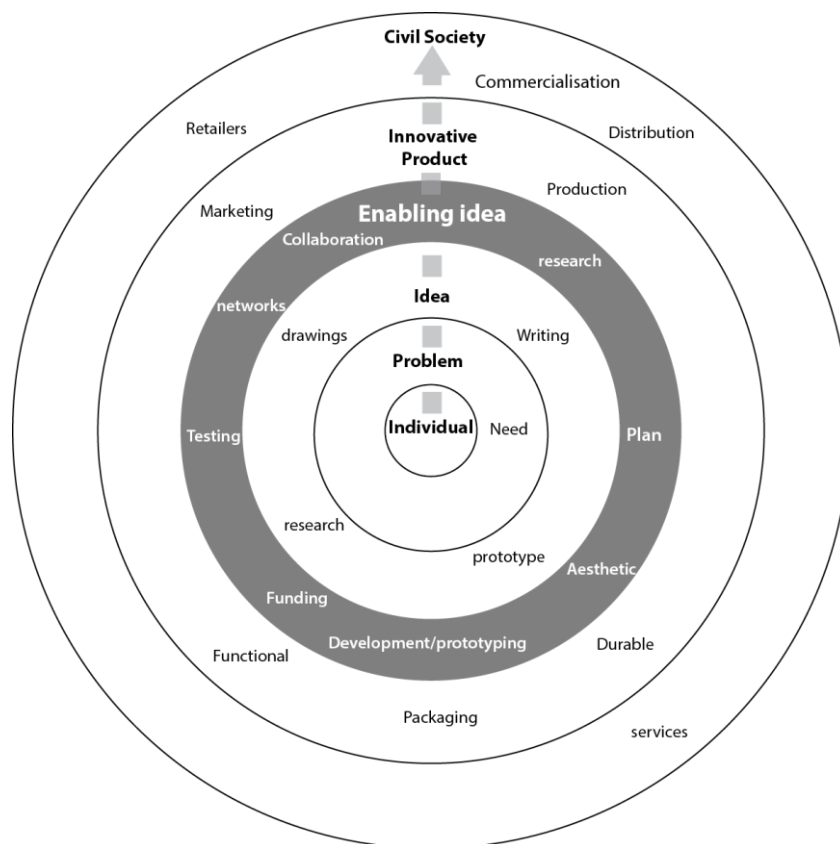
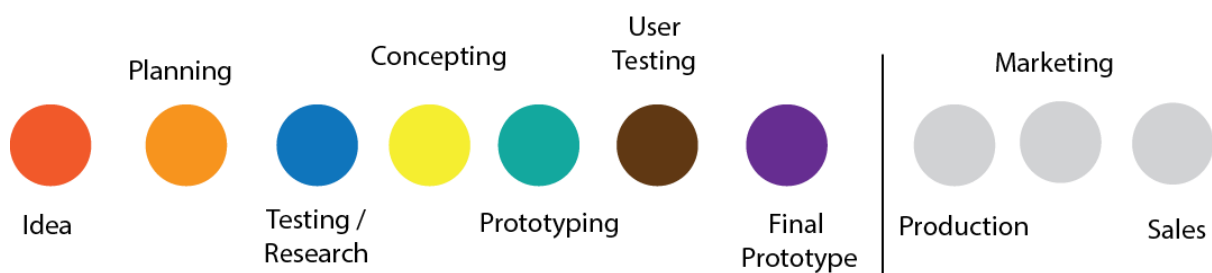


Figure 3: Area of commercialisation focus
(Image by Author)

1.7 Delimitation of Study

This thesis is an exploration into what such designed supportive and creative environments might be comprised of and whether they already exist, in order to enable the most effective development of innovative ideas. Due to the limited scope of this thesis, the specific focus has been on ascertaining those elements – the structures and environments – required to progress an idea towards a production-ready prototype. This means that the idea has incorporated all the steps necessary for it to be taken directly through to production and sales and developed to a point where marketing and production can begin. It will not identify how the product is then packaged, marketed and distributed, although this would still require interaction with the designer; nor does not emphasise the services and business models that would be required to then carry the product through into a sustainable business (See fig 4).



*Figure 4: Area of product development investigation
(Image by Author)*

What is explicitly being explored is the process and surrounding influences that support a product idea towards a final prototype. The reason for this delineation was the context of my being a product design graduate, able to identify valuable insights into the nature of the particular problem being investigated. Specific processes were explored so that stagnations and flows within them could be recognised and investigated, leading to the proposition of potential solutions.

The study is limited to the Western Cape region due to available time and resources. However, the method of investigation may apply universally. Only three case studies chosen for their diversity of subject matter were thoroughly investigated.

Nonetheless, the information and data explored through these cases may have an impact on a much larger context.

1.7.1 Western Cape

The Western Cape is geographically the fourth largest province in South Africa, with a population of over 5 million people (WESGRO, 2012). In the 2011 South African census, it was established that there are 51.8 million people living in South Africa. Just under 10% (5.2 million) of these have some form of disability (Statistics South Africa, 2012, pp. 24 & 46). The country's population is diverse across race, ability, ethnicity and class, creating a large distribution of needs and requirements for contented living. The gap in wealth between the rich and poor people in South Africa is one of the largest in the world (Oosthuizen & Nieuwoudt, 2002).

There is an estimated 17.2% of unemployment in the Western Cape, with the relevant youth making up over 80% of this calculation (NDA, 2010). The development priorities in the region are the promotion of entrepreneurship and the creation of jobs, focusing on the challenges of eradicating poverty and the high levels of unemployment (Ibid.). It seems appropriate, therefore, that an investigation into how the structured development of innovative ideas might be supported since this relates directly to promoting entrepreneurial activity.

1.8 Summary

This introductory chapter has briefly argued that the fundamental classification of commercialisation is in flux due to a newly emerging economic system, which is profoundly different from the current free-market, capitalist model. Design as a discipline has also been reasoned to be an evolving field with the capability, culture and potential to become the principle facilitator of this new commerce, just as it was able to mediate consumerism appropriately within the capitalist model. In the next chapter, these initial ideas are expanded on to provide a legitimate foundation for proceeding to the method of investigation employed, and then to the actual case studies.

The new role of the designer could be said to be one of enabling social innovations. Regarding this research, the role of design for commercialisation has been restricted specifically to creating an enabling, creative environment in the development of an innovative idea towards a final prototype. The university, design industry and civil society are the sectors investigated by this research as the primary environments where such design facilitation may occur. These investigations are carried out through the application of three relevant case studies within the Western Cape.

CHAPTER 2: Literature Review

2.1 Knowledge, Innovation, Design and Collaboration

This chapter investigates the topics of knowledge, innovation, design and collaboration to provide a foundational literature from which the case studies in Chapter 4: *Analysis of Findings*, can then be analysed. The topics and the order in which they are presented aim to provide a systematic evaluation of the material. Beginning with knowledge and why it is significant as a topic for enabling ideas, the review examines the current economic system and how it has changed over time. This is important as it allows the identification of themes and trends relating to knowledge and commercial activity, which may provide insight into what the most supportive environments within these economies are now, and may be in the future.

The ubiquitous topic of innovation is explored, using knowledge to gain insight into what it is and how it works. This will include different theoretical models of innovation, how they have evolved over time, and are now seen to span several different categories.

The literature then looks at who does the innovating and the different sectors that it impacts, exploring entrepreneurship and the role that design may play in enabling these innovators. The roles of design and designer are also investigated in order to understand the culture and practices they follow and how these may be an appropriate vehicle for sustainable social development. The reason for this investigation is that, as a society, we have moved from the industrial and consumer ages into the age of networks and therefore, design requires a paradigmatic shift to facilitate this new era (Manzini, 2015, p. 180).

Collaborative product development is the primary investigation in the final topic. The reasons for collaboration and how these operate in open systems, as well as how products may be fabricated in such conditions, is examined here. Finally, the chapter concludes with a brief look at what the proposed quadruple-helix model entails, as well as some collaborative product development examples that are taking place within Western Cape.

2.2 Knowledge

The way that knowledge is being produced, exchanged and used has shifted so dramatically over the last century that today, it is possible for just about anyone with a cellular phone and an Internet connection to access the *World Wide Web* (Internet) and acquire whatever information they may need. The current *knowledge-based economy* recognises that human and technologically embodied knowledge are the primary drivers of today's economy (OECD, 1996).

In this topic, we explore the economic component of knowledge and its relationship to commerce and capital. The different forms of knowledge that exist and how these are accessed are also examined, providing insight into what this might mean with regard to design, commercialisation and production.

Creative knowledge environment is a concept that has been used to explore how the environment within which individuals or groups work affects their creativity (Hemlina, et al., 2006). Creativity is essential for both the production of knowledge through research, as well as the use of this knowledge in the form of innovations (Stehr, 1994). Thus to be able to create environments that enable these conditions would be beneficial and is the focus of this thesis.

2.2.1 Economic Systems

Commerce is “the social dealings between people” (Oxford University Press, 2015). To speak of commerce and environments that have supported it, it is important to have a general understanding of how these systems of exchange have evolved over the years. This allows for some perspective on what has been traded and for what reasons. The development of western economics is the primary focus, as it is this system that now dominates global trade. Every economy has always contained three fundamental systems: a form of communication; energy; and mobility, each of which has changed quite drastically over every successive industrial revolution (Rifkin, 2014, p. 77). A short overview of these transformations is necessary to comprehend the nature of current commercial society and the predicted future paradigm.

2.2.1.1 Economic Revolutions – Agricultural, Industrial, Service and Electronic.

2.2.1.1.1 Agricultural Revolution

The first economies to arise took the form of hunter-gather economies, with land as the economic component and tribes being how these economies were organized (Hughes, 2013). The agricultural revolution created a new economics, based on land as well as labour and organised through both tribes and institutions, such as during the Middle-Ages in Western Europe (fig 5). Here the dominant economy was Manorialism; a system based on the Lord's Estate (Encyclopædia Britannica, 2014). Within this estate the people who lived and worked there, were generally sustained off the land by participating in communal tasks divided between the aristocrats and the labourers. Here, we begin to see the emergence of large scale cooperation to create a self-sustaining system. This system was succeeded by the mercantile economy, based on imperialism, where a nation sought to export more than it imported and thereby build its state wealth (Ibid).

2.2.1.1.2 Industrial Economies

Mercantilism thus laid the ground for the first Industrial Revolution of the 18th and 19th Centuries, where the new economic system now included capital as the overarching and overriding economic driver, above land and labour and organised by the tribes and institutions around the addition of a global market (fig 5) (Hughes, 2013). This revolution evolved as a result of the emergence of improved techniques and practices, along with machine-powered technologies. This allowed the mass manufacture of agricultural output, material and consumer products (Yale-New Haven Teachers Institute, 2015). The societal system was driven by coal and steam via locomotives and railroads. Communication was in the form of the printing press and the telegraph (Rifkin, 2014, p. 24). During this period, the world population rose from less than 1 billion people to approximately 2 billion (Worldometers, 2015).

2.2.1.2 Post- industrial production (Service) Economy

In the 20th Century, rising from the technological, economic and social platforms provided by the 1st Industrial Revolution, the post-industrial production economy (or 2nd Industrial Revolution) emerged, based primarily on the service sector. This system was driven by oil and the internal combustion engine via road infrastructure. Communication was primarily in the form of the telephone, radio and television, via a centralised system of electricity (Rifkin, 2014, p. 24). From this system originated the

Internet, a revolutionary new way of sharing information and resources (Internet Society, 2015). Within this timeframe, the global population rose from approximately 2 billion to 6 billion people (Worldometers, 2015).

2.2.1.3 Knowledge-based (electronic) Economy

Now, in the 21st Century, this transformation is currently evolving into a third industrial revolution - that of the information/electronic age (fig 5). Here the new economic driver is information as the overriding force directing capital, labour and land (Hughes, 2013). The additional organisational structure required to make this work, then becomes networks within and across the markets, institutions and tribes (Ibid). The energy of this system will use distributed renewable energy that will power automated driverless vehicles, logistics and drones through one cohesive "Internet of things" (Rifkin, 2014, p. 62). The global population now sits above 7 billion people and is estimated to reach 9 billion by 2040 (Worldometers, 2015). This exponential increase of the global population over the successive revolutions has created new social, ecological and economic challenges that requires unprecedented entrepreneurial activity to effectively address them (Sirolli, 2012).

In this new economy, the values and power structures are essentially completely different to those of the industrial and post-industrial economies and are therefore disrupting the entire system (Heimans, 2014). In the industrial age, scarcity of information, hierarchies, ownership, division of labour and buying products were what contributed value to the economic structure. Within the knowledge-based economy, abundant accessible information, collaborating through networks, distribution of labour and sharing products is valued most (Hughes, 2013; Rifkin, 2014, p. 90).

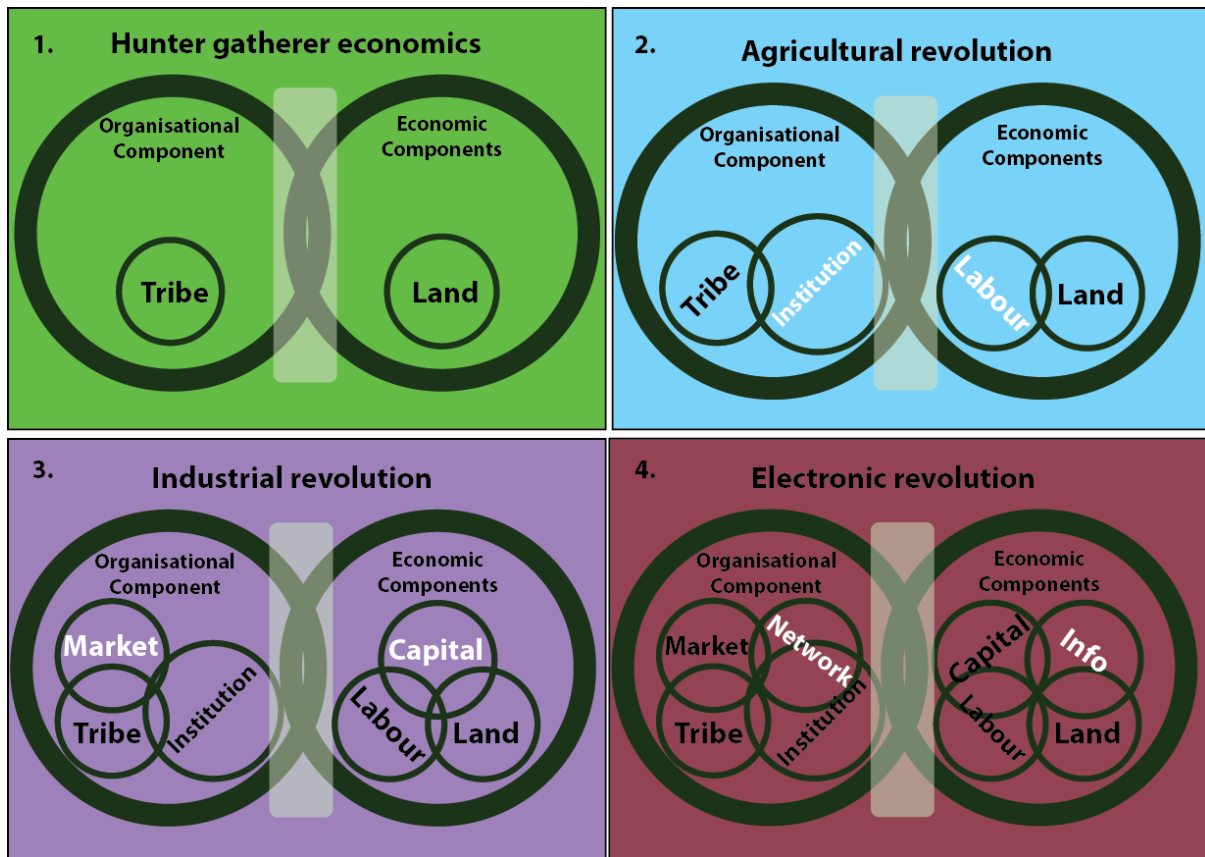


Figure 5: Evolution of economic systems
(Image from Hughes, 2013)

2.2.1.4 Capitalist, Socialist and Command Economies

Capitalism is an economic system based on private ownership and profit, primarily using the supply and demand of a free market to function (Merriam-Webster, 2015). Whoever owns a business in this market can employ people to work for them at a set rate, whilst all profit created through the business is that of the owner (Grant, 2014, p. 2).

Karl Marx and many others believed it was unethical for some people to get rich off the labour of others, which is central to capitalism, so he developed his theory of socialism as an alternative. Here, the ownership of personal private goods is accepted, but ownership of private property used for the production of consumer goods is not. In this system, the workers would collectively receive the profits from a business that would otherwise go only to the owners in a capitalist system (Stanford Encyclopedia of Philosophy, 2010).

The opposite of the Supply and Demand Economy, is the Command Economy, such as under Stalin's rule of the Soviet Union. Here, a central authority dictates all economic activity, such as what will be produced, how it will be made and at what cost it will be sold (Encyclopædia Britannica, 2014).

The Command Economic system relates directly to futurist Jaque Fresco's society of a resource-based economy. In his theory, he explains how human greed and misperceptions are the basis of an unstable society, causing corruption and inefficiency (Fresco, 2007, p. 71). If computational machinery were to take on the service of traditional government, these factors could be eradicated by making decisions primarily on the basis of available resources for a sustainable global economy where all global resources are the common heritage of all its inhabitants (Ibid, p. 21; Joseph, 2012).

In 2014, there were 13 billion sensors connecting appliances and equipment with human beings. IBM predicts that by 2020, there will be 30 billion sensors connecting everything with every being, and by 2030, there will be one hundred trillion sensors connecting everyone together in an enormous lateral neural network (Rifkin, 2014, p. 62). This prediction and current corresponding technology and societal developments, make the command economy based on computational systems certainly both conceivable and feasible.

2.2.1.5 The Collaborative Commons: Beyond Capitalism and Socialism

It has become evident in recent decades that capitalism as an economic system is unsustainable, since it is a model based on infinite growth from limited resources (Grant, 2014, p. 2). Capitalism does not take into account the social and environmental value of the system on which it depends, but focuses purely on economic profitability, which is often directly opposed to both of these; thus capitalism acts like a cancer destroying its host (Boehnert, 2013, p. 9).

This contradiction within the system, coupled with the emergent phenomenon of zero marginal cost, is leading to the introduction of a new economic system based on what economic theorist Jeremy Rifkin calls the *Collaborative Commons* (Rifkin, 2014), and an age which Professor Ezio Manzini refers to as the *Age of Networks*

(Manzini, 2015, p. 180). Rifkin explains the introduction of a third industrial revolution due to the rapid reduction of the marginal cost of products, sometimes to the point of zero, or so close to it that it is making products essentially free¹. This is a result of the current powerful technology revolution spurred by capitalism and, paradoxically, potentially ending capitalist society (Ibid.). The reason that this is occurring is that consumers are now also becoming producers (otherwise known as prosumers). An important aspect of this revolution is the distribution of new technologies and the generation of independent media. Wikipedia, along with many other businesses facilitated through the medium of the Internet, often excluding corporate producers altogether is an example of the collaborative commons. Information is no longer being restricted and monitored by an elite trying to achieve specific agendas, but is instead being actively created and distributed openly by society at large. Other activities of prosumers include a DIY approach to life, growing one's own food, repairing goods rather than making new purchases and self-sufficient barter networks.

It was assumed that this form of sharing would be unable to traverse the virtual space of the Internet and move into the physical domain of tangible products, but this is not the case. Again, this shift is being made possible through the technological revolution. Three-dimensionally designed objects can now be accessed free of charge and produced by consumers at minimal cost in their homes, by machines such as 3D printers (Grynol, 2015).

2.2.2 Global knowledge; Civil Power

Although we have only recently progressed into the knowledge-based economy, the conception and classification of knowledge has long been around. Aristotle (384-322 BC) describes three types of knowledge; that of *episteme* (scientific knowledge), *techne* (technical knowledge) and *phronesis* (ethical knowledge). Phronesis, although having no contemporary equivalent (possibly wisdom), applies generally to how the first two forms should, or should not, be brought together practically and ethically (Goertzel, 2010). Independent media – through the Internet – is allowing for

¹ Marginal cost is that of producing a single product after all the fixed costs have been covered (Business dictionary.com, 2015).

the first time in history, the possibility for vast collectives of individuals to disperse information, free of capitalist agendas. Importantly it also allows for open dialogue, transparency and networking to better understand and act appropriately (Rifkin, 2014, p. 64). Social media for both global and local movements is creating a change in the way business works.

Today, globalisation is one of the effects of humanity moving into the knowledge-based economy where leaps in technological advancement have created universal connectivity and very specific specialisations. Aside from agriculture and labour intensive markets, there is now, core to these, the knowledge-based economy and as a result, intellectual property rights have become a critical and unresolved issue (Thurow, 2000, p. 19). Many activities today - such as in the industrial and technological sectors - rely on several actors, both tangible and intangible, to complete their objectives. The problem here, is of understanding how the knowledge flows between these actors so that it can be harnessed effectively (Smith, 2002, p. 5).

Knowledge is differentiated from data or information, as it may be seen as a form of legitimate information i.e. it has been authenticated (Jofre, 2012, p7). Due to the globalised economy, knowledge and the way it is represented, stored, found and used, namely through the advancement of the Internet, is transforming the way traditional institutional structures operate and hold power (Heimans, 2014). One of the primary reasons for this is the radical emergence of what is known as “open-access” knowledge, which potentially offers the most dramatic impact over small to medium enterprise, rather than for large established firms, corporations and even countries, by creating a democracy of knowledge (Carayannis & Campbell, 2012, p 43).

Online activist Jeremy Heimans believes that the way power has been enforced throughout western history is shifting to a new form, which is in general opposed to the old. Instead of being held by a few it is held by many; instead of being driven by leaders it is being driven by peers; instead of being based on currency, it is based on current affairs and so forth (Heimans, 2014). Another important radical emergence out of this change includes *peer-to-peer* financing, which has been hypothesised by

a director of the bank of England as possibly able to challenge current financial institutions (Mulgan, 2009).

2.2.3 Open Access Knowledge and Learning Systems

Chris Anderson, curator of TED talks, a non-profit organisation devoted to spreading worthy ideas, explains how thousands of individuals and organisations are now sharing their knowledge and data freely and openly on the Internet. This is allowing a new generation of learners to arise, directly benefiting from these available first-class teachings, free of charge (Anderson, 2010). Not only this, but the learners are then able to respond and interact directly to the material with a community network of likeminded learners, thereby continuing and completing the knowledge cycle and adding further valid and valuable information and insights to the subject matter (Green, 2012).

This new open-media phenomena is allowing for what Anderson refers to as *Crowd Accelerated Innovation*; knowledge which, before the digital revolution, could not be accessed due to geographical, linguistic, technological and other constraints. Now, it can easily be found and experienced instantly, notably in the form of instructional web videos. This media educates and inspires others to emulate and then innovate, on a truly global scale. Anderson believes that the web video is especially relevant when compared to literature as it allows learning to occur in a much more primal, direct, understandable and inspiring way (Anderson, 2010). He explains how there are three factors required to encourage *Crowd Accelerated Innovation*.

1. A crowd of people who have similar interests and who are able to innovate. Importantly though, this crowd also provides the ecosystem for innovation to take place through the roles of the individuals within it. This includes things like eccentrics, commenters, “super spreaders”, cheerleaders, sceptics and trend-spotters.
2. Light for the crowd – an environment that allows those who are innovating to be visible so their capabilities can be openly viewed and experienced by the crowd, who are then able to interact with the material.

3. Desire of the innovators – Through the possibility of the light and the size of the potential crowds who may view it, individuals are inspired to innovate and improve (Ibid).

2.2.4 Forms of Knowledge

Knowledge can be defined in several different forms, each expressing specific properties, such as formal or informal knowledge, or knowing how, what, who or why (Elahi, de Beer, Kawooya, Oguamanam, & Rizk, 2013, p18). Tacit knowledge is that which individuals gain through first-hand experience, whereas explicit knowledge can be viewed as codified and/or articulated knowledge in the form of language or symbols, such as books, articles or recordings (Jofre, 2012, p. 7).

Figure 6 illustrates a matrix of these different forms of knowledge and how they are managed.

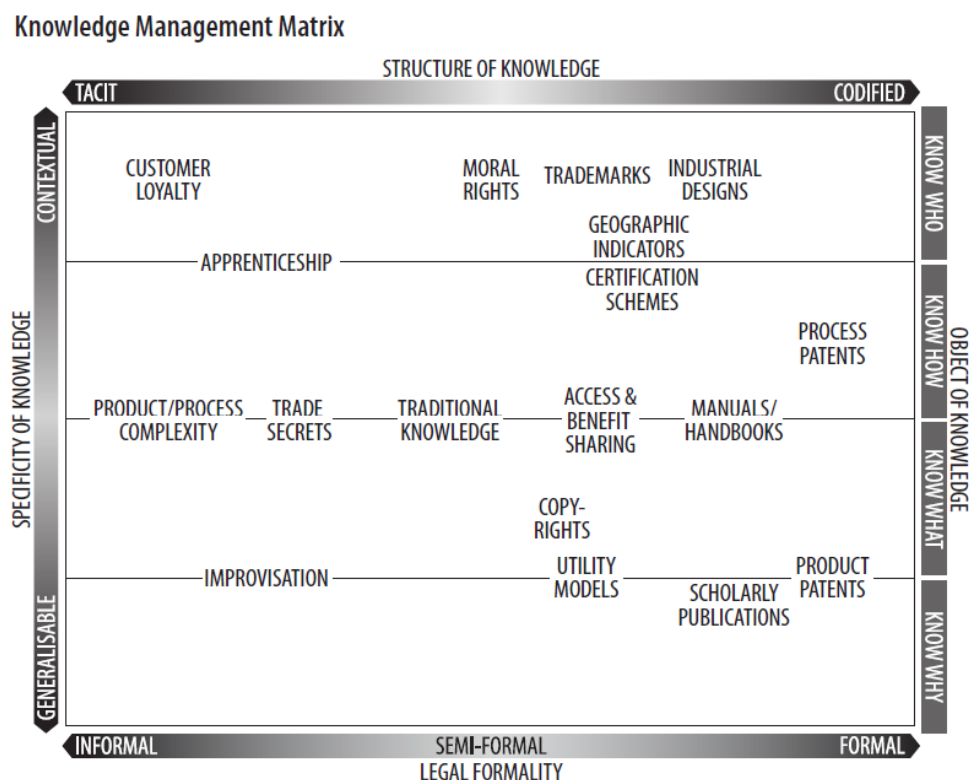


Figure 6: Knowledge Management Matrix
(Elahi et al., 2013, p. 19)

Knowledge transfer, which is seen as a key factor for innovation to take place, exists in both formal and informal environments. Formal transfer of knowledge is well documented in the form of patents, licenses and collaborations, often between

universities and firms through research and development activity. Informal knowledge transfer on the other hand, is by its very nature, less acknowledged (Jofre, 2012, p11). In Jofre's (2012) work, informal knowledge transfer, through interpersonal relations for example, is explored as the very underpinning of formal knowledge transfer, and key for innovative progression; it is required to both form and inform the formal exchanges that do occur. In Africa, the primary economic activity is within the informal sphere, which encompasses learned skills, labour and embodied knowledge. It is recognised that this way of doing business is also a stable phenomenon due to its operational functionality (Elahi et al., 2013, p92).

Two models of how knowledge is produced have been formally established. The first is concerned purely with the scientific production of knowledge through research; it is field specific and not primarily concerned with its application. The second model is achieved through transdisciplinary efforts (amongst other principles) to solve specific real-world problems. It is based on the development of useful technologies through the application of scientific knowledge. (Carayannis & Campbell, 2012, p. 3; Kogan, 2005, p. 19).

A third model of knowledge production has been proposed, but not formerly established, and is expressed as, "...the nexus or hub of the emerging Twenty-First Century Innovation Ecosystem, where people, culture, and technology meet and interact to catalyse creativity, trigger invention and accelerate innovation across scientific and technological disciplines, public and private sectors and in a top-down, policy-driven – as well as bottom-up – entrepreneurship, empowered fashion." (Carayannis & Campbell, 2012, p. 3).

"Knowledge clusters" and "Innovation networks", sit at the heart of this proposed third model of knowledge production. Here the clusters represent different actors in a system that may represent tacit and/or codified knowledge. "Innovation networks" represent the links between different configurations of knowledge (clusters), tying them together so that an interactive relationship can take place, thus allowing for potential mutual benefit and sharing of knowledge. In this way the dynamics of the associations that are shared between the different clusters and their connections (networks) can be viewed as an "innovation matrix". (Ibid, p9).

Where the first two models of knowledge production seem to be aimed specifically at top-down private initiatives directed by individual corporations and their partners, the third model proposes that the first two models operate simultaneously, and be introduced into society to inform grass-roots entrepreneurial activity, in what they refer to as a '*g/local*', (global and local) community and a democracy of knowledge, creating an open innovation system (Ibid, p. 11).

2.2.5 Intellectual Property and Monetisation

Intellectual property (IP) refers not only to patents acquired. Trade secrets, designs, know-how, copyrights and trademarks are also legitimate forms of IP (Von Seidels, 2015).² Intellectual property may be protected when it is in the form of new methods, products or machines being invented, such that their inherent knowledge can be monetised. This monetisation may be a result of the IP being used exclusively by the inventor to produce the invention through his own venture, or in the form of licensing agreements by the inventor to other parties (Ibid.).

To acquire formal IP protection, the creation should be novel and be relevant to trade, industry or agriculture; this novelty may be in the form of aesthetics or functionality (Nel, 2014). To ensure that one's IP is novel, a search should be carried out through international patent databases, such as *Google patents*. If the idea appears to be unique, then it is necessary to engage a local patent attorney to register the IP (Ibid). When disclosing an invention to other individuals prior to obtaining IP protection, it is good practice to have them sign a non-disclosure agreement before divulging the knowledge. This allows a more supportive environment to be established for collaboration through the insurance of confidentiality.

2.2.5.1 Licensing

Once IP protection has been obtained the owner may now license that knowledge to a licensee in order to commercialise the idea. Payment for this may be in the form of a once off fee or in royalties. Licensing an invention may be a cost effective alternative to continuing research and development of the idea to a commercially

² For more information on this, see <http://www.vonseidels.com/wp-content/uploads/2014/10/8-Technology-Transfer-Negotiation-Strategies-Von-Seidels-South-Africa.pdf>

viable solution rather than actually having to develop it oneself (Von Seidels, 2015). Different types of licenses include exclusive, sole, non-exclusive and sublicenses, depending on which is most appropriate for the required outcome.

2.2.6 Design Knowledge

Design is elaborated on in-depth as one of the next topics, but it seems appropriate to include a brief discussion on knowledge specifically related to design at this point. Relative to the majority of other fields of academic study, design is a relatively young discipline. As such, it does not have an extensive repository of knowledge to validate and inform other participants' application of specific design activities and practices. Design research can be divided into three areas: *design for research*; *research on design*; and *research through design* (Manzini, 2015, p. 38). The first two hold academic value, but the third, although equally, if not more significant for designers themselves, does not. *Research for design* involves the investigation of better tools and methods for designing, such as the study of ergonomics, where *Research on design* helps in understanding the nature of design itself, such as through sociology and history (Ibid.).

Research through design is based on the knowledge required and uncovered through each design process (Ibid). The professional practice of design is heavily based upon implicit forms of knowledge and skills (Boehnert, 2013, p. 5). The design process involves the creative and subjective implementation of activities, as well as reflection and discussion about them (Overbeeke & Hummels, 2013). As a result, this type of research is unacceptable by the standards of scientific traditional research, due to the lack of observable qualities. This form of design research nevertheless needs to be documented so that it may benefit others, who may find themselves needing to solve similar problems. Thus to include *research through design*, it is necessary to make what is unobservable, in some way explicit, so that it can be discussed by others. To be used effectively for design, knowledge should be “clearly expressed, easy to discuss and be easily applied by other designers” (Manzini, 2015, p. 39).

Before ending this review on forms of knowledge, it is important to note that it has been credibly argued that the foundational premise for the rational understanding

from which society has been evolving has been ignored, and thus the current knowledge production system is erroneous (Boehnert, 2013, p. 14). This premise states that the social and environmental context – of which the current economic system is a sub-system – are interdependent and cannot be separated from the economy itself. Knowledge production in the capitalist system, which sees economic profit as the principal value, has methodically excluded this fundamental aspect on which it depends to survive, and so, is fundamentally flawed. This continued flaw has resulted in the systemic degradation and devaluation of both society and the environment, on which the economy relies for its existence (Ibid, p. 7).

All of the above information provides a distinctive outlook on how commerce and the structures that support it have evolved, and where they appear to be heading. If commerce is not going to be based solely on capital exchange but rather on collaboration and communal ownership, then how might future economic activity operate? Innovation and entrepreneurial activity are explored in the research that follows, in order to examine how this landscape functions.

2.3 Innovation

The phenomenon of globalisation has created the need to reform, if not completely reinvent the way our global economy operates (Thurow, 2000, p. 11). This is due to the highly evolved and complex nature of the universal networks and knowledge that now exist, and their implications for innovative development. The Western economy is no longer based solely on labour and agriculture, but also on strategic ingenuity and partnerships (Carayannis & Campbell, 2012, p. 3). A study in Japan, suggests that the collaboration between their Triple Helix³ is weakening due to this shift, as ideas and production become sourced and executed externally, leading to deficits in their national economic growth (Jofre, 2012, p. 10).

Studies into the country's successful system of innovation prior to this, suggest that it was the country's domestic capabilities that made it successful, rather than the influx of knowledge and external partners (Ibid.). In a sub-Saharan African study, it was

³ The Triple Helix is a system of partnerships between government, industry and universities to stimulate economic growth and innovation (Jofre, 2012, p. 13).

discovered that the greatest amount of employment created outside of the farming sector, was by entrepreneurs choosing to start their own household businesses, rather than enter into the private wage sector (Elahi et al., 2013, p. 69). These case studies point to the context-dependant nature of innovation, and how each context operates within its own unique ecosystem.

2.3.1 What is Innovation?

Innovation is a widely used term, often associated with the advancement of a physical product or technology. In fact, there are several types of innovation, all based on the premise of a positive change taking place (Deloitte Touche Tohmatsu, 2015). According to Sergio Jofre (2012, p. 4), innovation is divided into three primary groups of study; social, economic and technological. In each case, innovation itself can be seen as either the output of a product, process or system, into a market place to improve or create market value. This may occur in either incremental or radical stages (Ibid.).

Radical innovation, often referred to as disruptive innovation, is those changes to a product or process that may render the previous versions (and all their competitors' versions) obsolete, or open up entirely new markets. Henry Ford's introduction of the automobile, in a time when horse drawn vehicles were the standard, is an example of a radical innovation, as it began the obsolescence of an entire system.

Incremental innovation is the sequential development of a product such that it is improved in a gradual manner (World Bank & OECD, 2013). Initially, innovation was seen as linear and sequential but was later understood rather as complex and iterative (Duin & Ortt, 2006, p. 393). Although these points of view are still very much debated, the linear model is still the prevailing one, a fact which Jofre ascribes to its "analytical simplicity" (Jofre, 2012, p. 4).

2.3.2 Economic Innovation

The national innovation system (NIS) is an example of economic innovation. It is defined as "a historically grown subsystem of the national economy in which

various organizations and institutions interact with and influence one another in the carrying out of innovative activity” ” (Groenewegen, 2006, p. 280). The main operating function of this system is the generation and diffusion of knowledge and innovation (Jofre, 2012, p. 6). Suggestions of how to determine the workings of such a system include: conceptualising institutions into hierarchal layers; examining how they operate and why; determining key players; blockages; how the different institutions have co-evolved and finally, how changes in the system have occurred both incrementally and radically (Groenewegen, 2006, p. 280).

2.3.3 Technological and Non-Technological Innovation

Technological innovations are usually associated with changes in products and processes, whereas non-technological innovations are often related to organisational and marketing changes although the two are often interconnected and dependent on one another. If, for instance, a new and innovative product is developed, new marketing strategies will need to be established to accommodate it. Alternatively, if the way of making a specific product is altered, then the operational structure of a company will need to change accordingly, in order accommodate this (World Bank & OECD, 2013).

2.3.4 Social Innovation

Social innovation can be described as the use of technology, design or communities to drive initiatives that foster and develop new work through the active participation of those who drive them (Mulgan, 2009). These initiatives are often principally motivated by the desire to provide improved holistic value to a society rather than to a single person. An example of social innovation includes the fair trade movement, whereby the workers of traders are guaranteed living wages and suitable working conditions (Stanford Graduate School of Business, 2009).

Every social innovation can be said to contain a “hero”; either an individual or a group of people who are dedicated to pioneering the new venture. These people are not common in society and if their passions are unsuccessful, then the initiative may be short lived. It is the designer’s obligation to be able to locate these heroes,

facilitate their ideas through a set of tools, such as products and services, and be able to transition their ideas from working prototypes to finished products (Manzini, 2013). The point here is that people are not seen as passive consumers but as active impassioned citizens, capable of effectively carrying out a business of their own, aided initially by some intelligent insight and assistance.

This rationale aligns with the view of economist Amartya Sen, who articulates an ethical attitude known as the capability approach (Wells, 2013). The essential idea is to do with the moral significance of individuals being able to lead lives that they value, and wish to pursue.

Other established approaches which are chiefly used in economic policies for metrics such as gross domestic product (GDP) often only include utilitarianism or resourcism. These focus only on the “ “subjective well-being or the availability of means to the good life, respectively.” ” (Ibid.).

2.3.5 Different Types of Innovation

Current authors on innovation and entrepreneurship, John Bessant and Joe Tidd, have developed a theoretical model to better understand innovation, which they have termed the 4P's. They have divided what they understand to be the holistic innovation setting into four general quadrants: product, process, position and paradigm innovation. Positive change is the principal requirement for any of these to be considered innovations (HIF, 2015). For simplicity's sake, the term product will be used here to express either an actual product, a service, a process or the actual business itself.

Product innovation refers to the changes of the actual product being offered; process innovation is the way the product is made or delivered, while position innovation relates to the context in which the product or service is understood and by which it is surrounded.

Paradigm innovation refers to fundamental changes in the expression of the product, such that completely new avenues of investigation are explored (Ibid.). This kind of innovation has also been called *disruptive* or *radical innovation*, as it creates a new order of operation potentially reshaping the industry it affects. This may be true for

3D printing, which has the potential to disrupt the manufacturing sector (The Economist, 2015).

Open innovation occurs when ideas used for a company to develop are sourced both internally and externally (e.g. citizens) and also delivered to market through internal or external channels; they may even be outside the business of that company (Vanhaverbeke & West, 2008).

Jugaad is an Innovation model that is characterised by a frugal and flexible approach to problem solving, as opposed to the sophisticated, capital intensive production orientated method (Bobel, 2012). This method has obvious benefits for entrepreneurs who lack abundant capital resources.

Multiple types of innovation can be engaged to identify new opportunities to add value to a product. This then allows greater profit margins and a more unique product (Deloitte Touche Tohmatsu, 2015). In the *DOBLIN* Innovation model there are 10 types of innovation (fig 7). This appears to be a more detailed examination of the environment than the 4Ps. It considers how the company is structured, through to the actual product offered and ending in customer engagement. The following are short descriptions from this model. For a more comprehensive explanation please see appendix A.



Figure 7: 10 types of Innovation
(Deloitte Touche Tohmatsu, 2015)

Profit model innovation: New avenues of transforming what a company already has to offer into money.

Network innovation: Benefit through harnessing the strengths of others.

Structure innovation: Organizing human, concrete and intangible assets to add value.

Process innovation: Optimizing activities that relate to the principle output.

Product performance innovation: Improvements in the value, features and quality of the product.

Product system innovation: Developing products and service that connect together to create strong and scalable ecosystems.

Service innovation: Methods of improving and ensuring the performance, usability and value of the principle output.

Channel innovation: How the output of the company is connected from the company to the user.

Brand innovation: Improving the communicated awareness of the product, service or company with the user.

Customer engagement: Understanding and using customer insights to create connections between them and the product.

(Deloitte Touche Tohmatsu, 2015)

2.3.6 The Evolution of Innovation

Some key concepts explored in innovation literature include that of co-existence, co-evolution and co-specialisation. These concepts provide a framework for explaining how different knowledge paradigms, modes, and production come about and form co-specialised units, with the basic principle being that no one actor in a system is independent, but rather inter- and/or intra-dependant to that system (Carayannis & Campbell, 2012, p. 4).

The concept of innovation has developed significantly over the years, with the advent of the globalised economy, evolving over three successive models, with a fourth now being proposed (Duin & Ortt, 2006, p. 392). The first of these models was based primarily on the push of technology that was being discovered through scientific exploration. Where the first model was not based on market interests, the second began to be centred principally on the pull of these conditions, incrementally adding value to society. The third generation innovation then began to balance the push of technology and the pull of the market (Jofre, 2012, p. 5).

The reason for the evolution of the proposed fourth model is the assertion that, although the previous models take into account the push of advancing technologies and the pull of current markets, thereby increasing technological capabilities, it does not acknowledge the role of non-technological innovation. This fourth model therefore suggests a shift towards what has been referred to as “open innovation”, where the system of partnerships and relationships between science and industry is

complemented with knowledge of markets and technology, such that the underlying network/matrix of organisations and individuals is understood (Ibid.). These matrices can then be adapted according to the innovation taking place, and entrepreneurs are seen to play the central role here (Duin & Ortt, 2006, p. 293). The progression of these models of innovation relates directly to how the production of knowledge has evolved through the successive approaches which were explored in the previous topic, *Forms of knowledge*. This links the progression of knowledge and how it is distributed, with the progression of the models of innovation.

2.3.7 Entrepreneurs and Innovation

An entrepreneur is someone who is able to take advantage of a market opportunity by investing their own time and capital into creating a business venture from it (BusinessDictionary, 2015). Where a strictly business orientated entrepreneur looks specifically at generating a profit and returns to determine whether their business is successful or not, the social entrepreneur includes the level of positive social impact they are creating in addition to these factors (Soni, Shaikh & Karodiaa, 2014). Entrepreneurs are described as being at the heart of the fourth model of innovation, as they allow for the interchange of knowledge between what is happening in industry and science, with what the market needs and what the actual technological possibilities are (Jofre, 2012, p. 5). In this way, they allow for knowledge transfer to occur, which is seen as a key factor for innovation to take place (Elahi, De Beer, Kawooya, Oguamanam, Rizk & Open A.I.R Network, 2013, p. 19). In this way, developing countries are now able to achieve rapidly accelerated growth as they engage and exploit international technological knowledge (Szirmai, Naude & Goedhuys, 2011, p. 3). An example of this can be seen where individuals in Africa are able to create highly technologically advanced equipment, such as a 3D printers, from electronic waste (This Is Africa, 2014).

Sustainable economic development expert, Ernesto Sirolli, has worked in 300 communities around the world helping to start more than 40,000 businesses (Sirolli, 2012). With the exponential growth of the global population in recent years, for a sustainable future it is important that individuals can contribute positively, as active participants in society (Manzini, 2013). Stimulating entrepreneurial economic

development is derived from the entrepreneur's passion. Creativity and knowledge are futile without this driving force (Cardon, Wincent, Singh & Drnovsek, 2009, p. 520). The knowledge to ensure these capabilities can be developed is now freely accessible, so what is important is to catalyse the passion embodied by an entrepreneur and provide the structures appropriate to support and normalise this drive (Manzini, 2015, p. 59). The most important thing that these individuals need, therefore, is the help to go out and find the knowledge to make their passion a viable business (Sirolli, 2012).

For organisations to assist entrepreneurs, they must offer them privacy and confidentiality and be excellent at helping them (Ibid.). Planning is essentially discordant with an entrepreneurial society and economy as it inhibits the dynamic instinctual movements required to succeed (Drucker, 2006, p. 312). Therefore, to be able to work effectively with entrepreneurs, an organisation needs to first offer them privacy and devoted passionate service. Once their trust is earned, the entrepreneur must learn that to create a sustainable business they must have three things; an excellent product, marketing scheme and financial management, which no one person can successfully do alone (Sirolli, 2012).

Social innovation is currently primarily in the domain of social managers and policy makers, but a design approach is now also needed (Manzini, 2013). Originally the designer has been the facilitator of taking innovative technologies and making them user friendly. It is now also the designer's duty to identify social innovations in society and - using products, services and technology - to enable these activities, which means to make them more stable, able to last and replicable (Ibid.).

2.4 Design

The most ubiquitous current understanding of what design is and who practices it, held by society in general, seems to be that of the professional who creates the outer form of products, or the graphic layout of printed material. This view seems to be a result of the rapid progression of the commercialisation of products since the first industrial revolution in the early 19th Century up to the present day (Whitney, 2012). Since this time, goods have been produced at higher and higher volumes for lower and lower

costs, resulting in exponential population growth, exploitation of the earth's natural resources and increased levels of pollution.

This circumstance has created a multiplicity of exceptionally complex problems, leading now to the enormous task of a global shift to sustainable alternatives. Over the course of the industrial revolutions, humanity began to recognise the unsustainable consequences of the capitalist consumer model. This recognition created a global ideological transition from what was known as modernity from the mid-20th Century, to the present post-modern system. Despite this, the systems, and ways of thinking and acting linked to modernity still dominate our society (Walker, 2013). What is interesting regarding the potential for this transition, is that throughout this progression of the industrial productive activity, the tools that make a sustainable alternative possible have also developed. It is through the corresponding revolutions in communications, transportation and energy which these tools are allowing that may permit the required systemic changes for the transition to actually occur (Rifkin, 2014, p. 19).

2.5 Design beyond Physical Products and Graphics.

2.5.1 Defining Design

Today, the word design has been extensively used and misused, such that it has numerous interpretations and meanings. The need to redefine design and its aim and mission as a discipline, are prominent in current global dialogue among leading academics, especially with regard to the topic of sustainability. Professor Ezio Manzini, an active and credible figure in this dialogue, asserts that “ “To talk about design, it is a pre-condition to move away from thinking of it in the traditional way which is that of a product or graphic designer, and to look at it in a systemic way, considering the product the service and the overall system; and to develop the idea that there is strategic design, service design and communication design.” ” (Manzini, 2013).

The literal meaning of design - from the Latin *designare* - meant to “ “mark out, devise, choose, designate, appoint” ” (Harper, 2015). From this definition it is possible to appreciate that design is a much more comprehensive field than that of simply creating appropriate form. It is a process of being able to understand a problem, how to approach it and how to make sense of it, so that suitable actions can be taken to arrive

at a solution which intelligently incorporates the appropriate epistemological and technical knowledge pertaining to it. The International Council of Societies of Industrial Design (ICSID) - leaders in the current global design movement - have defined design as, “the central factor of innovative humanisation of technologies and the crucial factor of cultural and economic exchange.” (ICSID, 2015)

The way humans build our shared world in its physical and symbolic way has been said to exist in two forms; the conventional mode and the design mode (Manzini, 2015, p. 30). The conventional design way of approaching the world is that of tradition - doing things in such a way that the results are widely known, specific, socially acknowledged and accepted (Farlex, 2015). This way of functioning allows the repetition of a solution to a problem that has been solved before. The design approach, then, applies to problems that have not been solved before, or that require updated solutions that have no predefined approach. The design mode is becoming ever more prevalent for everyone in today's interconnected world, as traditional structures and ways of thinking become less applicable. Design acts as a bridge between the technical and social environments. As a modality, it requires three natural human gifts to be approached effectively; a critical, creative and practical sensitivity to thinking and acting upon a problem and creating meaning (Manzini, 2015, p. 31).

The application of design is often referred to as that of solving problems, which may range from physical products to digital interactions. More recently, design has developed to also include solving system and process-related issues, such as how to improve productivity in a workplace (Boehnert, 2013, p. 4). As explored earlier, design is in fact even broader than this. Not only is it a practice defined by solving problems as it is commonly understood, but equally significant, it is a practice of creating meaning - of making sense of particular cultural narratives. As a result, a professional design activity may not focus on producing a finished product, but rather on facilitating a complex issue so that a more coherent and workable picture of the issue can be defined (Price, 2013, p. 130). If, for example, an organisation is not running efficiently, this may be the result of multiple facets that are not being addressed in a way that is sensitive to the culture in which it operates, through observation and intelligent, creative changes, efficiencies can then rise. In this respect, design is in one way based on the physical and biological determinants,

following technically based procedures, while in another way, it is based on cultural determinants following processes based on meaning and sense making. One is to do with the physical, biological and virtual environments that we live in, while the other is to do with the cultural context in which these arise, “the social construction of meaning” (Manzini, 2015, p. 35).

From this discussion, it is now possible to allow a more comprehensive definition of what design is and who is involved.

Design is a culture and a practice concerning how things ought to be in order to attain desired functions and meanings. It takes place within open-ended co-design processes in which all the involved actors participate in different ways. It is based on a human capability that everyone can cultivate and which, for some, the design experts, becomes a profession. The role of design experts is to trigger and support these open-ended co-design processes, using their design knowledge to conceive and enhance clear-cut, focused design initiatives. (Manzini, 2015, p. 53)

2.5.2 Design as a Professional Practice

Professional designers are those people who have been specifically trained in the discipline in order to earn a living. ICSID has called a professional designer, “an individual who practices an intellectual profession, and not simply a trade or a service for enterprises.” (ICSID, 2015). This may be either the production of their own unique products for market, or, more often, specific products created for a client. Such projects often have strict constraints and incentives, to ensure that the work is carried out to a specific standard, within a given time frame and budget (Woodhouse & Patton, 2004). The clients can represent any part of society - those in the design industry, government, civil society associations and innovative businesses. In each case the designer is responsible for promoting the many different ideas that are relevant to these clients (Manzini, 2013). They are able to actualise the tacit knowledge they have acquired through years of study and practice, applying it to each unique design challenge. These skills may involve the capacity to carry out effective research, to visualise their ideas through different mediums and interpersonal skills and to produce prototypes for testing and user feedback. Design is often a transdisciplinary practice requiring the input and integration of several other professional practices to be able to arrive at an effective solution (Boehnert,

2013, p. 5). It is also noteworthy that a design professional's function is not to be a planner; it is rather to operate at specific points throughout a project's progression, exploring appropriate possibilities at each point (Manzini, 2013).

Design is an evolving discipline that is constantly growing and learning how to respond to the changing conditions presented by the multitude of complex problems of the 21st century. As new, more successful interventions are proven to be effective, so they are then integrated and further developed (Boehnert, 2013, p. 6).

Consequently, the professional practice changes accordingly. A striking example of this can be seen in the transition of how products for society were initially created and marketed on a needs basis, but in order to continue sustaining a capitalist consumer economic model it was necessary to convert to a desire-based system of production and marketing instead (The Century of the Self, 2002).

To better understand professional design it may be helpful to know the different forms in which it manifests. Design can be divided into five principle categories; systems, product, service, spatial and communication design. Within each one of these categories, are specific professions of design⁴. For example, within the product design category there are mechanical, furniture, designer-maker, fashion, textile and industrial designers.

Since the ideas of Industrial Designers, and Design-Makers are the primary focus of this paper, these fields are explored briefly here. Industrial design is concerned with the creation of physical products for mass manufacture. The Design-Maker refers to the creative entrepreneurial activity of individuals principally focused on small production runs and oriented around their own particular craft techniques (CCDI, 2014).

From an academic perspective, understanding the mind-set of a designer may seem difficult, as they are not governed by the same sets of rules. Where academia is based on linear credible assertions and specific, set, sequential methods of enquiry, the principles for effective product design often arise primarily out of learned, embodied and tacit forms of knowledge. The designer needs to know a large variety of different criteria, such as material selection, aesthetics, culture and economics

⁴ For a more comprehensive understanding of each category and the designers that work within each, please see http://c.ymcdn.com/sites/www.ccdi.org.za/resource/collection/E6E8C48A-73EB-415A-B87A-D4194A73AEF0/Careers_in_Design_-_Digital_Publishing.pdf.

and be able to integrate these into a completely new reality (Overbeeke & Hummels, 2013).

Industrial designers sit between the artistic, conceptual, ideation of a product and the scientific, engineering, production of it, as well as being involved in its sale and marketing (Ibid.). This places them in an appropriate space to facilitate the interaction of a non-professional designer's idea for commercialisation. The industrial designer is well informed as to how industry operates and is trained to find the most appropriate materials and processes for production.

The role of the industrial product designer is changing rapidly and significantly from its original responsibilities. Initially, industrial design was concerned with receiving information acquired solely from market researchers. The designers would then develop products for these specific markets, generally without direct user interaction (Soini, 2006, p. 2). The new paradigm of the industrial designer - moving out of the experience-based economy and into the knowledge-based economy - sees their role transmuting into one where research and design are being found and integrated, unaided by these professionals (Stappers & Visser, 2007). As a result, it is becoming ever more common that firms are seeking to employ designers who are also capable of effective research (Ibid.). Together with these changes, the user-designer interaction has also transformed radically, to the extent that users are now beginning to dictate which products should be produced, while the designers are taking on the role of facilitators, who participate with the consumers, rather than operating in isolation (Michael, 2013, p. 64). It appears important, therefore, that a clear understanding of how the product design innovation ecosystem operates, so that both industrial designers and users can collaborate effectively to create meaningful, sustainable and market worthy products.

2.5.3 Process, Place and Production

The result of professional design activity used to be considered a closed-ended process, where the final product, service or communication artefact was the end of the initiative. But more recently, with the increasingly complex issues faced by societies, design has evolved to incorporate an open-ended process. Here, the activity of the professional designer does not revolve around the simplistic notion of a

finished product, but instead on multiple initiatives aimed at making sense of the on-going processes (Manzini, 2015, p. 52). As there is not necessarily a finished product that can be measured and in which the designer can tangibly demonstrate “success”, the criterion depends on whether the process in which the professionally designed interventions have taken place was effective, and whether the process has positively progressed as a result.

The second criterion to be measured with this open-ended process, is the impact that the design initiatives have had on the broader setting surrounding their involvement, such as their effects on the stakeholders, institutions and cultures surrounding the process (Ibid.). These initiatives may include mapping the relevant material of the process under investigation, creating artefacts that enhance communication around a specific issue, or piloting projects to envisage or investigate the effects of different possible scenarios to those of the current approaches.

Until recently, design has been recognised as a de-centralised activity, where neither the places for production nor the development of the idea were considered significant. Lately, the importance of designing locally has been increasing, as the need for sustainable and socially integrated solutions has become an evident reality. Simultaneously with this need, the powerful technological revolution has arisen, providing both the means of communication via the Internet, as well as the possibility of manufacture via miniaturised production units (Rifkin, 2014, p. 95).

2.5.4 Design Practices

As design research has evolved over the last century, the inclusion of end-users within the design process has become a common practice, such that developed solutions contain a holistic understanding of the problem and how it can be integrated into the target community (Sanders, 2002, p. 2). End-users are now not only used to obtain specific information regarding the identified problem, but to actively be involved in the process of developing a solution (Bergold & Thomas, 2012, p. 192).

To allow designers to approach identified problems effectively, a number of different process models have evolved within the design discipline, which essentially all follow

the same stages of progression required for the design process to be effective. To explain these stages the Double Diamond Design Process Model, developed at the design council (UK) in 2005, will be used as an example (fig 8). This model represents both the divergent and convergent stages of the design process, representing the different methods of thinking that designers need in order to accomplish a project (University of British Columbia, 2014).

Divergent thinking is the process of looking and exploring more options, while convergent thinking is the need to narrow, determine and limit options (Bernhard, 2013). Identifying the problem is a divergent process, as it requires understanding the problem and involves market and user research, through activities such as focus groups. The next stage of then defining the problem, is a convergent process, since it requires taking the information gathered in the discovery process and developing this into a project plan and finally, a brief; the brief is a document that allows both the designer and the client to clearly understand the goals and scope of the project, as well as any specific challenges that may be faced (Idaho Design & Communication, 2013).

The *6 thinking hats* is powerful technique for developing creative thinking for designers, as it allows them to approach a problem from different angles. Each hat represents a specific way of understanding or expressing ideas about the challenge in order to attain a holistic understanding (Karadağ, et al., 2008). Once the brief is developed, the process becomes divergent once again as multi-disciplinary work and development takes place. Finally, the product is tested and delivered to the relevant market (University of British Columbia, 2014).

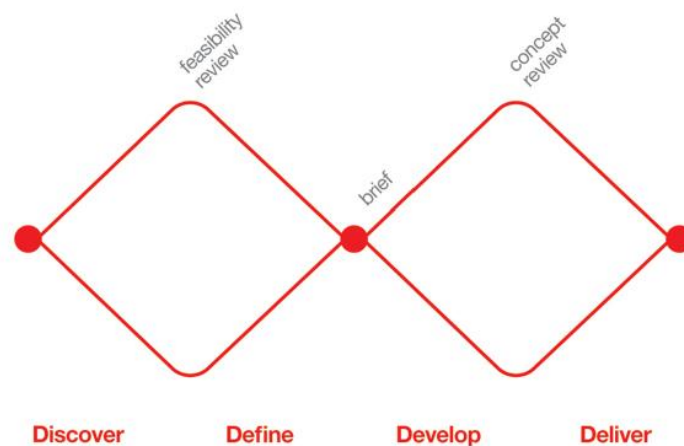
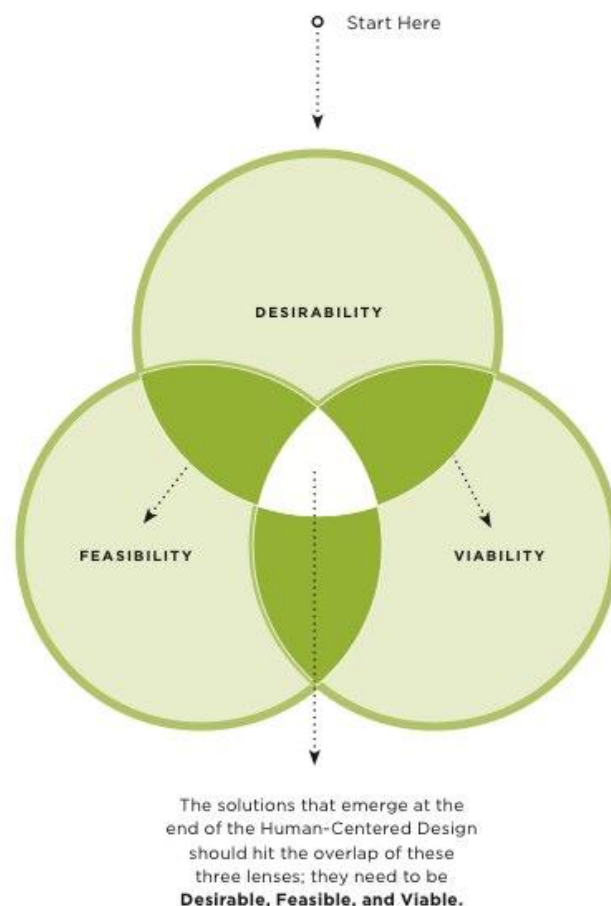


Figure 8: Double Diamond Design Process Model
(University of British Columbia, 2014)

Within the above mentioned process, although desirability, feasibility and viability of the final product will be factors that are integrated into the design process, they are not explicitly stated as the key components here. For this reason IDEO - a world leading design organisation focusing on product, service, environment, organisation, and interaction solutions - prescribe a simple process of focusing on these important factors. Simply put, the solutions that emerge from a design process such as explained in the *Double Diamond Design Process Model*, should meet all three of these requirements (see fig 9). This model was originally developed for organisations working within impoverished areas (Ibid.).



*Figure 9: IDEO design constraints
(University of British Columbia, 2014)*

2.5.5 Society and Design

The world contains two types of designers, diffuse, and expert. Diffuse designers are those who have naturally accumulated capabilities that can be applied to solve problems and create meaning, while expert designers are trained specifically in the discipline of design with specific capabilities and a culture to support them. (Manzini, 2014, p. 6). The current world population has grown from 1.65 billion to over 7 billion people in just over a century (Worldometers , 2015). In one way, the fact that there are so many people currently on this planet may seem like an overwhelming problem due to limited space and resources, pollution, etc. But viewed another way, there are now billions of intelligent individuals, each capable of solving problems through their inherent design capabilities which may potentially benefit many others.

2.5.5.1 Design by Society

The Internet and open access movement (explored previously) are the primary platforms that are allowing citizens to actively engage as diffuse designers. Having access to specific knowledge and to detailed instructions and demonstrations allows people to learn quickly and effectively how to solve issues they may face (Anderson, 2010). Since people are able to both consume and produce this content, lessons are learnt and new solutions are arrived at and published. The result is that Individuals are using their own initiative, and creativity to solve the difficulties they experience, which can then be further developed by others and so on.

2.5.5.2 Design for Society

As previously stated, the current global environment presents countless complex problems, being faced by billions of people. As a formal discipline, design has the appropriate tools and culture to address many of these difficulties through appropriate methods of investigation and application of technology. Through intelligent research, designers are able to provide solutions for people whom they have not necessarily directly participated or interacted with. However, participation as a research design methodology with communities in need has become widely accepted as an effective and appropriate method for identifying and integrating product and service-based solutions (Bergold & Thomas, 2012, p. 197).

The Q Drum is a product solution designed specifically for people in rural areas who have to spend many hours a day collecting water from places far from where they live. The design allows larger amounts of water to be transported more effectively by making the container itself into a wheel as shown below (QDrum, 2011).



Figure 10: Q Drum
(QDrum, 2011)

2.5.5.3 Design with Society

Originally, the designer was the facilitator of taking innovative technologies and making them user friendly. The designer's duty in the new paradigm, is to identify social innovations, and enable them using products, services and technology. This means to make them more stable, more durable and replicable. For this to be a sustainable reality and for the designer to be able to appropriately integrate the technologies, it is important for the designer to work within the community during the facilitation (Manzini, 2013). When individuals begin creating and engaging in socially responsible initiatives, they not only create a source of income for themselves but may provide work, and potentially education, to others whilst also providing a valuable service. (Stanford Graduate School of Business, 2009). Clean Team Ghana is an appropriate example to illustrate this type of design initiative, as it is also applicable to the South African, Cape Town context.

Here, a company has been formed as a waste management business that deals with the terrible sanitation conditions faced in high density settlements. The company delivers a service of providing customers with free toilets and then collecting the waste for an affordable price. This provides socially responsible employment for some of the people in these communities (fig 11). The company is now looking into

appropriate uses for this collected waste, such as power generation in biogas chambers (Clean Team Ghana, 2011). Here the role of the professional designer is shifting to discovering how they can facilitate the necessary cultural context for these businesses to succeed - evolving from a role focused on product, to that of relations (Manzini, 2015, p. 36). This relates directly to the investigation of how design can enable the commercialisation of innovative product ideas.

We are no longer looking at design as a way of solving a specific problem, but rather as a way of understanding and exploring a context which may in turn, assist these non-professionals in developing their innovations.



*Figure 11: Clean Team Ghana
(Clean Team Ghana, 2011)*

Society can be either empowered or disempowered to engage in the complex problems that are currently being faced by communities globally through the specific design of their systems. Social resources are perhaps the most abundant natural reserve available in today's connected world. Catalysing these resources through socially innovative design initiatives allows for a more sustainable future (Manzini, 2013).

2.5.6 Design, Capitalism and Sustainability

Up until this point in history, the profession of design has principally been concerned with aiding the driving force of consumerism. Due to knowledge rather than profit being the objective for students in universities, this environment offers a unique setting for the exploration of ideas free from obsession with profit inherent in the capitalist system (Walker, 2013).

The primary reason for design being largely concerned with consumerism seems to be that the current structure of the global capitalist economic system allows only for this objective. Within this system, generation of profit is both the driving force and the primary feedback of concern to the design industry (Boehnert, 2013, p. 15). Factors outside this narrow scope are systematically ignored, as they are deemed to be externalities by producers. In other words, the chief concern about what actions have been taken, to, for instance, produce a certain product, is how much those actions have cost in capital. Consequently, factors surrounding ecological and human resources are either completely excluded or enormously devalued (Ibid.).

Capitalism, although extremely effective at production, is not a self-sufficient system. It depends on a healthy community and ecology (Mulgan, 2009). The global economic system is in a state of crisis. The role of design also requires, and is in the process of, a paradigmatic shift from the consumer age, into the age of networks, made possible through incremental and radical shifts in our technological, economic and social capabilities (Manzini, 2015, p. 65). For design to adapt as the present situation demands will only come about through experimentation and learning to stimulate civil society to become more capable and entrepreneurial (Mulgan, 2009).

As the medium of communication develops (digital platforms), society becomes more fluid, technologically advanced and connected, with new models of organisation (Manzini, 2013). The capitalist model has reached its peak and is now beginning to decline and a new economic system is emerging (Rifkin, 2014, p. 7; Joseph, 2012). At the core of this new system is collaboration and open, communal access, which is explored in the following topic. Product development and the commerce that this creates requires a definition that is closer to the original English definition of, “social dealings between people” (Oxford University Press, 2015), as opposed to the

current definition of “The activity of buying and selling, especially on a large scale”
(Ibid).

2.6 Collaboration

There is a growing scepticism with our current global economic model, not only in countries facing economic hardship but in others like Germany, where a significant majority of the population views growth and capitalism with scepticism (Hughes, 2013). As explored previously, due to the power of the technological revolution, and successive incremental and radical changes that have (and are) taking place both in the societal and ecological domains, a new economic model is emerging which has variously been called the Collaborative Commons (Rifkin, 2014, p. 7), bottom-up economics (Redlich, et al., 2011) or the age of networks (Manzini, 2014, p. 180). Meanwhile, the capitalist model has peaked and is now in decline (Rifkin, 2014, p. 7).

Integral to the new collaborative economy are things like networks, sharing, distribution of labour and processes, open-access with collaboration as the most thorough form of interaction (Hughes, 2013; Redlich, et al., 2011). Through the virtual domain of the Internet - currently the most prominently affected space - this economy can be clearly experienced in the emergence of what is known as the "open-source movement". It is important to note that this collaboration is not restricted to the virtual space. This is merely where it is currently most dominant, but it is also apparent in the new de-centralised modes of production which include prosumers using 3D printers (Rifkin, 2014, p. 112; Redlich, et al., 2011). A prosumer is an individual who is simultaneously a consumer and producer of a product and contributes to its production in some way, through personalisation, for instance (Redlich, et al., 2011).

2.6.1 Collaborative Product Development

Depending on how complicated, and technologically advanced an idea is, collaboration is a fundamental factor that allows for the different specialised capabilities required to execute a working prototype. Essentially, being able to come up with an innovative product idea, fund the initiative and employ (or partner with) the appropriate professionals to develop it into a prototype, are the key steps in achieving this goal. A number of different methods and structures have evolved to support entrepreneurs who are trying to achieve such objectives.

Collaboration offers the possibility of being able to accomplish projects that would otherwise be too complex for any one person (or even a company) to effectively take on. These collaborations facilitate access to the technical capability required and may reduce the cost of realising such innovations (Leek, Naudé, & Turnbull, 2003, p. 88). Collaboration has been defined as the act of companies becoming mutual partners, rather than the outsourcing of work from one to another (Elfving, 2007).

2.6.2 Open Collaboration

Open collaboration projects are relatively new initiatives that have arisen in the past twenty years, allowed by the radical changes in information and communication technologies (Benkler, 2006, p. 32). These projects are common in the way that they operate to the open-source software community (Riehle, et al., 2009, p. 53). These systems are characteristically online environments that:

- (1) Support the collective production of an artefact
- (2) Are a technologically mediated collaboration platform
- (3) Present a low barrier to entry and exit
- (4) Support the emergence of persistent but malleable social structures.

The reason that people collaborate together in an open framework is because they are trying together to reach an end goal, which they are all interested in pursuing, often for diverse reasons. (Forte & Lampe, 2013).

It is the feasibility of producing information, knowledge, and culture through social, rather than market and proprietary relations—through cooperative peer production and coordinated individual action—that creates the opportunities for greater autonomous action, a more critical culture, a more discursively engaged and better informed republic, and perhaps a more equitable global community. (Benkler, 2006, p. 92)

In the above quote, the author examines how people are motivated to take part in these projects, not because they will be receiving money in return for their actions (generally), but because they are interested in and engaged with the subject matter and in sharing a common social interest, understanding and goal. Commons-based peer production has been responsible for some of the world's best software, such as GNU/Linux. Projects such as these may be worked on by thousands of individuals with no reliance on managerial hierarchies or market pricing, with some people being

paid and others volunteering (Benkler & Nissenbaum, 2006, p. 394). A principle hallmark of these projects is that everyone who participates in them agrees that no one shall be excluded from using the product (The Open Source Initiative , 2015).

2.6.2.1 Crowdsourcing

Crowdsourcing is a popular current tool used to generate knowledge, expertise, time or resources (University of Maryland, 2015). It is the application of sourcing the valuable needs mentioned above, through posing specific problems to individuals who are willing to collaborate, either for capital gain, personal or altruistic purposes (Crowdsourcing LLC, 2015). It is a term that is often associated with the use of the Internet, but in fact, the concept of crowdsourcing has been in use long before this to engage and solve difficult problems (Ellis, 2014, p. 1). If the term is to be used in science-based journals however, it must meet the following characteristics:

- (a) There is a clearly defined crowd;
- (b) There exists a task with a clear goal;
- (c) The benefit received by the crowd is clear;
- (d) The crowdsourcer is clearly identified;
- (e) The compensation to be received by the crowdsourcer is clearly defined;
- (f) It is an online assigned process of participative type;
- (g) It uses an open call of variable extent; –
- (h) It uses the Internet.

(Estellés-Arolas & González-Ladrón-de-Guevara, 2012)

An example of a crowd sourced initiative is *iStockphoto*, which developed as a network of photographers and graphic designers sharing their work over the Internet. Here clients can find photographs they may need, and pay only 1% of what they would otherwise pay to a professional photographer to acquire the same quality image (Jeff, 2006). This example also shows how the previously mentioned collaborative commons as an economic model, is already a current reality.

Crowdsourcing can be used to develop products or activate participation around a cause with individuals who would not otherwise be able to connect and collaborate. It can be used by anyone from businesses, governments and groups to individuals, to

either grow their initiatives or support their causes. There are four different ways in which crowdsourcing works, It:

1. Allows access to a large, online labour force where workers can be identified, or post work to be identified.
2. Allows the crowd to help find the solution to a particular question or problem.
3. Helps organise and find existing knowledge.
4. Obtains different ideas and feedback from the crowd.

(Crowdsourcing LLC, 2015)

These different applications have led to a number of specialised crowdsourcing initiatives directed at accomplishing specific tasks.

When the crowd is used to collect and organise information, this is called accessing *Distributed knowledge*. *Crowd funding*, is when capital is raised from many individuals who believe in the cause adding small sums of money which can add up to a sizable amount. *Cloud labour* is the term used when crowdsourcing is used to connect with an on demand, scalable workforce to perform a broad range of tasks. *Open innovation* is when diverse and creative people are used for generation of new ideas and problem solving. Creative media, content or art, accessed through the crowd is called *Crowd creativity* (Ibid.).

In South Africa, *Thundafund* is the leading *Crowdsourcing* marketplace, providing innovators and creatives and their respective projects and ideas a platform to raise money and build a support network (Thundafund, 2015). *Kickstarter* is the world's largest crowdfunding platform and since 2009, they have pledged more than \$1.9 billion dollars, funding 91,000 creative projects (Kickstarter, 2015). There are several other crowdsourcing platforms and tools for various other activities, such as research and development, marketing, design and idea platforms, human resources, freelancers platforms and open innovation software to name a few (Board of Innovation, 2015).

2.6.2.2 Product Fabrication

Being able to transition an idea into a working prototype is a difficult process for the average individual. Once the initial process of conceptually developing the idea to a point where it can be manufactured is reached, being able to then find the

appropriate knowledge, skills and equipment to make it into a working model can prove difficult. Here we explore the different collaborative environments, spaces and communities that may allow for this challenge to be approached effectively.

A number of spaces, known as “*makerspaces*” have been appearing all over the world in the past decade. These provide citizens with the space, know-how and machinery, both traditional and digital, to be able to create whatever it is they are trying to make (Tweney, 2009). There are both commercial, and *non-profit* organisations that provide these facilities as open-access to the public (Cavalcanti, 2013). Commercial businesses provide these facilities to individuals on a membership basis, while the *non-profits* are either free or at very low cost (Ibid.). “*Hackerspaces*” are initiatives similar to the *makerspaces* except here, the primary focus is generally on programming, computers and working with digital technologies (Benton, Mullins, Lori; Shelley & Dempsey, 2013). A commercial *makerspace* that can be found in Cape Town is called *The Maker Station*; providing space, tools and expertise for their members (Weston, 2015).

Fabrication laboratories, otherwise known as “Fab Labs” are a prolific phenomenon of high-tech workshops, networked on a global scale, initially trademarked as an MIT (Massachusetts Institute of Technology) outreach program (FabFoundation, 2015). They are open, knowledge sharing spaces for learners, educators, technologists, researchers, makers and innovators, and provide all the tools necessary to enable inventions. The workshops all use off the shelf, industrial-grade fabrication and electronic tools. Fab Labs were originally intended as prototyping facilities for local entrepreneurship, but have increasingly also been used by educational institutions to teach students about design and engineering (Ibid.).

It has been argued that digital fabrication capabilities will be required in the near future, especially in the practices of engineering and design, just as computer skills are currently required by so many today (Blikstein, 2013). The central vision of *Fab Labs* is that by providing developing communities with the tools to physically make things, they are able to solve the unique and specific technical problems that they face autonomously. It is also believed to be the most sustainable way of addressing how to bring the 21st Century digital revolution to these populations (Mikhak, et al., 2002). The *Fab Lab* approach is based on the idea of being able to make objects

collaboratively, such that people are participating and learning in a democratic way, with the process taking place in a way that is decentralised from the industrial sector (Gershenfeld, 2005). The *World Bank* has described these initiatives as being very efficient ways of:

- supporting STEM (science, technology, engineering and mathematics) education
- commercialization of research at higher education institutions
- evolution of smart cities and waste management
- local industry development and entrepreneurship

(The World Bank, 2014)

The Cape Craft Design Institute (CCDI), a not-for-profit company in Cape Town, hosts a *Fab Lab* product support space. It is a joint initiative of the Western Cape Government and CPUT. Their mandate is to develop capable people and build responsible creative enterprises trading within local and international markets (CCDI, 2015). They facilitate this by providing these individuals with product, marketing and business support.

Within the product support space, machines and know-how are offered through one-hour consultations, free to any individual trying to develop their idea (van Staden, 2015). Equipment includes a wide range of hand tools, digital fabrication machines such as a line bender and vacuum former, and fabric related machines for sewing, embroidery, thermal transfer and sublimation printing. Design and web research computers are also available for use (CCDI, 2011).

They have a comprehensive list of suppliers and manufacturers for many processes and materials in the Western Cape with whom they interact and whose details they are willing to disclose (van Staden, 2015). In these ways the CCDI provides a supportive creative knowledge environment for enabling innovative ideas. Together with the Western Cape Government, the CCDI have recently launched a strategy for design, to unlock innovation and drive competitive advantage in the Western Cape. They explain in their strategy summary that there is a need for a design strategy in the Western Cape; “to create an enabling environment that facilitates the optimal use of design to catalyse economic growth and improve quality of life for all in the Western Cape.” ” (CCDI, 2014).

2.6.3 Quadruple-Helix

The triple helix innovation system represents the three pillars of a country's economic, educational and political activity, suggesting that the union of these institutions drives innovation (Leydesdorff, 2010). A proposed evolution of this model, sees civil society (which includes the media and culture-based public) forming a fourth helix to represent the importance of the role of the public within the system (Carayannis & Campbell, 2012, p. 12). Here, what is known as the entrepreneurial university, is seen as the core of this system as its function is to create and diffuse new knowledge and technologies (Jofre, 2012, p. 7). Carayannis & Campbell (2012, p12) re-affirm this with their statement that:

...university researchers properly informed, empowered, and supported are bound to emerge as the architects of a prosperity that is founded on a solid foundation of scientific and technological knowledge, experience, and expertise and not on fleeting and conjectural “financial engineering” schemes. (Carayannis & Campbell, 2012, p. 12)

Collaboration between industry and universities can take many forms such as student internships, industry consulting, patent licensing and more. Intellectual property rights have been shown to encumber collaborations between these parties (Jofre, 2012, p. 9)

Essential to the development of new knowledge and innovations is creativity. Creative environments⁵ that encourage this spirit is important, whether it is for an individual or a collective. Research in science is key to this development, but the arts are also central (Carayannis & Campbell, 2012, p. 15).

2.6.4 Collaboration in Cape Town

Within Cape Town, several communities exist, collaborating openly or through membership, as virtual communities or at physical locations, aimed at developing innovative ideas through to commercialisation. We will briefly explore some of these communities and the way they are structured.

⁵ creative knowledge environment (CKE's): spaces that are influential for individuals to engage and advance in creative work (Carayannis & Campbell, 2012, p. 15)

A commercial *makerspace* found in Cape Town is *The Maker Station*; providing space, tools and expertise for their members (Weston, 2015). There is also an industrial design Facebook web page with over 1,200 members. Here, local individuals can ask related queries and share valuable insights with likeminded members.

The Silicon Cape Initiative is a community of over 9,200 members aimed at aiding the start-up of new companies in the Western Cape. This network includes tech entrepreneurs, creatives, developers, as well as venture capitalists and angel investors (Silicon Cape Initiative, 2015). This network allows for collaboration and funding opportunities. The funding will depend upon the stage of development of the business, the commercialisation strategy and the scalability of the idea (Smith, 2015).

The South African government's Technology and Innovation Agency (TIA), provides a youth funding initiative aimed at supporting South African citizens below the age of thirty years old (TIA, 2015). They provide a supplementary income of R5,000 per month for up to four inventors each, for two years. They also offer product certification, incubation and business coaching services, use of technology stations and services and intellectual property protection⁶. TIA also initiated a seed funding initiative at universities across South Africa in 2013. Here they offered funding of up to R500,000 for innovative ideas which they had approved and that had been developed from within universities, for their continued development.

Launch-Lab is a company in Stellenbosch (just outside of Cape Town) focused on developing innovative ideas. They act as a link between universities and industry, assisting researchers who want to start businesses from university projects. They offer office space, coaching, mentorship and workshops (Smith, 2015).

⁶ For more information, please see [http://www.tia.org.za/funding/YTIF+\(YOUTH+TECHNOLOGY+INNOVATION+FUND\)](http://www.tia.org.za/funding/YTIF+(YOUTH+TECHNOLOGY+INNOVATION+FUND))

2.7 Summary

In the above literature review, the research has explored the different types of economies that have evolved in recent history and the economic interactions upon which these were based, from the agricultural revolution based on labour, to the industrial revolution based on capital, and finally to the beginning of the current electronic revolution, based on knowledge. The environments that have supported each of these economies and enabled their operation have shifted appropriately from institutions, to markets, to networks. The economic system on which all the interactions have been based up to this point has been the free-market capitalistic economy. Current theory supports that this system is now in decline and a new, collaboratively driven economy based on communal ownership is emerging. This is being made possible through the open, transparent democratisation of knowledge and power, through the communicative power of the Internet.

The different forms of knowledge that exist and how they may be exchanged commercially were also explored, leading on to the topic of innovation.

Innovation can effectively be split up into three major groups: economic, technological and societal. It is based on positive changes taking place in one of these groups, either incrementally over long periods of time, or radically over very short periods. There are several different types of innovation, relating either to the way the product is developed, to the product itself, or to the way the product is delivered. The process of innovation has evolved over four successive models, from being seen as a linear and sequential, to complex and iterative. Networks between different clusters of knowledge (human or technological) allow for innovative interactions to potentially take place.

Finally, entrepreneurs are seen as the fundamental drivers of the current innovation system, as they are able to transfer knowledge effectively from industry to develop market worthy products. Passion is the driving force behind these individuals and to ensure that they succeed with their ventures, they may require assistance in finding the appropriate knowledge and partners. Design may be able to provide this assistance through a shift in the pre-existing culture and skills that are available to it.

Design is a way in which the world is built when new problems are faced and/or meaning may be required. It is a natural human capacity that acts as a bridge

between the technical and social environments. Design professionals are trained to have specific skills and transdisciplinary tools depending on their specialty. The discipline is evolving to positively facilitate new challenges in the 21st century; especially that of social innovation. People who are now more capable of solving problems due to being in a fluid, technologically connected society, can undertake useful projects. The free-market capitalist economic structure that is currently in place is not conducive to enabling design for social and ecological change as these priorities are systematically undermined in the pursuit of market growth and profit before all else. This global economic system is now in a state of crisis as a result of its single minded pursuit for profit. Design as a discipline requires a paradigmatic shift along with the economy to enable a more sustainable future.

Collaboration offers the possibility of being able to accomplish projects through partnerships, which may otherwise be too complex for any one party. Open collaboration projects are those in which essentially any interested and capable party can take part in its development, with the condition that all work created within that project can be used freely by anybody else. Crowdsourcing is an activity that provides support for open collaboration to take place through enabling a workforce, support, knowledge acquisition and the generation of new ideas.

Makerspaces are physically located open access spaces that contain the tools and know-how for a regular citizen to be able to accomplish the development of a physical prototype. *Hackerspaces* are similar to *makerspaces* but are focused primarily on virtual and computational activity. The public role of civil citizens is proposed as an additional sector that should be included in the economic collaborative structure along with universities, government and industry. There are activities taking place in Cape Town supported by all of these sectors and promoting the development of entrepreneurs.

In the following chapter, the methodology used to obtain the primary research relevant to the intent of this thesis is presented.

CHAPTER 3: Methodology

To gain insight into the product development processes that are currently taking place in the Western Cape, three case studies from within this region were identified and investigated. Each of these projects were initiated by a different need which arose out of the specific economic contexts within which they were based; namely the civic, university and industrial sectors. To be able to analyse these cases in a cohesive and unified manner, each project was divided into three parts, namely, the initial inventor, the projects process and the environmental conditions of these developments. The human-machine theoretical model, which is explored below, was then adapted to categorise these case divisions, allowing for a formally structured relational context between the studies to exist. Within this theoretical framework, an official design process model was applied for the investigation of each product's progression, allowing further contextualisation of identified data (fig 12).

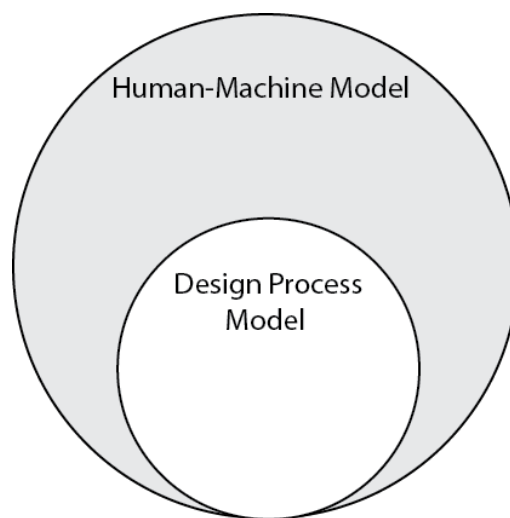


Figure 12: Use of Theoretical Models

(Author, 2015)

3.1 Theoretical Frameworks

3.2 The Human-Machine model

The *human-machine model* (fig 13) is a theoretical system that represents the relationships between a machine (product), its user (human) and the environment within which this takes place (Bridger, 2003, p. 7). The machine may be made up of sensors, actuators, a processing unit, controls and a display, such as a monitor. This machine then affects and is affected by the environment in which it operates and the human(s) that operate or are in contact with it, and vice versa. General environmental conditions include things like lighting, temperature, noise and vibration, whereas the immediate environmental conditions include matters like the design of the controls, displays and space (fig 13). These environmental conditions then also affect the human's physical and mental conditions, such as their posture and ability to understand how to effectively operate the machine.

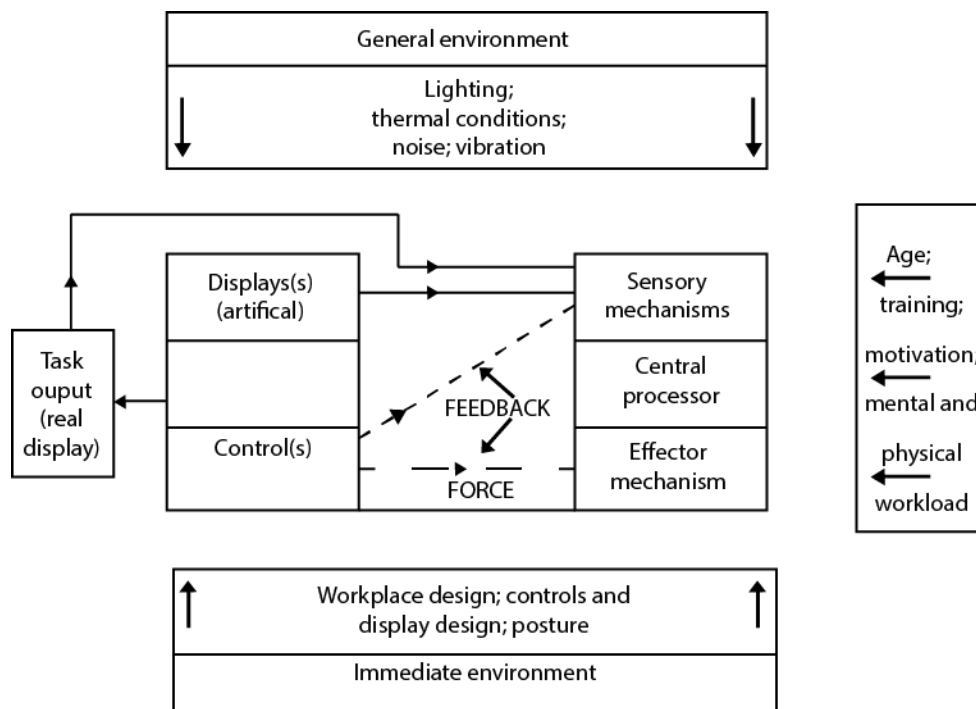


Figure 13: Illustration of the human-machine model
(Bridger, 2003)

Bridger’s model has been adapted for this thesis to catalogue the selected case studies and allow a coherent representation of the collected research (fig 14). This allows for a holistic view of all the elements being investigated so that a comprehensive understanding can be gained for analysis. The environment will be represented by the funding, tools, knowledge and collaborations that were used in the development of each case study; the human factor will cover the inventor and the background as to how and why the idea arose. Finally, the product will be represented by the process that each idea followed, as well as by the invention itself. Through this structure of intelligent groupings and the relational understanding of how each group affects the other, a coherent and workable arrangement of data was made possible for the findings, and consequently, the analysis of these findings in Chapter 5: *Analysis of Findings*.

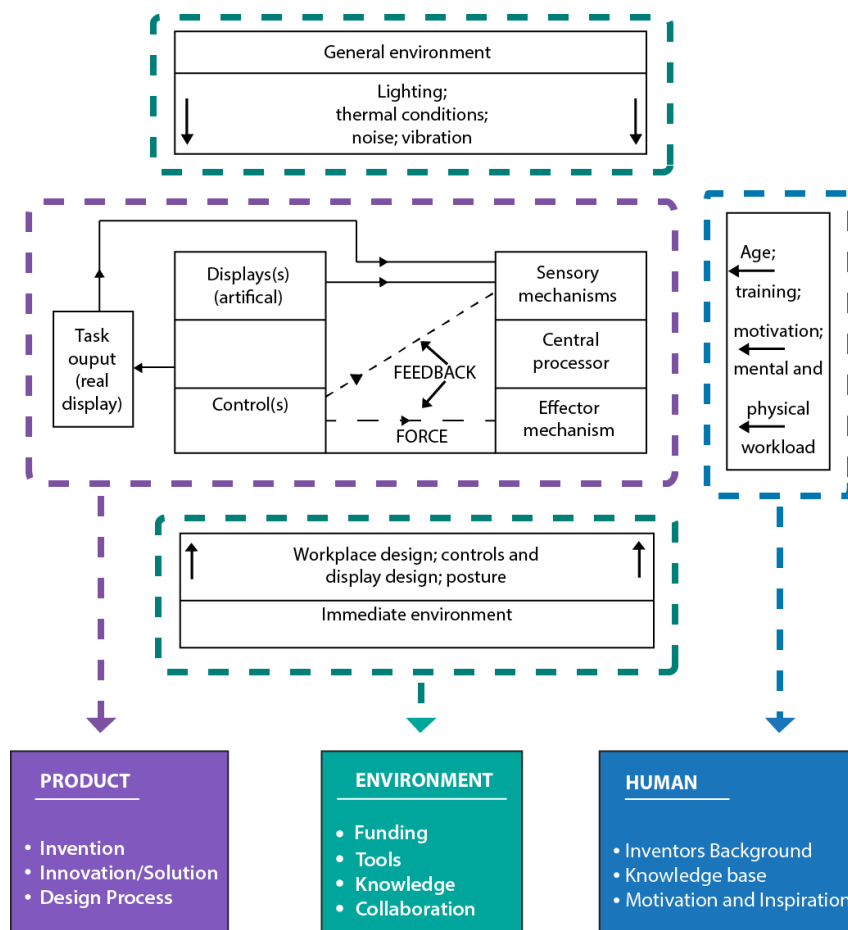


Figure 14: Adapted Illustration of the human-machine model (Bridger, 2003)

3.3 The Design Process

The product findings of each case study will be divided into categories relating to *D'schools Design Process Model* (fig 15), contextualising the data, and allowing a structured analysis of the process to take place. The process begins with an understanding of the problem and why it may be useful and meaningful to solve it. This is followed by defining much more specifically what will be focused on before generating ideas around this focus. Finally, these ideas are then prototyped and tested to identify what works the best, with the cycle often repeating itself several times over until an adequate final product has been developed. (The University of British Columbia, 2014).

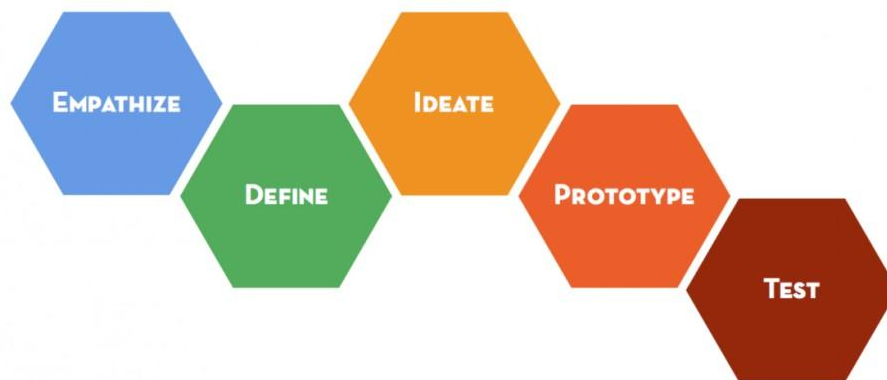


Figure 15: D.School Design Process Model
(The University of British Columbia, 2014)

3.4 Method

This study serves to better understand the dynamic of the different sectors, how they operate and where they may potentially change or adapt for a more integrated and effective innovation system. Due to the limitations of this research, the principal structures that are being investigated, and how they interact, are limited to universities, the design industry and civil society in the Western Cape. As a result, government are not included in the investigation, except where necessary, as they have been considered beyond the scope of this project. Three case studies, each representing a different need, were used to explore different areas of the society, economy and technology, and how these relate with the product development process. The three needs that have been focused on relate to physiological,

psychological and ecological needs (fig 16), allowing for a diverse examination of the product design process and how it may be facilitated.



Figure 16: Case societal sectors and needs addressed (Author, 2015)

As stated previously the ideas investigated by each case study initially arose from a different sector of the economic environment. After their first stages of development however the idea from the inventor in civil society was transferred to the university, and the idea from the designer in the university was partnered with a design company. The project that developed from within a business environment to begin with collaborated with another industry positioned partner. These varied interactions allowed a unique observation into the different environments and transactions that could potentially support innovative ideas (fig 17).

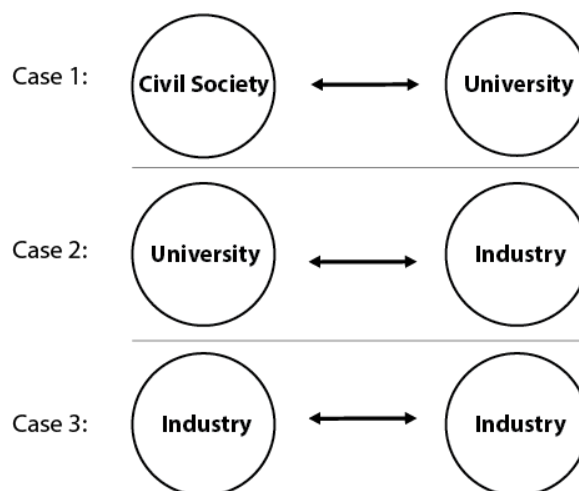


Figure 17: Transfer of case study ideas (Author, 2015)

The case studies generated through the university and civil society, involved the direct participation of the author, allowing an in-depth emersion into the material under investigation. The industrial design, graduate level of knowledge embodied by

the author was presumed to be advantageous to the research, in relation to the potential level of insight that it may have facilitated. To ensure that an objective body of research was observed, (considering the researchers' personal affiliation with the material), formal interviews with collaborative participants who were concurrently involved in these projects took place, to provide key supporting material. Wherever possible, direct links to documents in footnotes, appendices or the actual representation of material being discussed is offered, thereby evidently identifying the explored research.

A hybrid methodology of narrative ethnographic and autoethnographic research was used for the investigation of found material of both qualitative and quantitative data from these cases. The reason for this fusion is due to the unique circumstance of each study in relation to the author, and the emphasis that is placed on the process and dealings with others (Ellis, et al., 2011, p. 17). The case study relating to the idea that was initiated through the university was created and managed by the researcher throughout both phases of its development. As a result, autoethnographic investigations were appropriate here. The idea created by the individual from within civil society was initially developed entirely through his own efforts in the first development of the product without the authors input. A process of ethnographic investigation was therefore appropriate in this case. Within the second development of this project however, after it was transferred to the university, the author was both a co-designer with other participants and project manager of this phase, once again appropriating autoethnographic techniques. In the final case, the entire progression of this project was overseen by that individual from within the industrial sector thereby validating a principally ethnographic approach. The different levels of involvement and participation by the researcher throughout these cases thus allowed several different perspectives to emerge. This situation was able to promote objectivity as well as grounded considerations of the found material.

3.5 Case Studies

The reason that an exploratory case study has been used as the primary research strategy for this thesis is due to the fact that what was being explored was the current state of the product development landscape in the Western Cape. As the

context and the research topic are inseparable, an investigation of this sort seemed appropriate, allowing for relevant direct observation and enquiry into the nature of the investigation to take place. There may have been too many variables to account for through standard experimental and survey designs otherwise (Yin, 2014, p. 59).

A case study is appropriate as a method of investigation when a comprehensive enquiry into a single example of a social process, organisation or collective is required (Payne & Payne, 2004, p. 32). Within this thesis, three separate case studies were investigated to explore the same social process, that of commercially developing a product idea. The multiple-case study approach was used specifically for the purposes of covering the entire scope of the inquiry into the different economic sectors, as opposed to focusing only on a single case (Yin, 2003, p. 48). In this way a collection of data in the form of observations, unstructured interviews and participation, allowed for a cross-case analysis in Chapter 5: *Analysis of Findings*. Through the systematic production of these examples, the scientific grounding of this social study may have been strengthened; allowing for a combination of both quantitative and qualitative data to be effectively analysed (Flyvbjerg, 2006, p. 242). The social groups that were analysed within this research were distinct and easy to verify as they were concentrated around the defined product ideas. This method provided a manageable and limited scale from which new insights could be effectively developed (Payne & Payne, 2004, p. 33).

The substantive topics of this thesis have been identified and then used to identify the data elements being explored through each case, such as the product development process (Yin, 2014, p. 60). The narratives of the inventors and their inventions have also been identified as relevant for an analysis into the primary driving forces of these projects. The specific questions directed toward the studies were organised to understand how the topics of knowledge, collaboration, innovation and design were addressed. This includes the development of these projects and what may have been advantageous and disadvantageous.

A brief introduction of the case studies, followed by the specific areas of investigation and their methods of enquiry is provided next:

3.5.1 Civic Origin

The first case study examined an inventor from civil society who is disabled (only has one arm) and has developed a range of appliances that assist him in the accomplishment of his day to day tasks such as preparing food. These devices were then developed further by a group of graduate level industrial designers at CPUT. These products could be considered moderately technologically advanced.

Table 1: Civic origin case methodology

Study	Method
<p>This study represents a partnership between the inventor (civil society) and the Cape Peninsula University of Technology (CPUT) (university), funded by The Ackerman Educational Trust (Industry),</p>	<p>Unstructured interviews with core stakeholders took place and the data was analysed to obtain a holistic understanding of projects development and dealings between people.</p>
<p>The study explored the development, commercial interactions of this product and the contributions and networks of its actors.</p>	<p>Observation and recording of the development and central milestones of the projects.</p> <p>Unstructured interviews with key actors occurred to assess the social, economic and technological implications of the project.</p>
<p>The driving force behind the projects development was handed over to the university to develop.</p>	<p>Through unstructured enquiry, interviews and discussions an understanding of the core policies and networks that are in place was explored to expose strengths and weaknesses of the current system that is in place.</p>

(Author, 2015)

3.5.2 Industry Origin

The second case study examined the development of a product outside of the university environment. A product design that was identified through the Cape Craft and Design Institute (CCDI) was chosen to fit the specific criteria of being designed through an informal process and basic technological standing. These parameters were established to provide a different environmental context to the other studies.

Table 2: Industry origin case methodology

Study	Method
<p>This study was used to explore the informal knowledge and the specific networks and actors that operate in within the industry sector.</p>	<p>Unstructured interviews with the inventor took place and the data was analysed and visually mapped to obtain a holistic understanding of the existing networks and knowledge.</p>
<p>The study explored the development and commercialisation process of these products and the contributions and networks of its actors.</p>	<p>Observation and recording of the development and central milestones of the projects.</p> <p>Unstructured interviews with the inventor occurred to assess social, economic and technological implications of the project.</p>
<p>Here the inventor is part of the process and outside of the university politics.</p>	<p>Through unstructured enquiry, interviews and discussions an understanding of the core policies and networks that are in place were explored to expose strengths and weaknesses of the current system that is in place.</p>

(Author, 2015)

3.5.3 University Origin

The third case study examined a product that was developed through the university by a product design student who was awarded funding for its development. The study will use auto-ethnographic methods of investigation to examine this area as it is being carried out by said researcher and will involve some personal interpretation of found material using qualitative and quantitative data. This product is highly technologically advanced.

Table 3: University origin case methodology

Study	Method
<p>This study examines the relationship of networks and actors within the university and how industry is approached through this lens, using the inventor as the driving force behind the products development.</p>	<p>Unstructured interviews with core stakeholders took place and the data analysed and visually mapped to obtain a holistic understanding of the existing networks and knowledge.</p> <p>Through unstructured enquiry, interviews and discussions, an understanding of the core policies, stakeholders and networks that are in place were explored to expose strengths and weaknesses of the current system that is in place.</p>
<p>The study will explore the development and potential commercialisation of the product and the contributions and networks of its actors</p>	<p>Observation and recording of the development and central milestones of the projects.</p> <p>Unstructured interviews with key actors took place to assess the social, economic and technological implications of the project.</p>

(Author, 2015)

Each of these projects was chosen for the diverse distribution of data that could have potentially been obtained through them all, thus allowing a more holistic examination of the product innovation ecosystem to be obtained. This data includes economic, social and technological backgrounds to the innovation, the reason for the design

process, the commercial development of the designs and the processes and paths followed by each project.

Chapter 4: Research Findings

4.1 Introduction

Three current case studies are explored in this chapter to gain insight into the product development process in the Western Cape. Each of these projects was chosen for the diverse distribution of data that could be obtained through them. In this way a more holistic and robust examination of the product innovation ecosystem was observed. This data includes the backgrounds of the inventors, the design process followed, the invention itself, collaborations that took place, and the environments that enhanced or detracted from the idea's progression. The goal of each investigation was to discover the environments and interactions that allowed the ideas to develop throughout their life cycle. Each case is divided into three main sections addressing the human, product and environmental aspects, of their commercial development. Due to the design process itself being particularly significant, this topic has been separated into different sections that relate directly to a formal design process model. This allows for a structure in which the detailed information can be suitably considered.

4.2 Case Studies Summary

The first study explores the development of an idea based primarily on a certain physiological need. It was initiated by an elderly individual who, having only one arm, required assistance with the preparation of his meals. This led to, quite literally, the single-handed production of his designs; a multi-functional, modular device that would assist him in the kitchen. These initial designs are based on purely mechanical mechanisms which were created by the man himself using relatively basic tools to produce the initial prototypes. Later developments saw a team of industrial designers re-designing the original prototypes with mass production and enhanced usability in mind.

The second example was a product developed primarily to reduce the amount of waste that is burnt, littered and dumped into landfills in order to reduce environmental pollution. The other impetus for the product was as a creative outlet

for self-expression and the need to earn an income. The concept was conceived and developed by a single mother who had been trained as a professional seamstress. The product is a handbag made almost entirely of material that has been discarded as waste, or offcuts from virgin materials. In this process, input from others was only required for the scaling up of production.

The final case looks at the development of a concept based primarily on particular psychological needs. It was developed within a university programme by a student who was having difficulty falling asleep. Through research and concept-development, he established an idea that would potentially assist in the process of “winding-down” before bed. This would be accomplished through an interaction whereby the user would alter his or her heart-rate to a steady rhythm through a specific breathing routine; this process would be enhanced through the projection of particular images and sounds into the room, that were reacting in real time to variations in the user’s heart-rate. This project was clearly of a much more technologically-focused nature, bridging the divide between digital and analogue tools. The development of the first prototype for this idea was undertaken by a team of specialised professionals.

Figure 18 illustrates the above summarised case studies.





















CASE STUDY			Iwisa Bag
GENERAL PROBLEM	 Psychological	 Physiological	 Environmental
SPECIFIC PROBLEM	 Poor quantity and quality of sleep	 One-arm	 Prolific production and disposal of waste
REASON FOR PROJECT	 University Degree	 Food Preparation	 Financial stability & creative outlet
SKILL	 Research & design	 practical hand-skills	 Sewing
PROCESS	 Question, Examine & explore	 Question, Examine & explore	 Question, Examine & explore
SOLUTION	 Device to aid winding-down process before bed	 Mechanicallydriven, modular, food-preparation system	 Upcycled hand-bag
RESOURCES	Time Purly Conceptual Programs Internet Computer Journals	Time Workspace Tools Experience	Time Sewing machine Experience Workspace

Figure 18: Summary of Case Studies
(Author, 2015)

4.3 Case Study 1: CookAble Food Preparation Aid



Figure 19: Cookable Logo
(Author, 2015)

The information for this case study was obtained through an autoethnographic and ethnographic hybrid methodology (for more information please refer to Chapter 3: *Methodology*). This was because the project was initially invented and developed solely by the one-armed individual from civil society. It was then further developed through CPUT, with the investigator of this thesis acting as project manager and co-designer for its continued development. As a result, information was obtained through interviews, as well as first-hand experience with the research material. The device is only moderately technologically advanced when compared to the other case studies. Figure 20 illustrates a brief summary of how this idea developed, and table 4 highlights key aspects of its progression.

CASE STUDY	GENERAL PROBLEM	SPECIFIC PROBLEM	REASON FOR PROJECT	SKILL	PROCESS	SOLUTION	RESOURCES
			 Food Preparation	 practical hand-skills	 Question, Examine & explore	 Mechanically driven, modular, food-preparation system	Time Workspace Tools Experience

Figure 20: CookAble idea summary
(Image by author)

Table 4: Case 1 Context Overview

Individuals Drive	To be capable of preparing food effectively with one hand.
Individuals Passion	- Inventing - creating a better quality of life for people with the same or similar problems
Problem	Inability to effectively prepare food using only one arm.
Research	Life-time of first-hand experience as well as searching for already existing solutions.
Tools	Technical capacity to prototype. Drill-press, Table-saw Space Time
Solution	A device that allows people with disabilities, specifically having only one hand, to be able to accomplish the daily task of food preparation.

(Author, 2015)

4.3.1 Case 1: Human Factor



Figure 21: Mr Brink
(Image taken by De Vos, 2014)

4.3.1.1 Background

Mr Brink (fig 21) was born with only one arm, a birth defect known as amelia (Riyami, Ahmed, Tanzeem, & Abdul-Latif, 2012). He explained how as a farmer, he had grown up learning much about how to get things done practically, such building his house as a young adult (fig 22). After moving from his farm to Cape Town he began his own successful furniture retail store, starting the company with just 100 rand and creating a turnover of 400,000 rand in its first year (Brink, 2015).



*Figure 22: Mr Brink's Family Home
(Image taken by Author, 2014)*

Over the course of his life, he has developed many inventions and aids to assist him in accomplishing a variety of tasks (Brink, 2014). These inventions include kitchen appliances, self-care appliances and many other enabling devices. Please see appendix B for the full list of his products. He approached several key companies and individuals in the education and health industries before eventually finding partners who would assist in developing these objects further towards mass production (Ibid.).

His vision for this project was to provide all people having only one hand, the dignity and ease that two armed individuals have whilst preparing food (Brink, 2015).

4.3.1.2 Knowledge

Mr Brink does not have a tertiary qualification. All his devices were conceptualised and built by himself using only the most basic machinery, namely, a hand-drill, a file, handsaw, hammer and screwdriver in his garage workspace (Ibid.). The knowledge used here is nearly completely embodied from concept through to creation. In other words, through personal experience of each problem as it arose, he contemplated

what would be the most appropriate solution and then prototyped and tested the ideas on himself (Brink, 2015).

4.3.1.3 Project Motivation and Inspiration

The initial reason that Mr Brink created these objects reflects his inability to find anything on the market that could effectively help him with his difficulty (Brink, 2014). He was not able to effectively accomplish the tasks he needed to do, such as preparing food and so he decided to invent specific aids for each task. Over the course of developing these inventions, he became increasingly aware of the benefit that they could make in the lives of other people suffering from the same or similar difficulties. After seeing first-hand how well his inventions worked, he believed that they could certainly help others and this motivated him to not to give up on commercialising his ideas (Ibid.).

He explained how he has not been able to find anything similar, anywhere, and this is why he believed it would be a successful product range. This became the driving force behind his desire to commercialise the products en masse; not for money or fame, but primarily so that many other people can benefit greatly from his inventions. (Ibid.).

4.3.2 Case 1: Product Factor

4.3.2.1 Project Catalyst

Mr Brink was faced with the need to begin preparing his own meals when his wife became ill. Having only one hand, he was unable to accomplish simple tasks, such as chopping and peeling effectively. This led him to develop new devices to assist with these tasks.

4.3.2.2 Invention:

A multi-functional, modular device that allows people with disabilities, specifically having only one hand, to be able to accomplish a variety of tasks for food preparation. The range of products is held firmly in place by an integrated base, effectively acting as a holding hand, for specific tasks.



*Figure 23: Cookable product
(Author, 2014)*

4.3.2.3 Innovation:

The foundational unit of this invention is an object that adheres to a flat surface through the use of suction pads (fig 24). Once this unit has been attached to the surface, it provides the connection points required for the secondary utensil units to be attached, thus creating a secure tool to aid with food preparation (fig 24). Due to the modular nature of the product, potentially any number of secondary units can be developed to attach to the foundational unit.

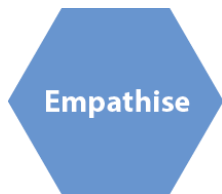


*Figure 24: Initial Prototype, foundational Unit and peeler attachment
(Author, 2014)*

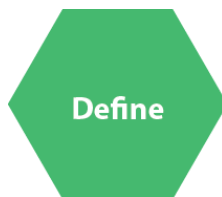
4.3.2.4 Design process:

Design Phase

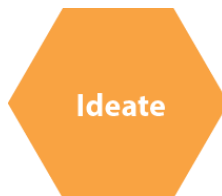
Case Progression: First Iteration



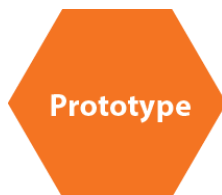
In 1979, Mr Brink began developing his kitchen appliance project using his own tools, practical skills and personal space. With regard to understanding the end user, in this case, the inventor himself was the one facing the problem and as a result he understood the difficulties better than would most.



The problem of having to prepare food was already clearly defined and each invention was developed as the need for it arose in the process of preparation (Brink, 2014).



He would contemplate the problem before going to bed and in the morning get up and begin making it. He did not draw proper pictures of his ideas before beginning to make them; he would just have a basic idea and act upon it (Brink, 2015).



He accomplished the initial prototypes on his own using the basic tools and space clarified previously. They were created as purely utilitarian objects with only the means available to him i.e. he was not concerned so much with how it looked so long as its functionality was “full-proof” (Brink, 2014). Polyethylene and stainless steel were used as the principal materials for the products, as these are food grade (ILSI Europe, 2000). He was able to acquire free materials in the form of off-cuts from a plastic factory which were suitable for his purposes. After explaining his venture and difficulties he faced, the manager there was inspired by his work and wanted to help him achieve his goal (Brink, 2015).

First he needed the products not to move when in use so he developed a board to which they would connect that would be stuck onto a table or counter with suction pads (fig 24). After creating this foundational object he was able to develop all the other products that could be connected to it in a modular

Design Phase Case Progression: First Iteration

fashion (fig 25). This simple idea of a modular base is at the core of the invention; having the ability for objects to be held without moving so that the other arm is free to work. He then created inventions for several applications such as cutting bread and vegetables, buttering bread, peeling vegetables, skinning chickens, holding cans and more, which could all be attached to the initial base.

Once he was happy with the product he had created, he drew out the technical dimensions so that the objects could be replicated (Brink, 2015). Later on he got jigs made to help with the effective production of future units. A jig is a device made for a specific fabrication process, to ensure that the parts being produced are identical (BBC, 2014).

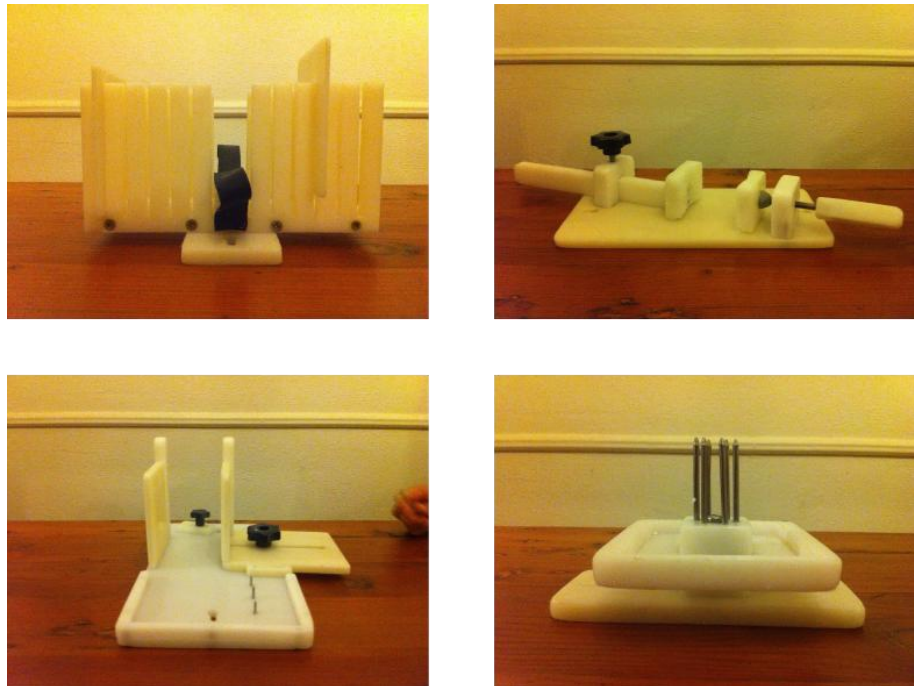


Figure 25: Initial Modular attachments
(Author, 2014)

Design Phase

Case Progression: First Iteration



Out of necessity, the inventor tested each prototype to make sure that it was fully functional for adequately performing the required task in the kitchen (Brink, 2015).

Having developed several utensils to connect with the base he put them together as a kit and decided to advertise it to see the public's response. The business was called *Hand Disability Aid*, and each kit was sold with a 45 minute training manual.

Although the users often struggled with the kit in the beginning, they were soon able to use it effectively (Brink, 2014).

People from overseas, including America, have purchased these products declaring that there is nothing similar on the market. He explained that since he was able to sell so many kits privately, he believes that if this product was mass produced it would do very well (Ibid.). He began selling this product in 2005, and still has seen nothing similar for sale up to 2015 (Brink, 2015).

After personally making so many units Mr Brink's hand began to feel the strain and he could no longer produce them himself. He then decided to rather invest his energy in getting the products industrially produced (Ibid.). He approached several businesses to demonstrate the product, trying to find partners who would assist him to develop his products for mass manufacture. Although these companies were generally impressed with the product they were unwilling or unable to assist him (please see exemplary letter, appendix C).

Ultimately, he approached Mrs Wendy Ackerman for assistance and she was so impressed with his efforts that, after determining that CPUT had the capacity to continue the development, she sponsored the project via the *Ackerman's Educational Trust*, essentially employing a group of design students (fig26).



*Figure 26: Sponsor and Design Team
(Author, 2014)*

4.3.2.5 Redesign Process:

These students began meeting weekly to advance the product towards a more marketable, and mass producible state (De Vos, 2015). This meant another cycle of the design process followed above. The team of five student designers, known as the *UD@HOME team*, began the process with an in-depth planning phase to determine how the product development would unfold and what deliverables could be identified and worked towards (Ibid.). Out of this group, a project leader was designated and the primary roles of the other members determined, namely, graphic material, computer generated designs and prototyping (Broodryk, 2015).

A milestones and deadlines chart was produced by the team to initiate a project management process (fig 27). Although this helped get a clearer picture of the project, the time and money distribution could not be accurately calculated because of the university's lengthy procurement system. This was problematic as the turnaround time for initial prototyping should be fast (De Vos, 2015).

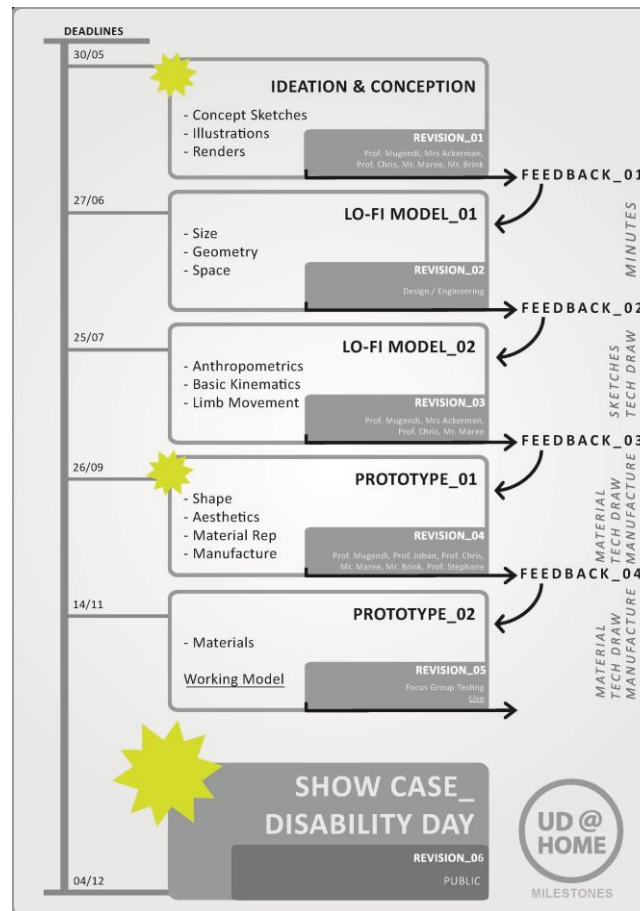
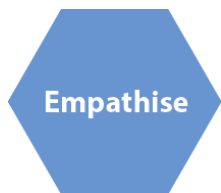


Figure 27: Milestones and Deadlines Chart
(Image by De Vos, 2014)

Design Phase

Case Progression: Second Iteration



Research was completed by the *UD@HOME* team into kitchen appliances, potential mechanisms, user groups and anthropometrics to gain insight and inspiration about the topic before beginning concept development. Figure 28 demonstrates part of the investigations into this research.

To fully understand the problem and how to improve the current solutions, the design team performed “empathy tests” to explore the original products (fig 29). Using only one arm to prepare a meal with the initial prototypes this lead to a number of understandings into what should be developed and why (Broodryk, 2015). This was seen as important research as it led to several findings that were then incorporated into the design

Design Phase Case Progression: Second Iteration

brief. A design brief is an outline of what needs to be accomplished within the scope of the project and is defined by a list of specific requirements to ensure its validity; it communicates the objectives and planned outcomes (Idaho Design & Communication, 2013).

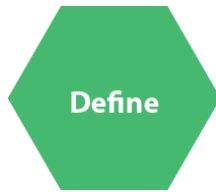


Figure 28: Research Mood Board
(Image by De Vos, 2014)



Figure 29: Empathy Testing
(De Vos, 2014)

Design Phase Case Progression: Second Iteration



From the illustrated testing session, a list of requirements was developed to work on specific appliances that would be most suitable for the given time frame and capital invested (Broodryk, 2015). This included redesigning the foundational base unit and four other appliances that attach to it, thereby increasing the modularity and potential functionality of the product (fig 30).

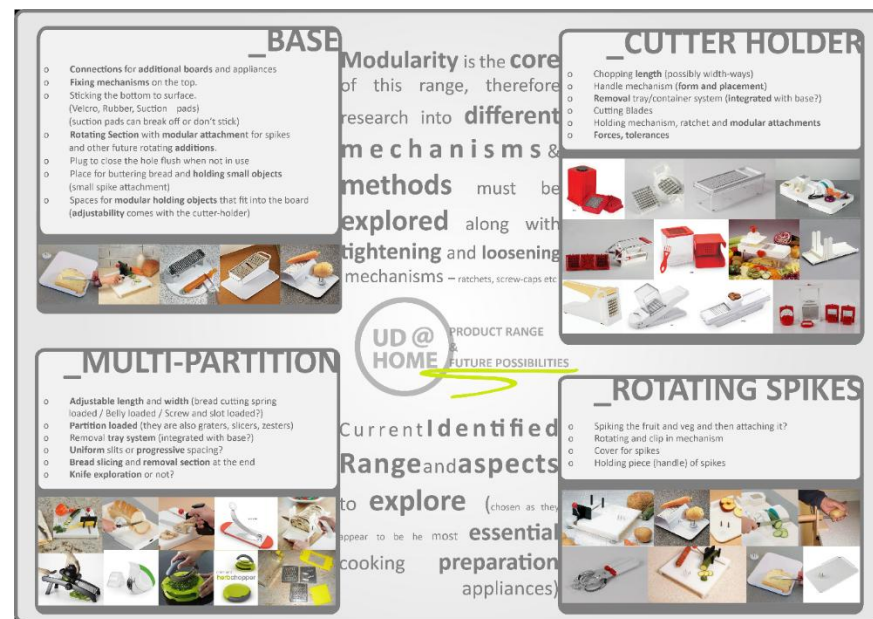
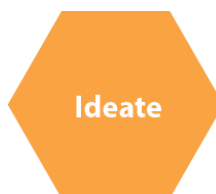


Figure 30: List of requirements
(De Vos, 2014)



The product design development took place almost entirely through hand drawn sketches and CAD (computer aided design) (fig 31). This process would usually involve quick and rustic physical prototyping alongside ideation but the university's procurement policies would have taken too long for this step, stalling the project and making meeting the deadlines impossible (De Vos, 2015).

Ideas, conversations and sketches at weekly work groups then began to inform how these products could be effectively

Design Phase Case Progression: Second Iteration

improved, integrated and modified for mass production and marketability (Ibid.).

Initial prototyping took place to allow for the first tangible interaction with the product and thereby identify the most effective way of proceeding (fig 31). Continued virtual and hand drawn design work groups then led to the development of the model, and finally the current design solution was arrived at (fig 31). The final mass production process was continuously kept in mind throughout the design progression to ensure the product would follow the proposed production methods (namely injection moulding) by having as few parts as possible, with only the essential material needed to guarantee the sustainability and viability of the product (De Vos, 2015).

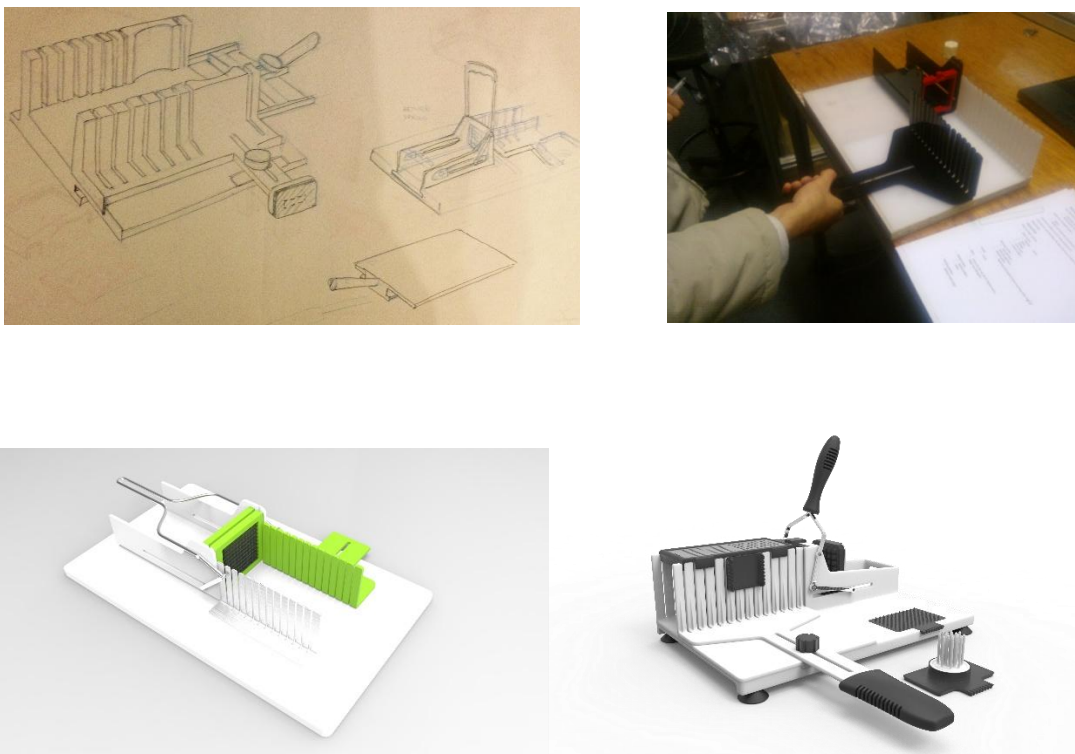
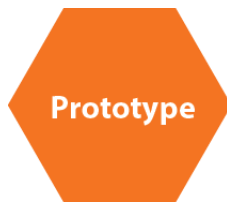


Figure 31: Concept Sketches, Spatial Prototyping, Initial CAD model & Final CAD model
(All images by author, 2014)

Design Phase Case Progression: Second Iteration



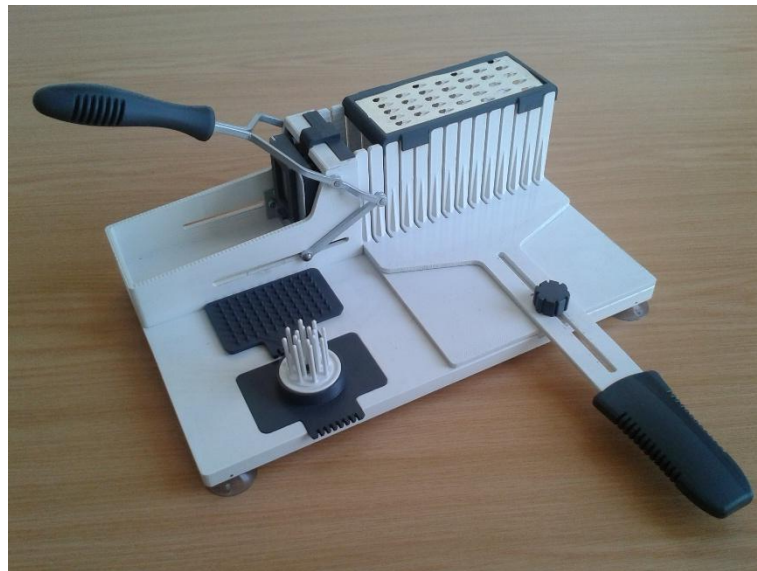
The first physical prototype of this design was then created for initial testing and inspection (fig 32). It was decided that outsourcing the prototyping process rather than using the universities' internal firm, the AMTL (Advanced Manufacturing Technology Laboratory). This was the most appropriate option, since the team had already experienced first-hand the complications of these interactions (Ibid.), which had left the team with a sense of confusion about the way that the AMTL operated as a business, and how it would be used effectively (Broodryk, 2015). It seemed apparent that they did not operate as a business but rather as research laboratory and that the process of using them in a business sense was new to everyone involved, which meant there were no clear procedures, rules or roles (Ibid.).

An outside company was approached to produce the prototype but it soon became apparent that with the fast approaching deadline of the project, that using an external business would take too long given the required university procedures (De Vos, 2015), which included obtaining three quotes from registered companies. The selected company would then have to be added to the university's vendors list before the quote could finally be approved, and work initiated (Ibid.). Despite the team's earlier misgivings, it was decided that the AMTL would create the prototype, with their in-house artisan stepping in to manufacture it, primarily through three-dimensional printing. He was able to do this by using the CAD drawings and files developed by the team.

The AMTL did not provide a quote until after producing the object and as a result ended up going far over the available budget of R60,000. Their charge was R174,000 of which they discounted

Design Phase Case Progression: Second Iteration

40%, making the final price R92,000. In one decision they made to try and save time, an amount of R15,000 was spent on a process that did not work (Coetzee, 2014).



*Figure 32: First Prototype
(Author, 2015)*

Test

Due to the model being 3-dimensionally printed the structural integrity of some of the parts could only be partly physically tested. Many features of the prototype at this stage still require considerable continued development before it will be suitable for user testing and subsequently for industrial manufacture (Broodryk, 2015). However, this product was showcased and presented at two events where it received positive feedback from the public.

A visual brand identity (fig 33) to support the product range was developed by one of the students, as well as a specific logo for the design team (fig 34). These were used to enhance the presentation of the prototype.

COOKABLE
Food Preparation Aid

*Figure 33: Cookable Logo
(Author, 2014)*



*Figure 34: Team Logo
(Author, 2014)*

Figure 35 illustrates a summary of the entire process examined above, from the need that arose, through to the redesigned prototype.

CS - Civil Society

I - Industry

U - University

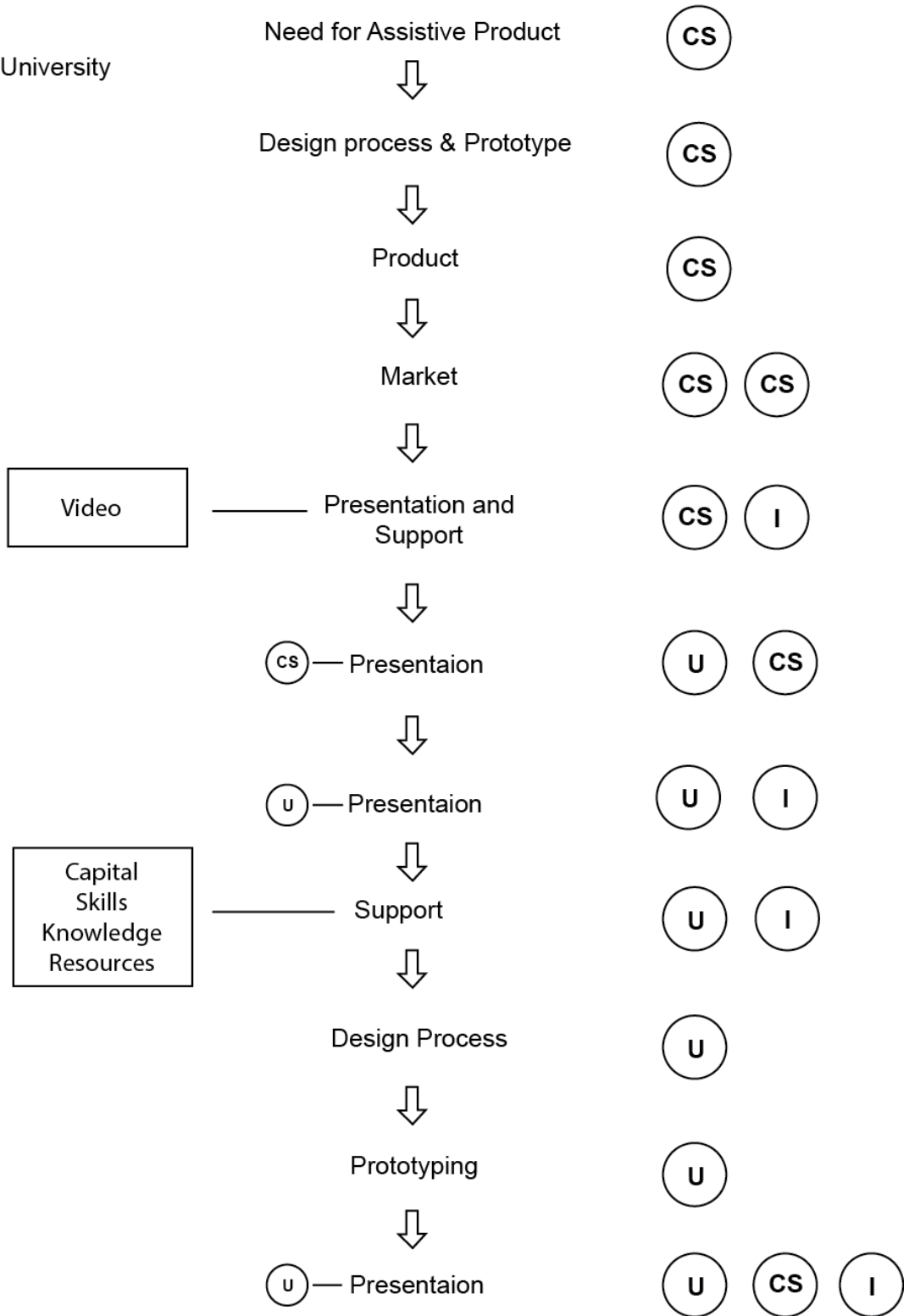


Figure 35: CookAble process summary

(Author, 2015)

4.3.3 Case 1: Environment Factor

Adapting from the general environmental conditions used in the *human-machine* model, the topics explored here relate to the environmental conditions associated with the process of developing an idea. These have been divided into topics (fig 36) relating to the collaboration, tools, funding and knowledge involved with the progression of Mr Brink's idea.

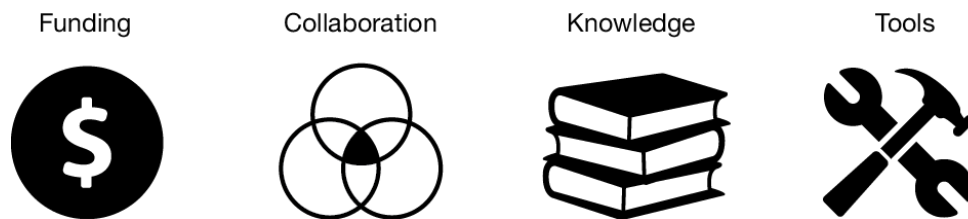


Figure 36: Symbols relating to the Environment Factor
(freepik, 2015)

4.3.3.1 Funding

4.3.3.1.1 The Interaction with Civil Society



Mr Brink believed the response he had of directly interacting with individuals seeking his products went very well as he sold more than a hundred sets initially, at a price of R1,000 each. Material prices rose so he raised the price up to R1,500 but this had no effect on sales, people still bought it (Brink, 2014).

In 2010, one of Mr Brink's friends saw all the work he was doing in trying to get the project mass produced and mentioned that the Ackerman's potentially had funding for such projects and that he should approach them. He called the Ackerman's Secretary and arranged for a meeting with Mrs Wendy Ackerman (Ibid.). He explained that although Mrs Ackerman did not specifically know how to help develop the project further she arranged for him to be recorded

demonstrating and explaining his inventions on a video, which is now included along with his kits.

4.3.3.1.2 Mediation through the Educational Environment

A CPUT employee from the Advancement department, which deals with university partners and the corresponding exchanges of monies and services, had met with Mrs Ackerman regarding bursaries for students at CPUT. At this meeting she told him about Mr Brink's project, and passed on the video, asking if he knew anyone who could help develop it (Lombard, 2015). A meeting was then set up with Mrs Ackerman and the university's Professor of Design where they arranged for the project to be sponsored through the *Ackerman Educational Fund*. This allowed the money to be simultaneously used to further the education of some of the students who were to take part in the project (Lombard, 2015). This initial money was distributed towards a prototyping project fund and bursaries for three willing graduate level Industrial Design students, who were each given specific project roles by the professor.

4.3.3.1.3 The Interaction with the Industry

In November 2013, a presentation was put together by two of the students to pitch the team's vision of the project to the donor for the appropriate funding. This presentation included the background to the project, what the team would be offering towards the development of the project, design intentions, reputation of projects that members in the team were involved with, and some initial research into similar pre-existing projects (Broodryk, 2015). From here, funds amounting to R155,000 were disbursed as R40,000 for two masters students each, to be split over two years, R15,000 for a bachelor student for one year and R50,000 for prototyping. Within one month these funds had been accepted and transferred from the Ackerman Educational Fund to CPUT (Lombard, 2015).

Soon after this, the 2014 Design Indaba, a prestigious design exhibition, took place. The donor was outraged not to have seen

anything about the *UD@HOME* project there (Lombard, 2015). The professor together with the employees from the *Advancements* office of the university arranged a meeting to explain to the donor why this was, thereby managing her expectations; here it was clarified that it had not been specified as an objective and that the redesigning process would take some time (M'Rithaa, 2014).

4.3.3.2 Knowledge

4.3.3.2.1 Input from Civil Society



Mr Brink was responsible for identifying and creating the initial objects that were rooted in a comprehensive understanding of what was required from his own personal experience. To do this he made use of simple tools and machinery to produce them using his own practical knowledge. He has 28 designs with patents and many more without patents that he still wants to create (Brink, 2014). He was also responsible for identifying the donor that would assist in funding the product's development to market.

4.3.3.2.1.1 Patents gained

In 2004, Mr Brink went to South Africa's patent office in Pretoria. After sitting in the patents office for weeks, he got all 28 of his products patented without paying for a patent lawyer (Brink, 2015). When people at the office saw what he was making and why, they were inspired to help him as much as they could, because of the nature of the project. According to Mr Brink, the patents could have cost up to R10,000 for a single design. He managed to patent all 28 for R3,000 in total (Ibid.).

4.3.3.2.2 Investment from Industry

The donor saw the potential of the project to help other disabled people in the same or similar situation and was willing to donate funding for development. She had the foresight to get the content

filmed so that in future it could be related to a third party that may know how to assist (Brink, 2014).

4.3.3.2.3 Input from the University

The university's employee from the *Advancement* office made the connection and interaction between the donor and the professor of design, thereby resolving the quandary of how the project could be developed (Lombard, 2015). The professor himself saw great potential in the project and was willing and excited to assist in its development (M'Rithaa, 2014).

CPUT then brought together the capacity to develop a more marketable product with this funding through the use of their facilities and students. This included:

- A group of five industrial design graduates
- A Professor of Universal Design - influential
- Use of rapid prototyping knowledge and facilities at the AMTL.
- Use of CAD/CAM knowledge and facilities at the PLMCC.
- Intellectual property by the Technology Transfer Office

Within the group of students that was being used, although they had had the same education in industrial design, they were given specific roles by the professor representing different understandings. These are as follows:

- Student A – Project Manager and Designer
- Student B – Designer and CAD Modeller
- Student C – Designer, CAD modeller and Graphic Material
- Student D – Marketing and Graphic Material
- Student E– Prototype Development
- Professor – Project Leader, Resources and Academic input

The general skills that each student brought with them were their product design education in research, drawing, computers and collaboration capabilities.

4.3.3.2.3.1 University's Intellectual property
Before going forward with the project CPUT had to create a partnership with Mr Brink so that they were now legally able to have rights to his ideas. To this end, Mr Brink gave the university permission to develop and potentially commercialise his ideas.

4.3.3.3 Tools



4.3.3.3.1 Utilised by Civil Society

To create the initial products Mr Brink used a range of different tools, these included primarily a handsaw, jigsaw, drill, drill-press, hammer screw drivers, an electric grinder and clamps.

After making the first prototypes and being happy with their quality, Mr Brink created jigs, with the assistance of an engineering firm, which would allow him to repeatedly produce the same exact units (fig 37). He had retired and therefore had the time to develop these products, and a space at the back of his garage (fig 37) was dedicated to making them (Brink, 2015).



Figure 37: work-space and Jig
(Author, 2015)

4.3.3.3.2 Utilised by the University

The university made use of a number of its resources in the development of the prototype:

4.3.3.3.3 Students' Input

The students were the driving force behind the progression of the project, equipped with drawing, computer, and prototyping skills.

The equipment and programs used included:

- Paper and pencils/pens
- Computers with specialised programs including:
 - Adobe Illustrator and Photoshop – graphic design programs
 - Catia and Solidworks – product design programs
 - Microsoft PowerPoint and Word – presentation and documentation programs.

4.3.3.3.4 University laboratory and Centre's Input

At the PLMCC, (Product Lifecycle Management and Competency Centre) the students worked on the computers and in the workshop space, which contained amongst others things, a:

- Laser cutter
- 3-dimensional printer
- 3-dimensional scanner
- Large working desks, with seats
- Cabinet of workshop tools
- Skilled workers
- Computers.

The AMTL was used once the model had been completely developed using the software program at the PLMCC. Among others, the tools included here were:

- 3-dimensional printer
- CNC (computer numerical control machine) machine.

- Skilled worker
- Laser cutter.

4.3.3.3.5 University Office's Input

The *Technology Transfer Office* (TTO) was used to ensure the legal procedures were correctly followed with regard to the intellectual property rights of the inventions and the monetary procedures required. Marketing and event management was facilitated by the communications office while the Advancements' offices provided the network of partners through which the project was found. Finally, the professor of design gave the university assurance of the project's progression and a credible figure in which the donor could place her trust.

4.3.3.4 Collaboration

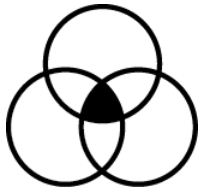
The table below catalogues the different parties involved in the projects development, their reasons for doing so and the specific input they were able to provide.

Table 5: Cookable Collaboration

Collaborators	Reason for collaboration	Input
Mr Brink	Develop his product, thereby carry out his vision to help others.	Initial knowledge, prototypes and vision.
Wendy Ackerman	Belief in Mr Brink's product to assist others in need.	Money
CPUT	Professor's belief in Mr Brink's product and the universities capacity to advance it. Relations department to acquire student bursaries and improve universities visibility and profile.	Professor and Students Facilities -TTO, AMTL, PLMCC - conceptual and physical development

(Author, 2015)

4.3.3.4.1 Principal Collaborators



At an organisational level, collaboration took place between CPUT, acting as facilitators in the projects development, the Ackerman Family Educational Trust, acting as sponsors/investors, and Mr Brink as the inventor (fig 38). This allowed the project to then be developed within CPUT.

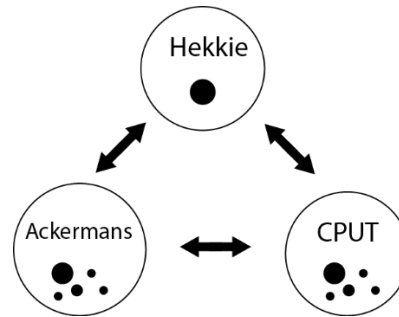


Figure 38: Collaborators

(Author, 2014)

4.3.3.4.2 Promotional Collaborators

Applications carried out by students and the university offices targeted at strategic events to gain visibility and attract potential sponsors, were successful, with the project being exhibited at the *Open Design Festival*; as a finalist in *The Better Living Challenge*; and as an exhibitor at the *Innovation Bridge* event, held by the government department of science and technology (fig 39) (for further information see appendix D). Although the project obtained visibility, no sponsors were found. The project was written up in an article by CPUT as well as exhibited by the university on World Disability Day, at an internally organised event.



Figure 39: Promotional collaborators

(Tyilo, 2014) (CCDI, 2014) (SARIMA, 2015)

4.3.3.4.3 Internal University Collaboration

Within CPUT the project was being developed by the team of student designers under the supervision of Professor M'Rithaa. Overseeing the spending of the capital invested by the sponsor, as well as the legalities of the intellectual property transfer, was the responsibility of the TTO. Two of the student designers were employees at the university in separate firms; one from the AMTL and the other from the PLMCC. These two students were strategically chosen by the professor so that maximum advantage could be taken of CPUT's product development network, namely: the AMTL for the use of their rapid prototyping facilities, and PLMCC for their CAD/CAM capacities (M'Rithaa, 2014).

Throughout the project's development, however, these departments were busy and the students who worked there had quite limited time to spend on the project as it was not officially the department's obligation (Broodryk, 2015). The PLMCC were able to allow one day a week for their student to work on the project, but the AMTL would not provide the other student with any time, unless they were paid for it. Figure 40 illustrates the different actors of the project within the university.

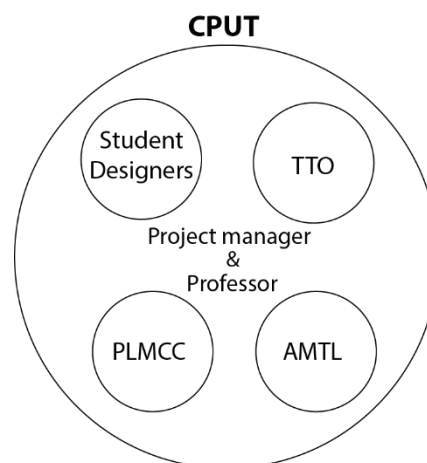
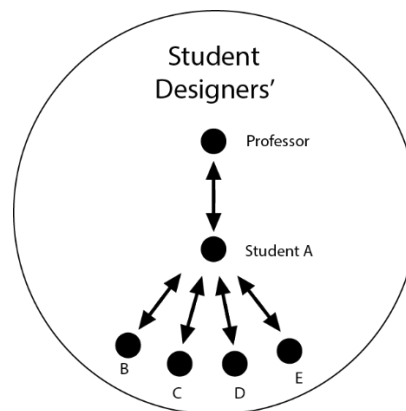


Figure 40: Internal university collaboration
(Author, 2014)

4.3.3.4.4 Student collaboration

Some months after the project had been funded there was little advancement, due to the initial project manager being unable to plan the project effectively, as he was too busy with his full-time employment. The professor chose to put one of the other students in his place to see if things would run better (M'Rithaa, 2014). This allowed for the project to move more effectively in the new hierarchy, consisting of the project manager interacting with the professor and directing the other students (fig 41). A bachelor of technology student was also later brought into the project to help developments, as this use of funding was agreed on by the donor (Lombard, 2015).



*Figure 41: Student Collaboration
(Author, 2014)*

4.3.3.4.5 Project management

A project management lecture was delivered by a CPUT representative explaining how to effectively manage and set deliverables and milestones (Lombard, 2015). This included listing everything that needed to be done, mapping the activities and personnel involved in the project and creating a chart estimating the time and money needed to progress to interim check points towards the final goal (please see appendix E and figure 27 for further insight). The role of project manager involved co-ordinating each member so that everyone understood where the project was

going, what they were meant to be doing and why, as well as setting deliverables, reporting to the professor, other firms and interacting with outside industry (M'Rithaa, 2014)

Three members made up the core team, working as a group to conceptually redesign the new product range. When deliverables set for members in this group were not met, the project manager had to approach the situation in order to determine what the problem was and how it could be corrected (De Vos, 2015).

The other two students in the group were approached separately by the project manager to achieve their specific project deliverables. One student was made responsible for overseeing the prototyping, which was occurring at his workplace and could be invoiced, while the other was directed to market the product by applying for events and competitions, as well as developing marketing and information graphics (De Vos, 2015).

4.4 Case Study 2: Iwisa Bag

The information for this case study was obtained through purely ethnographic research. The designer responsible for this product was interviewed over a period of several months to gain an in depth understanding of her process and the environment within which this took place. It examines a product that was developed by a single individual within civil society, with no assistance from the government or a university. The product is not as technologically advanced compared to the other case studies and was designed and manufactured almost entirely by the inventor. All information regarding Mrs Ramofolon and her design process was acquired over five separate unstructured interviews.

Figure 42 illustrates a brief summary of how this idea developed, and table 6 highlights key aspects of its progression.

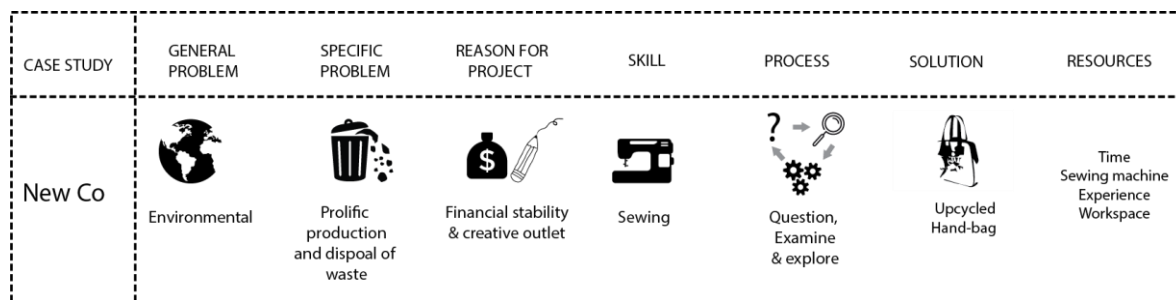


Figure 42: Newco Summary

Table 6: Case 2 – Context overview

<u>Individuals Drive/Need</u>	<ul style="list-style-type: none"> - “ “Doing something others wouldn’t dream of, achieving the impossible.” ” - Reduce pollution. - Provide for herself and her son. - Creative outlet
<u>Individuals Passion</u>	<ul style="list-style-type: none"> - Sewing - Creative exploration
<u>Problem</u>	<ul style="list-style-type: none"> - Pollution. - Income.
<u>Research</u>	<ul style="list-style-type: none"> - Secondary school education about pollution
<u>Tools</u>	<ul style="list-style-type: none"> - Sewing machine, employees, investor, space, creativity.
<u>Solution</u>	Alleviate the strain on the environment by up-cycling waste into designer products.

(Author, 2015)

4.4.1 Case 2: Human Factor



*Figure 43: Mrs Ramofolon
(Author, 2015)*

4.4.1.1 Background

Mrs Ramofolon (fig 43) has been nicknamed “ “The dumpster diving diva” ”, due to her occupation of collecting waste materials and up-cycling these into new products (fig 44). Up-cycling is the conversion of waste materials into completely new products. Her profession is to create custom garments through the art of sewing. She has two specific avenues of specialty that she is working on developing.

- She is the founder of her own start-up company named GORD (garments of rare distinction), registered in 2013, which has been producing approximately 10 pieces of Dutch Wax garments per month.
- She is also the designer of a constantly growing range of products made from up-cycled materials. Her range includes bags, backpacks, I-pad sleeves, wallets, passport sleeves and pencil cases.

Mrs Ramofolon’s vision for the up-cycled product range is to create awareness about environmental sustainability through the production of high quality up-cycled garments.



Figure 44: Up-cycled production
(Author, 2015)

4.4.1.2 Knowledge

Mrs Ramofolon has been trained by professionals in the trade of sewing and has developed her own unique style. Through her secondary education she became aware of the detrimental widespread effects of pollution and decided she wanted to change this in any way that she could (Ramofolon, 2014).

She began sewing in Bloemfontein in 2007, when a lady with a sewing machine agreed to assist her. This lady's name was Mamsi and she was well known in the garment industry there. She became Mrs Ramofolon's mentor, allowing her to use her equipment and giving her a sewing machine. Mamsi, provided Mrs Ramofolon with work and helped her develop her own unique skills using an industrial sewing machine. Unfortunately Mamsi passed away that same year. The workshop was taken over by Mamsi's mother, who was also well known in the sewing industry. She then became Mrs Ramofolon's new mentor, giving her full use of the space and machinery any time free of charge because of the prior relationship with her daughter. Mrs Ramofolon was also provided with extra paid work by the mother, sustaining her livelihood, giving her faith in her ability and allowing a space where she could grow and develop her skills.

4.4.1.3 Project Motivation and Inspiration

Mrs Ramofolon recalls Mamsi's very distinctive style, how it had no boundaries and was always pushing the envelope of what was possible. This gave Mrs Ramofolon

great inspiration and motivation as an artist, believing that Mamsi was a genius in her field.

In 2013 Mrs Ramofolon started making jackets from Dutch Wax, believing that these garments are something unique. The reason for this was an instinctive “gut feeling” that they would be successful. She believes that this is why she has been successful so far.

When Mrs Ramofolon was 12-years old she learned about pollution and how energy is conserved in her science classes. This touched her on an emotional level, as she realised that she was part of the problem. As a result she developed a guilty conscience around waste creation. Later, when she was applying for university she decided to apply for environmental science in Bloemfontein but was not accepted. She opted for environmental science because of Francis Rangoane, an environmental scientist, whom she looked up to. She had only a few interactions with him, but nonetheless, he made a big impression on her environmental views. She explained how she really enjoys her current work and gets immense satisfaction out of it, attributing it to these few interactions. As a child she was always free to do what she wanted and her mother explained things she did not understand kindly; she attributes her explorative style to these early open and accepting exchanges. Finally Mrs Ramofolon expressed how satisfying she finds her work and that this keeps her inspired to continue.

4.4.2 Case 2: Product Factor

4.4.2.1 Project Catalyst

Mrs Ramofolon wanted to develop a new product for her up-cycled product range aimed at a more affluent market. Her intention for the bag was also to “do something fun”, clarifying that there has to be some sense of fun that drives the process (Ramofolon, 2015).

4.4.2.2 Invention

The *Iwisa Bag* is a quality designed product using essentially only waste material for its production. A maize meal bag, together with other discarded and scrap materials are constructed to form the final product (fig 45). Although the majority of her product is made from waste, she has to buy some materials from retailers, such as the zippers, rivets, leather offcuts and glue.



Figure 45: *Iwisa Bag*

(Author, 2015)

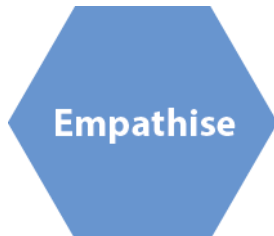
4.4.2.3 Innovation

Jugaad Innovation is the name given to the creation of objects through flexible improvisation (Bonala, 2015). Mrs Ramofolon explained that Instead of reinventing the wheel when it came to creating new items, she was more interested in being more creative with the way that they were made. The innovation therein, she believes, lies in being able to create everyday objects out of waste that are both attractive in terms of their artistic merits and also maintain a high standard of quality.

She explained how using waste as the material for production meant the availability of the product depends on the consumers' output of waste, as opposed to creating products from virgin materials, which are then consumed and turned into waste.

Since the source of material is inconsistent, there is no certainty that the range will continue, and Mrs Ramofolon therefore collects as much as she can, when she can (Ramofolon, 2015).

4.4.2.4 Design Process



As stated above, the reason for the creation of this product is in part a result of Mrs Ramofolon's secondary education; understanding the harmful effects of pollution and wanting to counter these effects through her trade. She recognised that maize meal was a staple ingredient of South African diet and therefore chose to develop this bag as there would be a ready source of waste for production.



Mrs Ramofolon has always been fascinated with bags and had made many others before this one. She described how everyone has a bag, and therefore the starting point for this product was “bags, bags, bags” (Ibid.). For the Iwisa bag she explained that she was targeting a high end market. Thus, to ensure her product's quality, she would adhere to a specific standard and she decided to use *Adidas* bags as a comparison for competition (fig 46).



Figure 46: product competition
(SportsDirect, 2015)

Ideate

A variety of fabrics, methods and shapes, were tested in the development of previous bags and Mrs Ramofolon believes the results of these products also played a part in the development of the Iwisa bag. She explained how she “loved the shape” of the design and the “punchy” graphic design of the maize meal bag.

Prototype

Initially she developed the bag using the *White Star* maize meal bag, as she liked its graphics (fig 47). She explained that while it looked good, the quality of the White Star packaging itself was poor, and as a result she began using the Iwisa brand. Iwisa was also the most popular maize meal and therefore the most easily obtained.



Figure 47: Initial Prototype
(Gray, 2014)

To arrive at a quality equal in durability to that of an Adidas bag she layered the inner surfaces with discarded curtain blinds and incorporated PVC banner into the design. She explained how the product had been improved upon through successive models, moving through incremental adjustments depending on what she identifies (Ibid.). There is no packaging for her products unless the client insists on it. She

clarified that the whole philosophy behind her brand is to remove waste from the environment and that packaging for her products was unnecessary and counterproductive to the objective.



Mrs Ramofolon has been testing her up-cycled product range at several events over the years. Her biggest exhibit was at the Baba Indaba in 2010. The FIFA world cup in 2010 also provided her with a platform for testing her products and seeing how they performed. She believed they sold reasonably well at these events. Her production up to this point has always been small-scale, although her goal is full mass production, with her products being available in every country throughout Africa (Ibid.). Her work has featured in a number of articles such as *Cut from the African cloth by Cape Towner*, *What would Harry buy?* and *House and Leisure* in 2013. It has also been photographed by Ed Suter, a distinguished photographer (Ibid.). She has been interviewed about her up-cycled articles by *Cape TV and African Image* in 2014, so she believes her products have been marketing themselves. She also believes that her past successes have been her feasibility study through showcasing her products and having interviews in blogs and pop up shops, demonstrating her products' market potential. Several shops in Cape Town are waiting for her product so she knows that there is a demand for them.

Figure 48, Illustrates a summary of the entire process that has been explored in this study:

CS - Civil Society

I - Industry

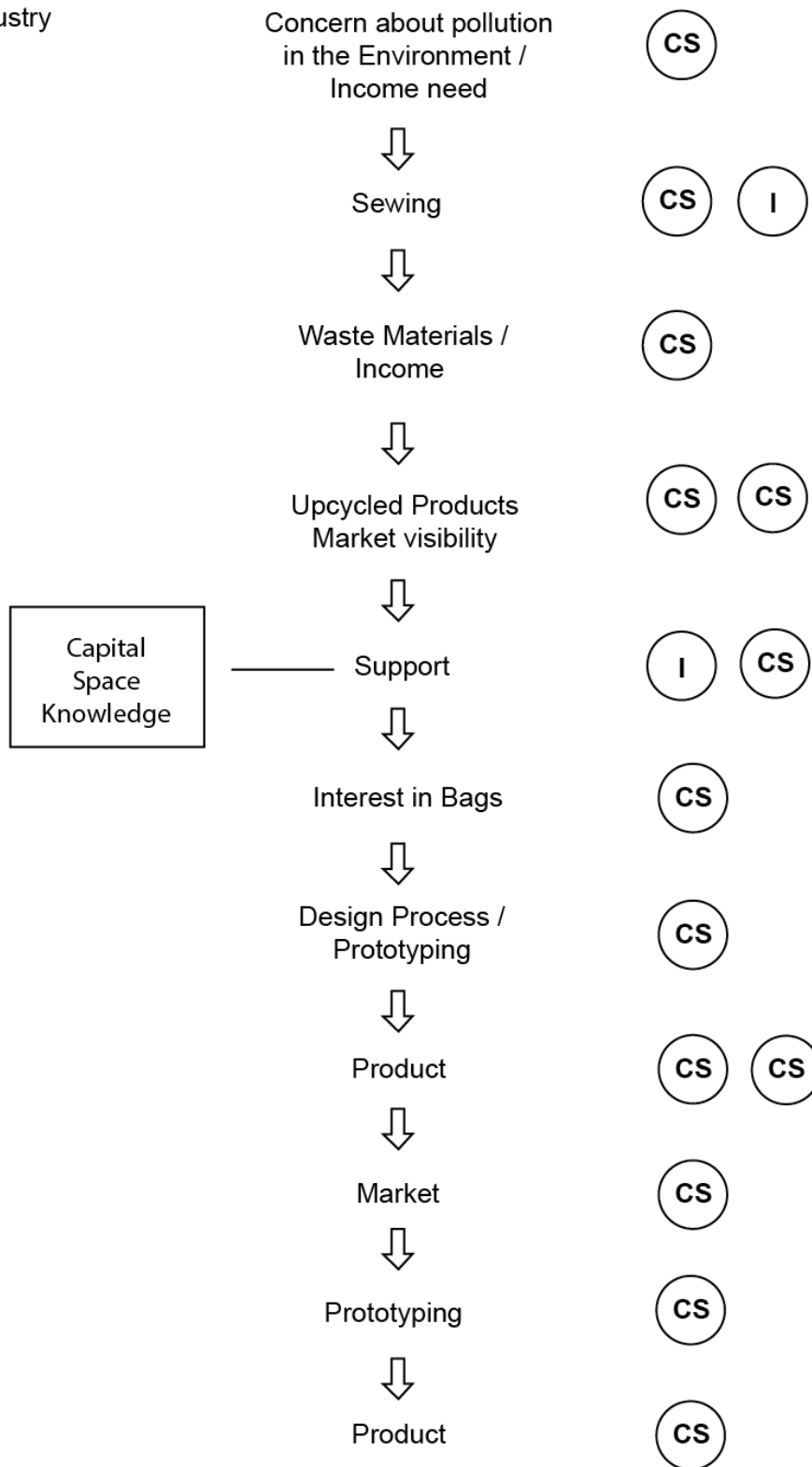


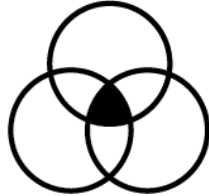
Figure 48: Iwisa bag process summary
(Author, 2015)

4.4.3 Case 2: Environment Factor

Funding



Collaboration



Knowledge



Tools



4.4.3.1 Funding

4.4.3.1.1 Civil Society



Mrs Ramofolon was initially able to support herself as a professional seamstress working under her mentors in Bloemfontein, whilst developing her style and skills. Due to the fact that her products are made from waste, there was little capital required for raw materials. She keeps in the back of her mind what may be needed as the supply is inconsistent, so she collects as much as she can when it becomes available.

4.4.3.1.2 Industry

After an interview on her product range, she was approached by an investor who was impressed with her work and willing to provide funding to expand her business. Although she was then responsible for being proactive about spending this money, she clarified that she had to be careful how she spent it. On purchasing small items such as materials, this was not especially an issue and she would generally interact only with her investor's accountant, who was well informed of their partnership and how to disburse funds appropriately. But for more expensive items, such as a sewing machine, discussion with her investor was required.

Several retailers in Cape Town stock her product and she is paid by these companies at each month end.

4.4.3.2 Knowledge

4.4.3.2.1 Civil society



Mrs Ramofolon was responsible for the complete process of designing and physically prototyping the Iwisa Bag. She was able to accomplish this through the understanding and skills she had gained over her many years of training and experimenting on other products.

Feedback from individuals such as her friends and clients helped her to refine her idea and align the product with these viewpoints

Over the years Mrs Ramofolon has also been able to build up a network of places and people from where she is able to retrieve the materials she uses for her product, as well as retailers that will stock it.

She explained that the commercial companies whose waste she uses for her products (such as the Iwisa bag) run Corporate Social Investment (CSI) projects, which have funds specifically to aid projects like hers. She went on to explain that it was therefore also in her interests to develop relationships with these companies in order to secure funding for her business, since she was using their waste. She believes that what is unique about her business model in this respect, is that it is not restricted to making any one specific product, or using any one brand; her objects have explicitly been made with used products. A competitor, the PPC bag (fig 49), uses only virgin materials to make a single product and is therefore less environmentally sustainable (Ramofolon, 2015).



Figure 49: PPC Bag
(Wendren, 2012)

4.4.3.2.2 Industry

The individual who invested in Mrs Ramofolon's business saw the potential of her work and believed that it could become a successful business. As a result he was willing to fund its development and become a shareholder. When needing to scale up her production, she was then able to find and employ other skilled individuals to assist her with this task.

Retailers that stock her products have seen the demand for them and are therefore willing to stock more of her products (Ramofolon, 2014). A local organization in Cape Town, called the Cape Craft and Design Institute (CCDI), which offers product, business and market support free of charge to entrepreneurs also helped Mrs Ramofolon. In 2008, when Mrs Ramofolon moved to Cape Town, she became a member of the CCDI. They gave her advice for expanding her business, by providing her with an assessment on the quality of her trade, what market to tackle, and the feasibility of the undertaking. She also attended a number of workshops there to gain a better understanding of how her trade is positioned in the Cape Town context.

4.4.3.3 Tools

4.4.3.3.1 Civil Society



The space, machines and materials, together with the paid work supplied by her initial mentors, created a supportive environment where she was able to develop her profession.

The tacit knowledge and skills embodied by Mrs Ramofolon and which she gained through her apprenticeship with her mentors, as well as her own personal experience within industry, have been an essential tool in the development of the Iwisa bag, as they have given her reference points against which to position herself.

Her drive to provide financially for herself and her child, to create something unique and to tackle an issue which for her has an emotional charge, are intangible elements that have fuelled the process. She believes she can personally make a difference, which then allows her knowledge and skills to be actualised.

Her current work location in the city, which has been provided by her partner at a reduced rental, is a valuable resource, as there is now enough space to work comfortably, as well as store her materials and machines. It is also valuable as most of the people and places that she needs to interact with for her business are situated in town so it is much easier to access them. However, the space has no natural light or ventilation and the electric lighting that was there appeared to be insufficient (fig 50). At the time of the visit to the premises there had been a power outage and using a power-generator had produced fumes which almost made Mrs Ramofolon fainting as a result.



Figure 50: Mrs Ramofolon's Current Work Space
(Image by Author, 2015)

Mrs Ramofolon is in possession of three industrial sewing machines which are used to produce the bags (fig 51). These are operated by herself and two employees.

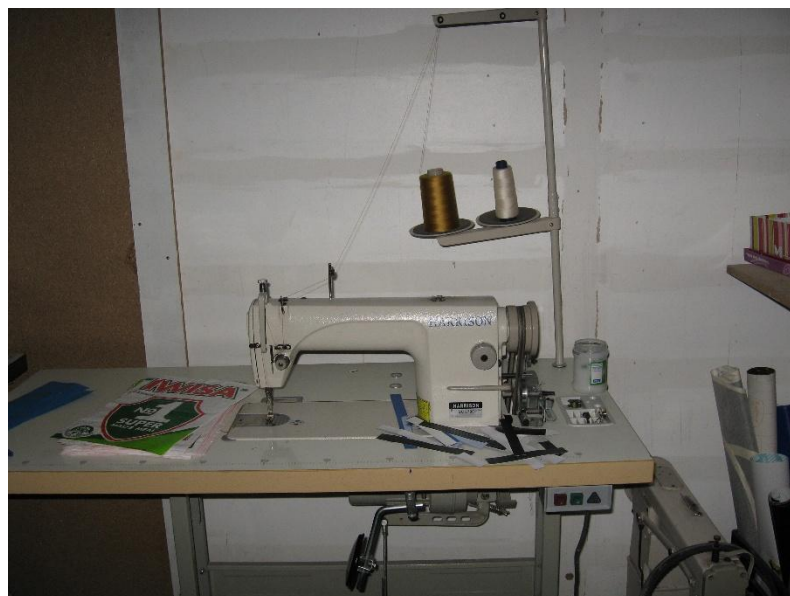


Figure 51: Sewing Machine
(Image by Author, 2015)

4.4.3.3.2 Industry

Waste material is acquired from several suppliers around Cape Town free of charge (Ramofolon, 2014). These suppliers are invaluable as

they provide the business with the raw materials needed for production.

Showcases, reviews, interviews, retailers and pop-up events have allowed the public to interact and give feedback on her products. It was a result of one of these interviews that her up-cycling company that she acquired her partner. Many of these connections have been allowed through the networking capacity of organizations such as the CCDI, which proves to be a valuable resource by connecting relevant parties. These have included high profile events such as the *Make it new - see.learn.do* exhibition at Cape Town Stadium which was a *World Design Capital* recognised event.

Her investor's input has been influential in the company's growth as she has been able to employ two additional sewers, purchase another sewing machine and establish suitable work premises to expand her business. Mrs Ramofolon explained that her investor is often very busy with other work so she has had to learn how to take control of certain business situations and only approach him for help when she is clear on what exactly is required.

The two gentlemen full time sewers allow production to continue at a steady pace while Mrs Ramofolon manages the business more efficiently and works on new designs (Ibid.).

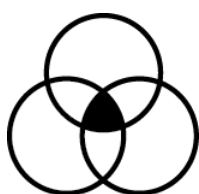
4.4.3.4 Collaboration

The table below catalogues the different parties involved in the projects development, their reasons for doing so and the specific input they were able to provide.

Table 7: Case 2 – Collaborators

Collaborators	Reason for collaboration	Input
Mrs Ramofolon	Develop her products and business, thereby carrying out her vision of creating awareness about waste disposal and earning a living.	Vision and drive to create a sustainable business. Product range. Complete design and skill set.
Mentors	Assist in training Mrs Ramofolon whilst using her to get sewing work done.	Skill transfer. Space and machinery. Money for work done.
Partner	Own 75% of the company. Assist in the company's growth.	Capital. Business location and reduced rent. Mentorship
CCDI	Develop capable people and build responsible creative enterprises.	Product, marketing and business support. Life-coach.
Employees	Salary.	Sewing
retailers	Business	Sell products
Waste Suppliers	Help Mrs Ramofolon with her vision	Waste materials

(Author, 2015)



4.4.3.4.1 Civil Society

It was due to Mrs Ramofolon's initial mentorship that she was able to develop her skills as a sewer whilst making a living at the same time. This was made possible through the space, machinery, materials and knowledge provided by her mentors. In return she was able to assist them with producing their products.

4.4.3.4.2 Civil Society and Industry

The individual who offered to fund Mrs Ramofolon's business of up-cycled products did so under the condition that he would then

own 75% of the business, leaving her with a 25% share (Ramofolon, 2014).

Mrs Ramofolon agreed to these conditions because she saw it as an opportunity to expand the business far beyond what she could do alone. With this funding, she was able to move to a bigger location in the centre of town, allowing improved storage, work space and networking possibilities. The capital also allowed her to take on two full time employees to handle tasks that she would otherwise have had to do on her own, thus freeing her up to manage the business and work on new creative projects. It also provided her with the security not to have to worry so much about the financial consequences of making important business decisions previously not possible, such as purchasing a new sewing machine (Ibid.). Finally her investor is a business man and has been able to assist her to understand how to optimize her revenue, such as by selling direct to the public, instead of going through retailers, which she is now beginning to do.

Mrs Ramofolon has identified several suppliers of waste materials throughout her time in Cape Town. Because these materials are often recycled or dumped at a rubbish site, suppliers generally give these to her free of charge. Through these relationships she is able to maintain a relatively stable stock of raw material to work with.

Retailers that stock the up-cycled products have expressed their enthusiasm to continue selling them, as they have experienced a demand for these items.

4.4.3.4.3 Civil Society, Government/University

CCDI were able to assist Mrs Ramofolon through their networking capacities to organize interviews and pop-up stalls around Cape Town, as well as access to workshops which shed light on the city's design industry. One of the things Mrs Ramofolon found

most helpful about their support was the provision of a life-coach with whom she could talk about anything at all. This allowed her the space to reflect on the bigger picture of how her personal life and business related to and interacted with one another.

4.5 Case Study 3: Cohere Biofeedback Application



Figure 52: Cohere Logo
(Author, 2015)

The information for this case study was obtained through auto-ethnographic research, as it was carried out by the author of this thesis. As such, it will involve a personal interpretation of the explored findings using qualitative and quantitative data (for more information please refer to Chapter 3: *Methodology*).

Information was obtained primarily through first-hand experience with the research material. The study examines a product that was developed through CPUT and was awarded funding for its development by a government organisation. The product is relatively technologically advanced in comparison to the previous two case studies. Figure 53 illustrates a brief summary of how this idea developed, and table 8 highlights key aspects of its progression.







CASE STUDY	GENERAL PROBLEM	SPECIFIC PROBLEM	REASON FOR PROJECT	SKILL	PROCESS	SOLUTION	RESOURCES
cohere	 Psychological	 Poor quantity and quality of sleep	 University Degree	 Research & design	 Question, Examine & explore	 Software driven device to aid winding-down process before bed	Time Purly Conceptual Programs Internet Computer Journals

Figure 53: Summary of initial Design process
(Image by Author)

Table 8: Case 3 context overview

<u>Individuals Drive/Need</u>	Create a thesis for bachelor degree: developing a product for chosen problem area
<u>Individuals Passion</u>	- Personal involvement in choosing problem: interest and knowledge in mindfulness meditation and sleep - Creative exploration
<u>Problem</u>	Getting the right quantity and quality of sleep
<u>Research</u>	Winding down, waking up, sleeping, mindfulness, biofeedback, pre-existing products and applications.
<u>Tools</u>	- Research and design capacity - Time (4 months uninterrupted)
<u>Solution</u>	A conceptual application-driven biofeedback (interacts with heart rate) device, designed to facilitate individuals waking up, winding down and relaxing.

(Author, 2015)

4.5.1 Case 3: Human Factor



Figure 54: Mr Wegmershaus
(Author, 2013)

4.5.1.1 Background

Mr Wegmershaus (fig 54) is a Bachelor of Industrial Design graduate and current Masters Design student. He thus has the educational grounding in what it takes to develop an idea from concept to production. He has had an interest in mindfulness meditation and has been practicing this technique for many years.

His vision for the project was to be able to help people become more mindful in their daily lives. Specifically, it focused on assisting people who have trouble falling asleep to wind down effectively before bed, through a product-based biofeedback interaction. This interaction was conceptualised to provide an environment that is conducive for winding down, whilst simultaneously facilitating users to learn how their physiology affects their mental state and vice versa.

4.5.1.2 Knowledge

Through personal interest and application Mr Wegmershaus has gained an in-depth understanding in the field of mindfulness, attending several teachings and courses. He has also suffered from insomnia and depression throughout his early adult years, which ultimately lead to his focus on this specific problem.

In his adolescent years, Mr Wegmershaus gained an understanding of how to build concrete structures by designing and building a skate park with his peers (fig 55).



Figure 55: Built Skatepark
(Author, 2015)

This led to an interest in design and throughout his university years he received an education in three-dimensional/industrial design. This included:

- History and theory of design
- Drawing: shading, technical drawing, perspective drawing, graphic layouts and computer integration
- Materials: joining methods, qualities and production processes.
- Hands-on material manipulation: wood, plastic, metal, cardboard, paper and foam.
- Conducting literature and graphic research and applying findings.
- Conceptual drawing.
- Two-dimensional computer graphics.
- Furniture design and manufacture.
- Deconstruction and redesigning of mass produced objects.
- Use of three-dimensional computer aided design programs (moving from paper to digital).
- Biomimicry: Using nature's principles to design objects and systems.
- Interaction design: design of computational and electronic objects/interfaces.
- Identifying and Integrating brand identities into a product.
- Material selection, ergonomics and anthropometrics.
- Product identification, development, manufacture, marketing and sales on mass.
- Academic research and conceptual integration.

4.5.1.3 Project Motivation and Inspiration

Mr Wegmershaus used his difficulty in falling asleep and waking up as the inspiration for this project. Through in-depth academic research into these topics, he was then able to explore and identify solutions and knowledge that already existed and identify gaps for potentially new aids.

Mr Wegmershaus's awareness that this research and the intended product designed from it would potentially be able to help other people facing the same or similar situation, was a steady motivator and inspiration for the student.

He was sure that mindfulness meditation would coincide with the topic of aiding the winding-down process due to his experience in finding it so beneficial in his own life. Through research, he was able to strengthen this assumption into a credible argument.

The research study was undertaken to determine whether a product would be able to assist individuals who have difficulty in the process of going to sleep. People do not always have a method of winding down before going to bed, yet this is an essential step required before sleep (Morley, 2013). To be able to fall asleep, a process known as cognitive deactivation must take place, which transfers the individual from a state of verbal, goal-orientated thought processing to non-linear abstract forms of consciousness (Lundh, 2005, p. 32). Mindfulness coupled with breathing techniques and visualisations has been linked to cognitive deactivation and bringing about a state of deep relaxation that is conducive for sleep (Villani & Riva, 2008, p. 9). People who have difficulty with the process of cognitive deactivation may therefore be helped to wind down through assistive technologies and a mindfulness-based interaction.

Electronic biofeedback is an interaction between man and technology that accommodates the ability to merge internal bodily functioning with external perceptual stimuli. Through assistive devices, individuals are potentially more able to regulate their biology in accord with the required relaxed state in order to sleep (Peira, Pourtois, & Fredrikson, 2013, p. 4).

4.5.1.4 Vision

Luciano's vision is to make people more aware and educated about the importance of getting the right quantity and quality of sleep and how to do so. To educate people and create more awareness of the importance of practicing mindfulness in one's daily life.

4.5.2 Case 3: Product Factor

4.5.2.1 Project Catalyst

During the 4th year of the industrial design course at CPUT, students are asked to identify any problem of their choosing and through research, design a product-based solution. The objective of the project was to produce a thesis that would provide insight into the selected problem and thereby identify the most appropriate potential solutions. One specific product design is then developed using this academic research. The final design was a fusion of both the academic findings from the research and the inventor's personal experience in mindfulness meditation. The solution did not have to be in the form of a final working prototype but could be entirely conceptual, provided it was feasible with current processes and technologies.

4.5.2.2 Invention

Cohere is an application-driven biofeedback device (fig 56) developed to promote mindfulness while assisting with the winding down period before bed. It interacts with an individual's breathing and heart-rate-variation by projecting images and sounds that relate to these changes.



Figure 56: Product concept

(Author, 2013)

4.5.2.3 Innovation

Through Mr Wegmershaus's research into the subject in the fields of mindfulness and biofeedback products, products oriented towards helping people mindfully wind down before bed and wake up appear not to have been extensively explored.

Through the application of specific requirements for the audio and visuals projected through the device, the most appropriate environment is potentially provided for winding down. In this way the solution is a novel innovation as it appears not to have been explored previously (see ideation – 4.5.2.4).

The purely conceptual nature of the project led to innovative new technologies being proposed for the final design.

4.5.2.4 First Design Process:

Below is the process the student followed in the development of the initial conceptual product. This idea later received funding and began a second round of development.

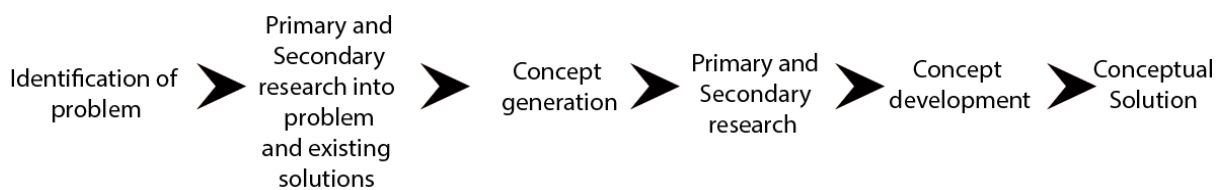
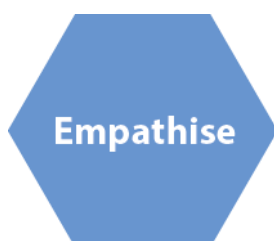


Figure 57: Initial Design Process

(Author, 2013)

Design Phase

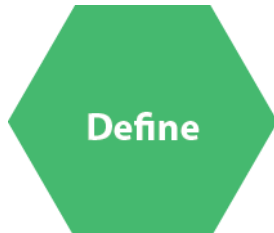


Case Progression: First Iteration

Mr Wegmershaus decided to investigate the problem due to his personal difficulties with the subject matter. Initially the problem chosen was for how to help individuals who have difficulty with the waking up process, as this was an area that he had found particular personal difficulty with. After developing a proposal for this subject matter so that he would be able to continue this thesis, Mr Wegmershaus changed course and developed a whole new proposal to assist the process of falling asleep instead. This was because, through

Design Phase

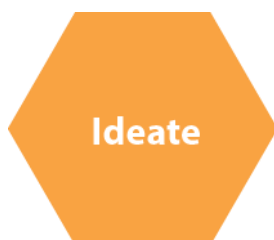
Case Progression: First Iteration



his initial research he discovered that one of the primary reasons for having difficulty waking up is due to incorrect sleep practice. He therefore reasoned that if he were to address this, the former would automatically be alleviated.

The initial research took the form of primary and secondary data collection and analysis through on-line academic reviews; the student also immersed himself in the context of a sleep clinic, where he gained valuable insight from a professional sleep analyst and psychologist. This initial research allowed a specific problem and sub-problems to be defined and focused on, as there was now sufficient data to draw upon. Further secondary and primary research provided sufficient ground to then begin hypothesising potential solutions. A specific focus was chosen as the most viable option to explore a product-based solution: how to aid the process of winding down before sleep.

This specific context was decided upon as a result of product reviews, online surveys, focus group discussions, interviews and auto-ethnographic research carried out to determine what people found to be their biggest problem with going to sleep. The majority of responses showed that slowing down thought processes and allowing enough time to wind down were the main sources of difficulty. This led to three main concepts being developed in line with these findings.



The knowledge gained through the primary and secondary studies allowed for an informed conceptualisation of the product throughout the design process. All of these factors combined to inform a list of requirements. Once these concepts were in place, the application-driven biofeedback design was selected as the most promising.

Design Phase

Case Progression: First Iteration

A range of factors influenced the design decisions made for both the physical object itself, as well as the process that the applications would follow in order to create the desired effect. These included how the user's body would be positioned, the ergonomic interactions between the user, the physical product and the application video output.

Through concept drawings, exploring what technologies would be appropriate and how these compact electronic products would be assembled, the idea started to progress from the purely conceptual towards the industrially possible (fig 58).

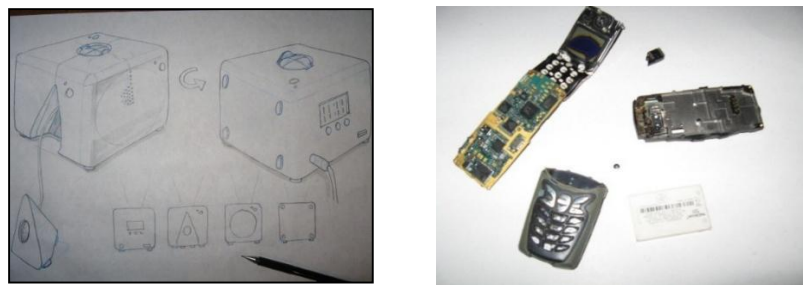
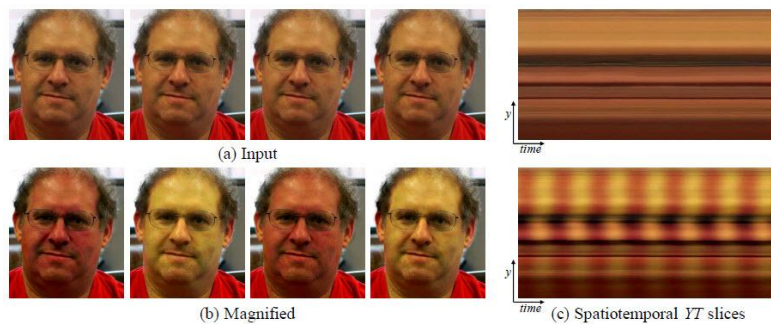


Figure 58: Illustration of initial concept & Electronic exploration

(Image by author)



Design Phase

Case Progression: First Iteration



Figure 59: Proposed tracking and monitoring software, Micro projector, Tamarisk 320 thermal Camera & visual examples of software application

(fine art america, 2013) (Barnett, 2013) (Jardine, 2013) (McKeegan, 2008)
(MIT, 2013) (Author, 2013)

Prototype

Since the project did not have to be in the form of a final working prototype but only a thesis and the technical drawings required to make the object, no physical prototype was made, apart from a simple block model built in order to demonstrate the object's size (fig 60).

Design Phase

Case Progression: First Iteration

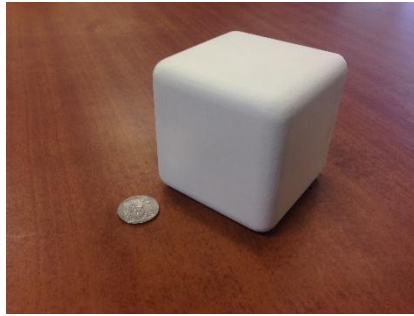


Figure 60: Block Model
(Author, 2013)

Although no physical model was made, a virtual three-dimensional model was created in order to demonstrate the aesthetics of the product, how the controls would operate and how the different technologies and parts would fit together (fig 61).



Figure 61: Final Concept
(Author, 2013)



After the thesis and design were complete, this product along with those of his classmates were presented to a panel of judges at the university, for a final examination and critique. The product was passed formally as successful for this project. At this session, the universities Technology Transfer Office (TTO) representatives were present and offered those who were interested, the opportunity to take part in a new annual “innovation competition” held within CPUT for its students (see appendix F). Mr Wegmershaus and a few other

Design Phase

Case Progression: First Iteration

students decided to apply for this event. The project was presented again to a panel at the TTO, and along with his classmates, Mr Wegmershaus was one of the winning finalists. The visibility of the project then allowed for the opportunity to present the concept at a seed-funding event, offered by the government through CPUT. A TTO representative who had seen Mr Wegmershaus's project, approached him and explained he should apply to this submission, which was open to any project within the university (Lombard, 2015).

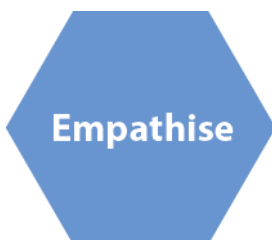
Mr Wegmershaus completed the appropriate application and the project was presented to a panel of judges who then awarded an amount of R480, 000 to develop it from concept through to a working prototype.

This capital allowed the project to continue into a second design cycle, whereby Mr Wegmershaus had to collaborate with professionals who could facilitate the concept's further development.

4.5.2.5 Second Design Process

Design Phase

Case Progression Second Iteration



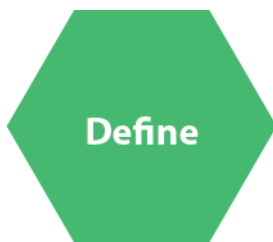
Mr Wegmershaus decided that going forward he would need some support with managing the project further. He approached his lecturer and professor, with whom he was personally well acquainted and asked whether they would like be part of the project's development. They both knew the project well and believed in its potential to succeed so they agreed to collaborate. Mr Wegmershaus decided to partner with his professor and lecturer for a number of reasons, namely:

Design Phase

Case Progression Second Iteration

1. Increasing the project's intellectual, technical and practical base.
2. Feeling more secure having trusted advisors and creative input for the project.
3. Boosting the prestige due to association.
4. Widening the association and access to potential beneficial networks.

The team then approached a local company that was developing biotechnologies to ask for assistance. This meeting led to the conclusion that what was in fact required was a different set of professionals, with different skills to those they had approached. With this in mind, an organisation which develops virtual interactive design experiences called *Formula D Interactive* (FDI) was identified and approached. The project was explained in a meeting between the parties and here it was established that FDI would be willing and capable of partnering up to develop the concept into an initial proof of concept.



Through informal conversations with a personal friend of Mr Wegmershaus's who works in the field of professional programming, it was identified that the project would unlikely reach a functional prototype in its current design. Some of the technology that had been proposed, although technically possible, would have cost too much in both time and money to develop. This led to the decision to change a feature of the original design to allow a functional proof of concept to be realised.

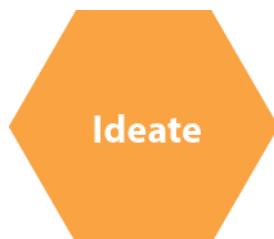
After some initial meetings with FDI, a partnership was made between the university and this company. FDI quoted for an

Design Phase

Case Progression Second Iteration

initial proposed project plan, and once this was agreed upon, a time-line with intermediate deadlines was drawn up.

Further meetings then took place between FDI and Mr Wegmershaus to try and establish the exact parameters for the application and how these would work with available biotechnologies. The FDI team for the project included the CEO, who is an interaction designer, along with a digital graphics programmer.



The first feedback formally presented by FDI was regarding the scope of the prototype, where they looked at different possible-use scenarios and how the application would potentially operate using imitation and synchronisation of the breath. In another meeting on the visual direction of the application, it was decided to use particles to make up patterns and images in virtual space (fig 62). This was presented by the digital graphics programmer and was approved by Mr Wegmershaus.

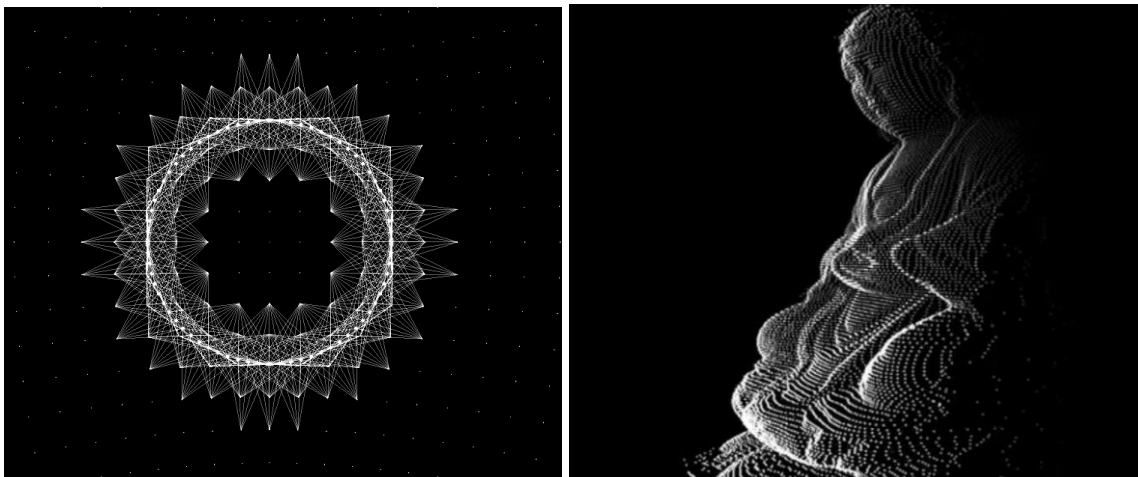
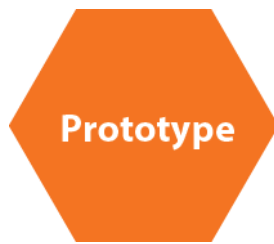


Figure 62: Visual style of application

(Author, 2015)

Design Phase



Case Progression Second Iteration

Initially, FDI acquired a *Fitbit* – a wrist-worn heart-rate-monitor – to begin prototyping with, but the limited constraints of being able to work with the data in real time, and deciding on the added input of measuring breath rate, meant this was returned for an open-source health measurement kit, which would fulfil these criteria (fig 63). This technology took many weeks to arrive from Spain, and when it eventually did, it was not what had been expected. The apparatus for measuring breath had to be placed under the nose, as opposed to a being on a chest strap, and the heart rate could not provide a live data feed. Once Mr Wegmershaus decided that this would not be acceptable, a new process of finding another sensor took place over several weeks, eventually leading to the purchase of one of the most advanced biotech measuring devices available, for a price of approximately R10,000. Once again, after this device arrived, the usability of the physical device and the complexity of the software were decided to be unsatisfactory for proceeding.

At this point, the project's trajectory was reconsidered once again and a decision made to attain yet another device that this time was based on an open-source, live data feed with an active online community. This is the current status of the project at the time of writing. Consequently, no testing of a developed product has yet taken place.



Figure 63: Progression of biofeedback devices tested

(Fitbit, 2015) (Cooking Hacks, 2014) (JST, 2014) (World Famous Electronics llc, 2015)

4.5.3 Case 3: Environment Factor

4.5.3.1 Funding



4.5.3.1.1 Interaction with Civil Society

Due to the project being initiated by the university as an educational activity with no physical working prototype required, there was no initial capital investment at this time, beside that of the student's course fees.

No subsistence capital for the student was included within the amount allocated later by the Government to develop the project. This made applying personal time, travel and communication difficult and slowed the potential progress of the project.

4.5.3.1.2 Mediation through the Educational Environment

The university, in collaboration with government, was beginning to initialise an incubation project, providing supported ideas with a space and resources for development. This gave rise to the university being provided with capital that was then partially invested in providing some of the incubation project managers with a portion of subsistence funding for a monthly salary. This capital allowed Mr Wegmershaus to approach the project with more peace of mind.

The university was responsible for hosting a seed-funding event at CPUT in 2013, whereby government officials from TIA were granting applicants a capital investment. The university thus acted as facilitators between the project and the funding. Once the funding had been awarded, the TTO was responsible for ensuring that the funds were spent responsibly, via Mr Wegmershaus. As a result, the director of the TTO, Professor Atkinson-Hope, had to sign off the invoices obtained by Mr Wegmershaus each time work was to be done.

4.5.3.1.3 Government funding

TIA, a branch of the South African Government was awarding seed-funding up to the sum of R500, 000 for promising ideas developed within universities. This funding was provided to allow the awardees the opportunity to develop their idea to the point of a fully functional proof of concept. Once the project had reached the point of a functional prototype, there would be a second presentation, where the TIA would decide whether they would provide further funding to take it through to commercialisation (Lombard, 2015).

The Cohere project was awarded R480,000 to go ahead with the concept. The actual funding was allocated to the university's TTO department.

4.5.3.1.4 Interaction with Industry and University

The quote from FDI for the first phase of the project's development came up and R163,056. The university agreed that this payment would be paid in three stages; 30% upon signature, 40% after approval of pre-production documentation, and the final 30% after delivery of product. FDI was then able to begin working on the project.

4.5.3.2 Knowledge



4.5.3.2.1 Input from Civil society

Mr Wegmershaus was responsible for identifying and creating the initial concept due to his personal experience with the problem of sleep deprivation. By undertaking academic research into this topic he was able to broaden his knowledge base and begin postulating solutions that would otherwise have little ground for credibility. A reasonable argument was established that projected imagery and sounds, interacting through biotechnology with one's breathing and heart-rate, could potentially provide an effective winding down routine that would assist with the process of falling

asleep. The possible technologies and processes proposed were also a result of this research.

Throughout the development of the project, getting psychological support from friends, colleagues and family members to pursue the idea, and advice on how to navigate difficult situations, was indispensable. It allowed for realistic reflection on the situation at hand

Through informal discussions with Mr Wegmershaus's professional programmer friend, it was established that specific aspects of the project would have to be changed to align with the given funding. His professor also put forward some initial ideas, such as contacting HealthQ and Bandwidth Barn, as potential sources of assistance, demonstrating his knowledge of useful networks.

Throughout his four years of education at CPUT, Mr Wegmershaus had acquired a comprehensive understanding and capacity to present his ideas professionally.

4.5.3.2 Intellectual Property Acquired

After a first meeting to discuss a partnership with his professor and lecturer it was established that for them to accept partnership they would need a share of the project's IP in order to proceed with the project. The TTO was approached by Mr Wegmershaus to draw up a document to include them as partners, but after a lengthy process he was told this was outside the organisation's policy, as they had not contributed to the IP generation of the concept, but that he could instead include them as shareholders of a new business.

4.5.3.2.3 Universities Facilitation

Before presenting for the innovation competition at CPUT in 2013, the university organised training sessions with business entrepreneur Mr Mcleod, leading up to the actual presentations

before a board of judges. Mr Mcleod provided valuable insight and feedback on what was being presented and how to best portray the necessary information.

It was through the university's ties with both the government organisation (TIA) and Mr Wegmershaus that the funding opportunity was able to take place. The university was also responsible for initiating the project through the industrial design department.

A commercialisation course was supplied via the TTO, allowing Mr Wegmershaus the opportunity to gain helpful information about developing the project further (for further information about this course, please see appendix G).

4.5.3.2.4 Intellectual Property Gained

CPUT initially owned all the intellectual property developed for this project, since work done by students for any projects related to the university is automatically the property of the university. The inventor however is entitled to 20% of profits, should the idea be commercialised (Atkinson-Hope, 2015). Mr Wegmershaus felt that this information had not been covered adequately, as he was not supplied with a coherent document explaining it in detail.

The TTO decided to provisionally patent the idea before revealing it to the public, thereby ensuring that the intellectual property which had been discovered and then applied through research, would be protected. This fee was a relatively large amount of money which the student would not have been able to pay for himself.

Once FDI had supplied their terms of agreement for commencing work on the project, certain conditions within this document were rejected by the university as they were against some of CPUT's policies. As a result, a new document was drawn up by the TTO's lawyer, to include FDI as partners in the project. In this way, both parties' policies could be accepted.

4.5.3.2.5 Industry Guidance

Speaking with professionals from HealthQ (Biotechnology Company) led to the realisation that developing the technology from the ground up was not required, but rather that it was possible to use existing devices to achieve the task.

FDI was approached due to their focus on content and concept development, design and production of digital learning applications and the production and supply of cutting-edge interactive media technology. After searching for companies in Cape Town that offered the same or similar services, there seemed to be none able to render the same level of quality and professionalism. Through the initial meetings, it became apparent through their past projects and personal input, that they would be capable of developing the proof of concept.

The two primary persons dedicated to working on the project had professional knowledge and experience in the field of interaction design and virtual graphic rendering.

4.5.3.3 Tools



4.5.3.3.1 Utilised by Civil Society

Mr Wegmershaus used a number of tools, both intangible and tangible, to assist him in the development of this project. Foremost, he believes, was his university education as this is what allowed him the capacity to undertake the research and development of the topic and ability to present it succinctly. The supportive environment available to him was another important tool. This took the form of his lecturers and professor assisting him with the intricacies of developing the project and his friends and family providing emotional support throughout the process. Past projects, available from the years before allowed a reference for the processes and research material to be covered. Mr Wegmershaus used mindfulness

meditation as a cognitive performance tool throughout the process which he believes permitted a more objective and rational approach. Time was another essential resource that allowed the project to be successful with approximately 3 months of primary focus.

The primary tangible tools used by Mr Wegmershaus were his personal computer, pencil and paper. Through the use of internet and software programs he was able to essentially complete everything required for the conceptual development of the project. Literature such as academic reports, theses, current journal publications and reviews were available to students through the universities website. These were helpful research tools especially when searching for specific forms of knowledge. The direct use of Google's search engine was an excellent resource for investigating both specific and general forms of knowledge. An online survey tool was effective for retrieving primary data related to the project.

Commercial computer software programs allowed a range of activities to take place which can essentially be divided into three categories:

1. Research and development programs which included Microsoft Word, Google Chrome and Adobe PDF Reader.
2. Graphic design programs which included Adobe Illustrator, Adobe Photoshop, and Microsoft PowerPoint.
3. Product design programs which included SolidWorks.

4.5.3.3.2 Contributed by University

The *Technology Transfer Office* (TTO) was used to ensure the legal procedures would be followed correctly pertaining to the intellectual property rights of the inventions and monetary procedures required. They were also responsible for hosting the government seed funding event through which Mr Wegmershaus's project received its investment.

The university also exhibited the concept at the CPUT industrial design end of year exhibition as well as an inter-university design exhibition in 2014. The innovation competition held by the TTO also held an award ceremony with an article about the product then being published in a local newspaper.

4.5.3.3 Utilised by Industry

FDI's primary tool was their professional employees in the field of interaction design and virtual graphics, along with the computers and software required to activate these skills. The company's premises allowed a sufficient space for these people and facilities to operate.

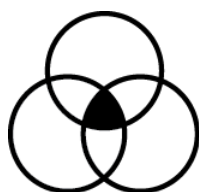
FDI purchased a wrist-worn biofeedback device for initial testing, but after careful consideration with Mr Wegmershaus decided to return this for a more comprehensive, open source biotechnology kit for the initial testing. The kit that arrived included a sufficient heart rate monitor for prototyping, but the device to measure breathing was not appropriate, as the data was not sufficiently responsive and the device was uncomfortable to wear. This resulted in a decision to order another device to measure the breath in a more user friendly manner, as well as monitoring the heart-rate (fig 63).

4.5.3.4 Collaboration

Table 9 catalogues the different parties involved in the projects development, their reasons for doing so and the specific input they were able to provide.

Table 9: Case 3 - Collaborators

Collaborators	Reason for collaboration	Input
Mr Wegmershaus	Develop his product, thereby carry out his vision to help others and begin a business.	Initial knowledge, research and development, concept and vision.
TIA	Boost economic activity in South Africa	Capital
CPUT	Facilitate government plan. Evolve universities innovation agenda.	Facilitation through the TTO
Formula D interactive	Business	Research and Development



4.5.3.4.1 University and Student

It was through Mr Wegmershaus's interaction with the university that the project was conceptualised. By graduating through each year, Mr Wegmershaus was then qualified to undertake the task of researching and developing a product-based solution to a problem in his fourth year of study. The university provided the environment conducive to succeeding with this task, in the form of a prior research and design education, facilities and resources including mentors available to assist him, literary databases and past projects to reference. Finally they established the criteria responsible to initiate the project; setting the task of identifying a problem, setting the requirements for the researcher to create a proposal and spend two weeks immersed in the problem's context and then to develop a thesis and final design.

Mr Wegmershaus was then eligible, as a student, to apply for the internal competition held by the university, as well as a seed-funded initiative by the government.

4.5.3.4.2 University, Student and Government

Through a collaboration with TIA and universities all over the nation, including CPUT, Mr Wegmershaus, as a student of CPUT, was given the opportunity to get funding for his concept by presenting it to a board of judges. Once the judges had granted the project funding, the TTO was made responsible for overseeing its development, by ensuring these funds were spent effectively through their office and CPUT's procurement system. Meetings were scheduled for each quarter year for the government to assess the project's progress. Mr Wegmershaus was then responsible for finding legitimate businesses to take on the project, which would be paid via the university.

4.5.3.4.3 University, Student and Industry

Through the process of searching for a company that would be capable of developing the concept, FDI was recognised as the most adept business. Being able to find this company involved having a clear understanding of what was required for the project to progress and the relevant professional skills to achieve this. Initially another company was approached to see if they could assist in the project but in fact they were not offering what was required although it was very much related. This interaction, however, was still able to provide insight into some aspects of the project necessary for it to progress effectively, i.e. that the development of the one device would not be necessary, and which business would be more appropriate.

Mr Wegmershaus had several meetings with FDI to define the scope of work to be undertaken, which led to an initial proposal and project plan being put forward. Once this had been assessed and specific objectives clarified and formally rectified, Mr

Wegmershaus presented the plan to the TTO which was satisfied and willing to proceed.

Several more meetings took place between FDI and Mr Wegmershaus to identify the most appropriate steps forward. FDI had to acquire outside technology for the prototype development before they could begin developing the software to interact with this technology. A presentation was created by the company and overseen by Mr Wegmershaus, to be exhibited at the university's first innovation showcase in August 2015.

Chapter 5: Analysis of Findings

5.1 Problem statement and research questions

The problem statement investigated through this research is that innovative product solutions developed by individuals, which hold commercial potential may not have supportive and creative environments for their structured development in the Western Cape region. Through the investigation of three diverse cases of products developed in the Western Cape, the primary research question asked is: how can innovative product ideas, developed by individuals, be supported for commercialisation in formal creative environments? The case studies were then used to effectively analyse the question by considering the structure of the environments in which they took place and what design processes occurred. The *Human-Machine* theoretical model was adapted to allow the content of these investigations to be supported by an appropriate structure through which the analysis could take place.

The basis for this analysis is to investigate how design may be able to assist with the commercialisation of the promising ideas of individuals in civil society through supportive, creative environments. Through the literature review, it became apparent that neither the meaning of 'design', nor of 'commercialisation', is entirely clear. Therefore, a re-examination of these terms is necessary before an analysis of the question can take place.

Design was found to be a practice of both the average citizen, as well as of the professional designer. This practice was understood as the ability to critically examine, creatively express and practically undertake, the solving of specific problems or/and the creation of meaning (Manzini, 2015, p. 6). It was reasoned that the role of the professional designer requires a shift, from its traditional practice of the humanisation of new technologies, to one of enabling social innovation if a more sustainable economic future is to be reached. However, it was argued that this shift cannot possibly take place within the current economic paradigm, since the design industry is currently dictated by motives that are principally profit orientated, as opposed to being socially or ecologically directed (Boehnert, 2013, p. 9).

Commerce was found to be either the “the activity of buying and selling, especially on a large scale””, which is the contemporary definition, or, “the social dealings between people””, which is the dated definition. Commercialisation, however, is defined as, “the process of managing or running something principally for financial gain”” (Oxford University Press, 2015). Here we see that the current definition of commerce and commercialisation makes an obvious connection, but if we use the dated definition of commerce, then the connection becomes less obvious.

Through this research, it has been established that the dominant, currently operating economic system on which this definition of commercialisation is founded, is fundamentally flawed. The reason for this base error is that the social and ecological factors on which a sustainable economy is established, have been systematically devalued in pursuit of market growth and profit before all else (Boehnert, 2013, p. 17). As a result of this negation, coupled with the vast communicative power of the Internet and the paradoxical phenomenon of zero-marginal costs, a new economic model to supersede the current capitalist free-market system is emerging, based on shared access and collaboration (Rifkin, 2014, p. 7). Commercialisation within this system would conceivably be more aligned with the dated or more original definition of “social dealings between people””, and could then potentially be re-defined as, ‘the process of managing something principally to achieve a shared goal’. This redefinition aligns with the material explored relating to open-collaboration, in which products are being developed by many people towards a common goal, without finance and profitability as the principal end (Benkler & Nissenbaum, 2006, p. 394).

Having established what the terms “design”, as well as “commercialisation” more broadly encompass, it is now possible to analyse the research question more appropriately; how can innovative product ideas developed out of necessity by non-professional designers be supported for commercialisation in formal creative environments?

5.2 Catalyst for Initiation

The incentive of money only occurred as the initiating factor in the case of the up-cycled, Iwisa bag. However, even in this case creative exploration, concern for the

environment and a sense of fun were also drivers for this product's development. The other two projects were focused entirely on solutions to problems, without money being the initial driving force. In the case of Mr Brink's ideas, his efforts were still reliant on the use of his own funds to produce his products. Within the Cohere project, the only constraint was that the product be a potentially feasible product, but because of the context in which it was conceived, it did not have any monetary constraints.

This progression of the concern and need for money in the different cases illustrates the powerful influence that money and profit may have on a project. The flexible and frugal ways of approaching the ventures demonstrate *Jugaad* innovation (Bobel, 2012) . The Iwisa bag used virtually free materials that were exploited to enhance their aesthetic and functional properties through Mrs Ramofolon's personal capabilities. Mr Brink's products were also produced through an economical sourcing and use of materials that were assembled intelligently with the means available to him. Similarly, the initial phase of the Cohere project was developed exclusively by the student through the tools and knowledge available to him that did not require any physical materials. It therefore seems that the concern or need for money may have both positive and negative implications for a project.

For the Iwisa bag, profit is a principal factor for the products creation due to livelihood demands. Although there is an aspiration to benefit the environment, this can easily be contradicted due to the need to generate a profit. This was made apparent when observing the process used to make some of Mrs Ramofolon's other products. The initial waste material must first be disinfected using a chemical solution. It is then enclosed in virgin plastic (fig 64). The question thus arises whether making money, or a concern for the environment drove the actual development, since the application of these processes contradict the environmentally conscious goal. This is an important point, as it was found within the literature that the design industry in practice discourages the flourishing of ecological and socially responsible projects in the capitalist orientated economic system (Boehnert, 2013, p. 15). So, although this project may be well intentioned, in practice, some of the products may not align with the inventor's base philosophy. However, the project appears to have arisen out of this concern for the environment, while the lack of capital is what

stimulated the progression. Money in this circumstance, becomes an incentive to innovate, to make the most out of what is available in a creative and practical way.

The attributes of the diffuse designer as explored in the literature can be identified here, with the inventor using her inherent design capabilities to navigate her problems intelligently (Manzini, 2015, p. 31). Through this process, a conversation about whether the philosophy and the end product align becomes possible, which may be beneficial for future investigations into such topics. In the example of the actual Iwisa bag, there is a much closer alignment to the ecologically responsible intent, since there is both minimal use of virgin materials and greater use of waste. Regarding the collaboration that took place between Mrs Ramofolon and her sponsor, this allowed direct control of making the decisions of how the money was spent, and on what was possible. Without this partnership, Mrs Ramofolon may not have been able to develop this project, thus illustrating the benefits of collaborative product development (Leek, et al., 2003, p. 88). The results of her efforts in this case could be clearly and immediately recognised through her autonomous actions, without bureaucratic constraints.



*Figure 64: Use of Virgin materials with waste materials
(Author, 2015)*

With Mr Bink's products, the issue of making profit was initially not a concern. In this case, the aim was purely to alleviate his own suffering caused by not having such an aid. As a result, the final products made by Mr Brink are directly aligned with the initial intent. The fact that there was nothing on the market to cater for this clearly apparent human need, on a global scale, clearly demonstrates the design industry's priorities for profit, principally oriented to mass markets (Boehnert, 2013, p. 6).

As with the Iwisa bag, due to the constraints of limited finance, the developments of Mr Brink's project were made possible through his frugal use of flexible prototyping. This same factor drove him to travel all the way to the source of the patent application process in South Africa. Here he was able to acquire patents at a fraction of the cost that would have been charged through conventional methods, further demonstrating the innovative power of how passion and motivation drive an entrepreneur (Cardon, et al., 2009, p. 512). At this point, however, one can presumably only deduce that his reason for patenting these products would have been due to a profit oriented interest.

After continuing to produce these objects for others, his customers were still willing to pay for them when prices were increased, indicating that the value of the need being met was not proportional to the cost of production. Although Mr Brink was making these products to reduce the suffering in people's lives, there was now the added incentive to make a profit from them. However, since the products were based on the original design, they could still fulfil this function, ensuring that the intent and the product were still aligned.

Once the university had taken over, project funding became an issue, since the funds were not able to be provided to the project as and when the project manager needed them. This again aligns with the work that describes how the entrepreneurial process is not compatible with planning (Drucker, 2006, p. 312). The financing in this case was, however, also beneficial, as it allowed both the acquisition of the students for the project and the prototype to be made. The lack of motivation and drive that arose with the formal transfer of knowledge between Mr Brink and the university may be primarily attributed to the lengthy and ineffective bureaucratic processes faced by the students. Other factors may include the unclear direct benefits to be gained by these students and a lack of consistently dedicated time. The effective harnessing of knowledge from one actor to another is a crucial factor for completing an objective (Smith, 2002, p. 5). If the above mentioned shortcomings had been addressed through a contextual mediation at this time of transfer, these deficiencies may have possibly been resolved. An example of such a mediation is explored later in this chapter under the *design intervention* topic.

The original concept development of the Cohere project was not based on making profit but rather producing an acceptable final thesis to ensure the student's graduation. Instead of profit being the initial driving force, as was the case of the Iwisa project, here, it was the accumulation and output of knowledge to meet the requirements of an academic qualification. Since the development of the thesis did not require production of a physical prototype, no finance needed to be expended on acquiring materials and developing processes. This meant that all the energy could instead be dedicated to research and conceptual development. After completion of the thesis however, and the awarding of funds to drive economic activity by the government, the motivation was no longer academic, even though the project was facilitated by the university. Distribution of the available funds by the university was more effective here than in the CookAble project, as FDI was employed in this case, instead of the student trying to develop the product through his own networks. The reason for this seems to be that FDI included in a single quote a series of different services and tools, some of which they then acquired externally with the available funding. Thus, the funding the company received from the university could be distributed immediately depending on what was required and when, without the lengthy delays caused by the university's procurement system. Although this allowed the movement of funding to occur, Mr Wegmershaus may have been able to progress more effectively had he been completely in charge of developments. Once again this demonstrates the problem of knowledge flowing effectively between the actors, since the company did not have the same motivation and intent as the student (Smith, 2002, p. 5).

In contrast to this, the students in the CookAble project were trying to obtain several external services and materials from various sources throughout the development. Processed separately, each of these sources would have required the same lengthy process that the single large transaction took in the case of the Cohere project. Thus, in both of these cases, it appears that the university – which is meant to facilitate entrepreneurial activity – actually prohibits it. Intellectual property and funding processes hindered this progression dramatically, aligning with literature findings on this matter (Jofre, 2012, p. 9).

The fact that the student project was granted so much financial support also meant that instead of being frugal and directly overseeing every part of the process, Mr

Wegmershaus was able to employ FDI. This allowed him to dedicate his time to other aspects of the project. However, the project management by an external stakeholder, rather than the innovator, impacted on the level of dedication and flexibility towards the project. The university's legal and procurement systems however required that an external stakeholder be involved to acquire services. As the project was funded through, and owned by the university, the student's motivation was limited by the fact that he was not clearly and directly able to benefit from his input, and that his own private resources were being depleted in pursuing the project.

From the above findings, it becomes clear that the availability of capital does not relate directly to the success of a project; it can certainly facilitate an initial development process, but the efficacy of that facilitation can have major shortcomings in both the cases that were not already industry oriented. These shortcomings do not seem to be the result of the added funding, but rather the ineffective methods of transferring the knowledge and motivation (Smith, 2002, p. 5). Although knowledge can certainly be transferred the driving motivational force seems to be the key factor that needs to be addressed (Sirolli, 2012).

In contrast, with regards to the Iwisa bag, the effect of the additional funding appears to have been only beneficial, as there was no shift in the responsibilities or impassioned action taken by the inventor. While the other projects were able to progress, in both cases, it appears that the slow rate and ineffectiveness of the developments that occurred, impaired their potential for success. This appears to be because the capital invested was being ineffectively managed as a result of the procurement procedure and, most importantly, a loss of passion and dedication by those involved as a result.

5.3 Ownership, Partnerships, Management and Trust

In the first phase of all three projects, the end goal of getting to the initial prototypes was undertaken essentially by the inventors alone. The initial prototypes that were achieved were all varied and reliant directly on the skills and resources available to the inventors at that time. Only in the case of the biofeedback product was the initial prototype in the form of a conceptual, research-based format. The other two were fully functioning physical prototypes, both of which had then gone through iterative

developments until they arrived at suitable products. In all of these cases, the double diamond design process (University of British Columbia, 2014), can be recognised in their systematic development, even though only one of the inventors had a formal design education.

The appropriateness of the products however were based on different criteria. To meet market demands, the Iwisa bag had to reach a similar standard to an Adidas bag; the Cohere project had to reach an academically acceptable report; while the food preparation products had to be fail-safe. Through these three different cases it is evident how, each product was developed for the requirements of the specific societal sector in which it was developed, and the different forms of knowledge required to develop them within these sectors (Elahi et al., 2013, p18). The industry-based Iwisa bag is focused primarily on generating profit whereas the idea that originated from the university, initially focused on the generation and diffusion of knowledge, and only later on stimulating economic activity. Finally the idea founded in civil society in the first phase of development had no goal of creating profit but rather of producing an object to operate in the most effective way, providing for a need that was not being met by industry.

Each of these ideas appears to include unique networks and knowledge focused on different outcomes, which sit at the heart of the proposed mode 3 knowledge production model (Carayannis & Campbell, 2012, p. 3). It is interesting, therefore, to observe the interactions and outcomes that occur when an idea from one sector is transferred for development to another (fig 65). It is at this point that the interests and motivations of other parties arise, which allow the ideas to then develop.

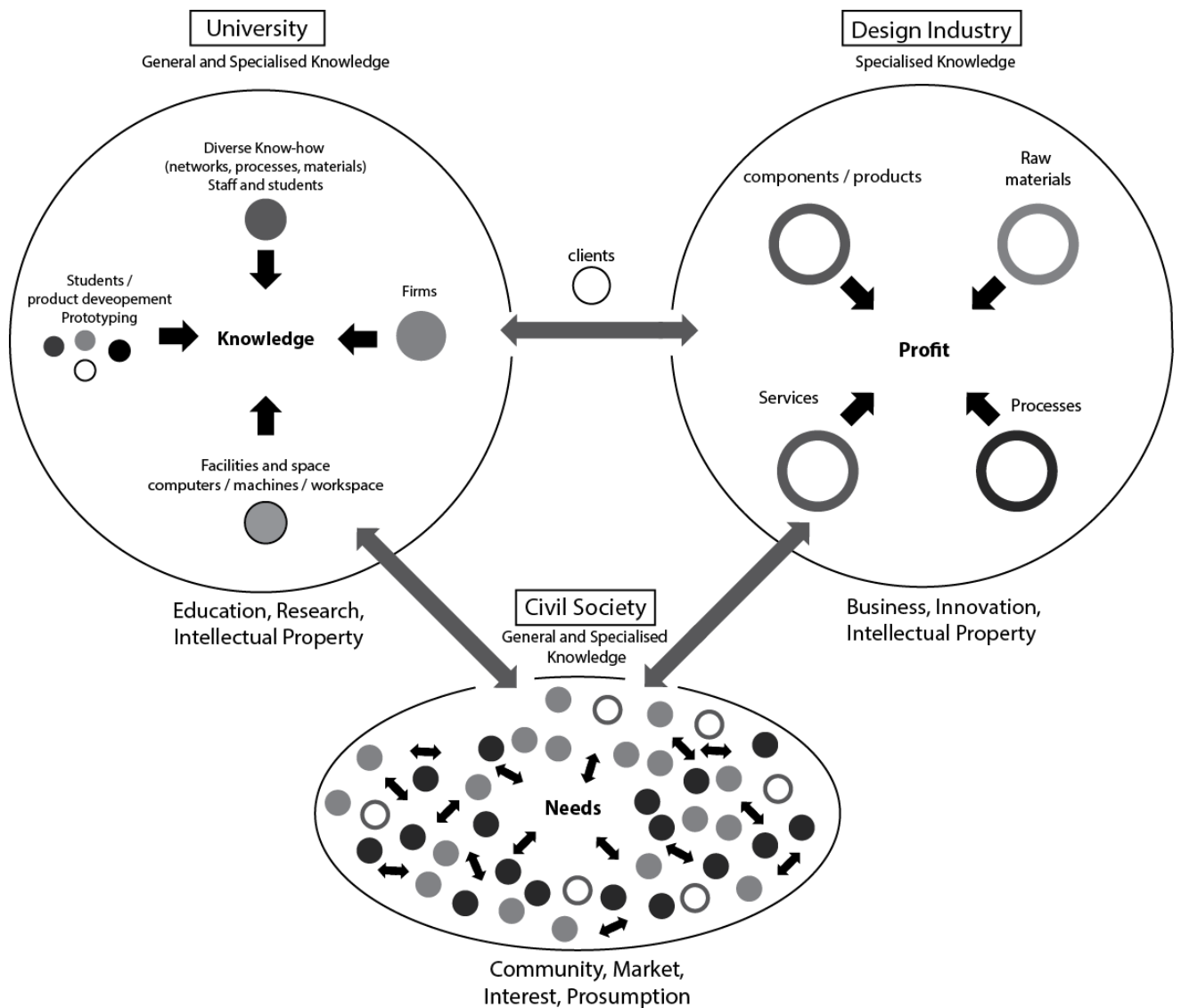


Figure 65: Transfer of ideas between sectors
(Author, 2015)

When these projects are transferred from one sector to the other, the initial ideas move progressively towards the zone of industry and profit generation (fig 66). Through these shifts, they were able access the knowledge and networks required through partnerships, that allowed the ideas continued progression (Leek, et al., 2003, p. 88). Only in the case of the Iwisa bag though, which was already industry-based and not reliant on IP rights, does the inventor stay central to the process, and only in this case is a completely developed, market-worthy product arrived at.

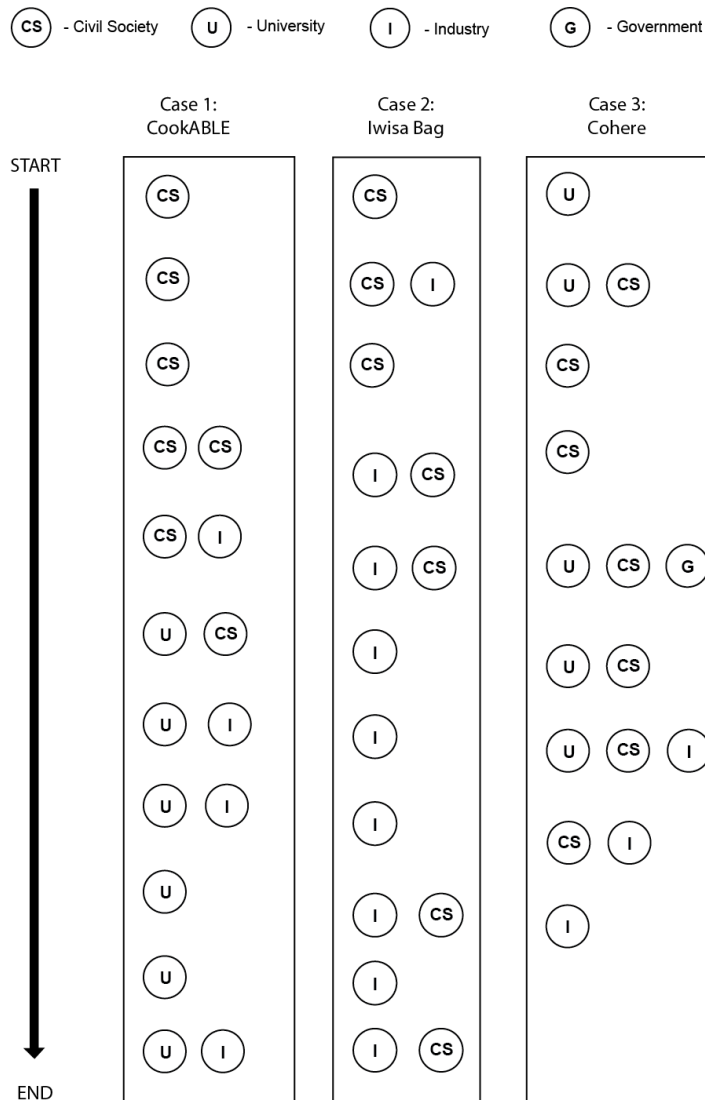


Figure 66: Progression of projects towards industrial sector
(Author, 2015)

In the initial product development phase, none of the projects, except Mr Brink's, were owned entirely by the inventors. In the case of the Cohere product, it was entirely owned by the university, while with the Iwisa bag, Mrs Ramofolon's company had split the ownership 25% to herself, and 75% for her sponsor. Although she owns only a quarter of the company she runs, it was only through her sponsor's investment that she was able to scale up her activities. Throughout this project she had been generating a livelihood for herself from the business, while in the other cases, the designers were not relying on income from their projects to sustain themselves. Mrs Ramofolon remained fully responsible for sustaining the company and making all decisions and initiatives, even though she now only owns a portion of the business. Her partner's funding allowed her more freedom to take the challenges that she felt would have most effect in moving her business forward, including the

purchase of new machinery and employing additional workers. Her vision and passion appear not to have diminished, but rather increased through this collaboration.

The Iwisa bag development was complete within one development phase (fig 67), as all the necessary skills and resources were available through the company. From this case it is apparent that the more freedom and access to relevant knowledge she had, (through her partner) the more the project was able to thrive. In the other case studies, after they progressed into their second phase, there was a restriction of relevant knowledge about how the sector (university) functioned, as well as a lack of freedom, due to the legal and monetary constraints, which resulted in multiple hindrances. These critical unresolved issues are central to the difficulties faced by these projects and support the literature findings on the difficulties relating to IP management (Thurow, 2000, p. 19).

The ownership of Mr Brink's products was initially entirely his own, but after going into partnership with the university, it became shared. From this point on, Mr Brink had little involvement in the continued development of the project, which was handed over to the group of students under the guidance of the professor at the university. While some of the students received an incentive to participate, in the form of bursaries from the sponsor, none of them received formal ownership for their work. Here it appears that with an inefficient procurement system and a lack of ownership (among the students and the professor), the project was unable to develop effectively. While it appears to have followed the appropriate design process, only the internal collaboration between the students was able to take place effectively.

External collaboration efforts were blocked by the procurement system while the university's own internal collaboration between departments appeared not to run appropriately due to vested self-interests. This apparent general confusion in working through the institution progressively led the students to lose hope and trust in approaching the project, although they were eventually able to arrive at a semi-developed prototype. The lengthy bureaucratic procurement process is aimed at reducing the likelihood of fraud. Thus, due to a general lack of trust, all university projects are subjected to the same rigorous protocols. However, with regard to the design and development of products, this system will continue to counter progress,

which relies on several iterative prototyping phases (University of British Columbia, 2014).

The collaboration, forced upon the parties by the university's involvement allowed the project to be approached with new skills and to move towards a new goal that, due to his limited skill set, Mr Brink could not have reached alone, once again demonstrating the benefit of collaboration (Leek, et al., 2003, p. 88). With no long-term motivating force for the students and the continued difficulties created by the system, the project now appears to have ended without reaching a fully functional and ready to be mass produced prototype.

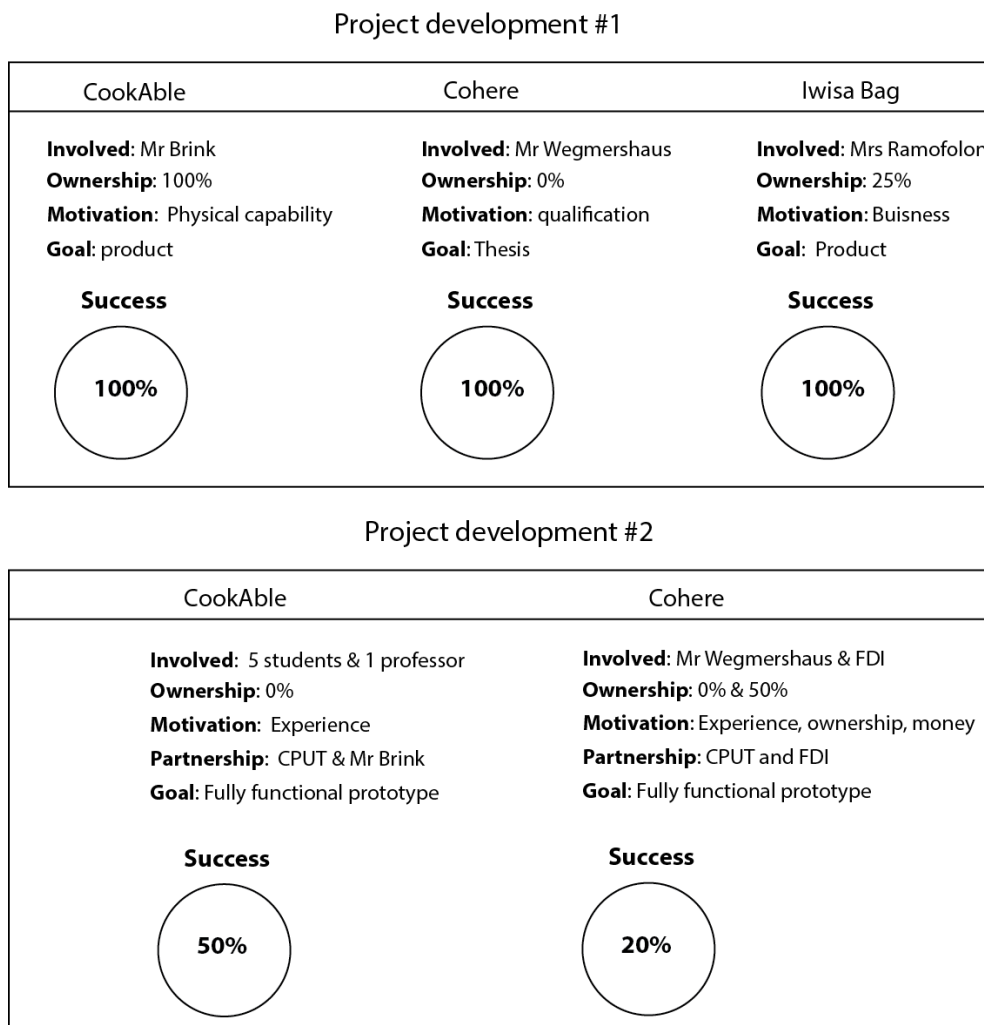
In the case of the Cohere project, the ownership of the concept was never that of the inventor. However the initial aspect of having to complete his Bachelor degree was a strong motivating force that generated a steady responsibility to complete the project to the best of his abilities. This relationship between motivation and ownership comes across as a principal factor in all three studies and relates to the importance of an entrepreneur's efforts for a venture's success (Cardon, et al., 2009). What is interesting is that this is not proportional to the ability to achieve their goals. Having formal ownership of an idea in the form of IP or partnership shares does not necessarily mean that there will be a strong motivation and responsibility to complete a challenge to the best of one's ability. Motivation may arise so long as the end goal will have direct benefit for the individual(s) applying themselves to it, as in all the initial phases of the projects. This understanding is relevant to the success of open source projects explored in the literature review, where individuals are willing to participate in projects because of the pursuit of a clear end goal that has a shared benefit for everybody involved (Benkler & Nissenbaum, 2006, p. 395). From these cases, what appears to be the most problematic aspect are the consequences of trying to use a university system, designed to accomplish different objectives, as well as the absence of clearly defined benefits of the projects for the individuals involved. Conventional approaches such as those adopted by these systems offer repeatable solutions for problems that have been solved before, however a design approach is required in these cases where new or updated solutions are needed (Manzini, 2015, p. 30)

After attaining his Bachelor degree, although the Cohere project had received a respectable amount of capital for its development, the problematic areas referred to above stifled the progress. The inventor had no ownership and there were no clear end goals with defined benefits for the student. The potential benefits were too intangible and indefinite to ensure consistent involvement from Mr Wegmershaus, especially when added to the universities bureaucratic and systemic insufficiencies. When the TTO office created a system to pay Mr Wegmershaus and the other government funded projects, this direct perceived benefit promoted enthusiasm to participate more actively for the five months that it lasted. FDI had been given 50% ownership of IP generated through the project and were also being paid for their work. However, it appears that without Mr Wegmershaus's vision and management to drive the project, its progression was insufficient. Once again, this project highlights the driving force of the individual behind an idea to create a successful project (Sirolli, 2012).

What can be seen here is that the first project development stage of arriving at a product was entirely successful, regardless of ownership in all cases (fig 67). This seems to be due to the fact that both the motivation and desired outcome were powerfully felt by the individuals involved. It is noteworthy that these projects were run by single individuals who each had the relevant skills to undertake the projects and to dedicate considerable time to them, in work spaces they could access whenever they required.

Here, the inherent design capabilities of these individuals, through the use of their specific embodied knowledge, allowed them to develop their solutions without the assistance of a professional designer. In the second stage of the products' development, however, the individuals who were engaged to work on the project did not appear to have either strong enough motivation or enough dedicated time to work on them. The Iwisa bag conversely did not require a second phase of development, so there was no issue in this regard since there was no transfer of knowledge or motivation. It is through these points of transfer that professional design facilitation may have benefited the other two projects' continuation (Manzini, 2015, p. 134). Figure 68 illustrates the different product development phases relating to who was involved and for what reason, as well as the estimated success of each development.

What is apparent from the two cases which developed into a second stage of development is that it is not formal ownership that is of primary importance in supporting an idea, but rather the motivation of the inventor.



*Figure 67: Project development inputs and success
(Author, 2015)*

5.4 Motivation and Passion

What becomes evident through the analysis of these cases is the passion that each of the inventors has for their project. Within the literature review, it was revealed that an entrepreneur's passion for his project is the single most important thing to be nurtured and cultivated to produce a sustainable business (Sirolli, 2012). Although the sustainability of a business is not the focus of this thesis, this passion affects the

development of a product, as well as how the ideas that arise out of specific needs are then fuelled by a creative drive and authentic interest on the part of the inventors.

Each of the inventors have different backgrounds, they are from different generations and cultures that seem to have supported the progression of their projects. Both the Iwisa bag and Mr Brink's initial products seem to have arisen from a culture that is primed to make use of the available materials and processes that they have access to. Mr Brink opted to make the products himself because there was no other option available; with the Iwisa bag, it was a matter of optimising available resources. By contrast, the younger, design student generation made use of a virtual approach, using research, drawing skills and computerised technologies, principally relying on other more specialised individuals to physically build the solution.

These generational and cultural variances and their corresponding approaches demonstrate variations in activity that have taken place through the emergence of a prevailing electronically orientated culture, reliant on specialised networks (Hughes, 2013). Both these approaches, physical and virtual, have their own benefits; the latter allows the exploration and creation of concepts that may not otherwise be investigated, and at a much quicker rate. The former allows direct contact and testing to take place, which can then immediately be produced or used once a suitable solution is reached. If the process of designing makes use of both of these capacities, then the development processes may be much more complete. In fact, the progression of the CookAble project did involve this integration, although not in the conventional systematic order, or to the same end as the conventional design process. What is clear is that each individual was driven by the available skills they possessed, which they had acquired through their personal interests over time, namely sewing, practical skills and design.

Although achieving an acceptable thesis was the principal need that motivated the Cohere project, the autonomous capacity of the student to decide on which problem would be approached created a secondary driving force. In this case, the initial driving force was to define a problem and develop a credible and cohesive argument to support the fabrication of a designed product to resolve that problem. The secondary driving force was the student's interest in the subject matter as a result of choosing a subject directly related to his life and it's potential to help others. Having

completed the crucial reason for managing the project, his thesis, the second development phase failed to provide an equally powerful driving force to take its place. While he was busy working on his thesis, all his energies were directed towards the process and he depended on no other parties to achieve his goal. This allowed a swift and direct route to the final product, especially since he was aided to complete both the research and development for the project through specialised computer programs.

During the next stage, the student had begun further studies and was busy with other projects and so was unable to dedicate all his energies to the Cohere venture. In addition, he depended on a variety of different actors to progress through this phase, and had to negotiate his way through the systemic delays caused by the university. Here it seems that the ineffectiveness of an inflexible system can severely jeopardise a creative venture.

The Iwisa bag seems to have been motivated principally to generate an income through exploiting the inventor's creative sewing skills and freely available materials. The secondary driving force seems to be Mrs Ramofolon's ecological desire to reduce the amount of waste that ends up in landfills. The fact that she is able to manufacture and direct her work, as well as to bring a sense of "fun" into the process was determined to be a key factor in driving her project.

Mr Brink proclaimed that the actual making of his objects was "only a pleasure", while Mr Wegmershaus also enjoyed the process of developing his solution. This autonomous approach of being able to accomplish the tasks that individuals are themselves inspired by, has been demonstrated to be a success factor in all three of the projects, relating to the requirement of passion to drive an idea (Cardon, et al., 2009, p. 512). Mrs Ramofolon's sponsor seems to have been motivated to fund the business due to his belief that it had the capacity to expand significantly, in which case his investment in the business would be realised through his shareholding. A shared theme amongst the sponsors of each case was this belief that the products could be successful.

The initial driving force for Mr Brink's products was to live a more capable life, while his secondary motivation was to assist others in the same situation. He was passionate about this endeavour, as he understood what a difference it could make

to these people's living standards. After his physical ability to continue producing his products ended, it was this motivation to help others, as well as the potential to make money, that drew him to continue searching for support.

5.5 People Willing to Help

Each project received assistance in a variety of different forms, but what is noteworthy is the way that the different participants were willing to support these projects. In the case of the up-cycled bag, the employees who worked at the recycling plants were happy to assist by supplying materials free of charge. Although it did not cost them anything financially, one can be certain that putting aside specific materials takes some extra time and energy. It therefore appears that there is a degree of altruism in these situations. The support that Mrs Ramofolon was able to receive from her sponsor was due to the potential he saw in her products; although not philanthropic, as he received 75% of the company, his assistance demonstrates the commercial promise of her products.

In Mr Brink's case the offcut materials which he was given free of charge to manufacture his initial products, demonstrate the willingness of people to help a worthy cause. Notably in these cases, however, this assistance occurs when what is being offered does not have a cost to the supporter's direct livelihood. Likewise, the initial funding that the sponsor supplied to the university did not apparently have a direct 'cost' to them if the project were to fail; on this occasion the support was given principally as a philanthropic gesture to aid the project, from their appropriate trust fund. The sponsor was motivated to provide this support based on the students presentation. The professor and students from the university were willing to facilitate the process because it aligned with their interests and specialisation in design, as well as in the humanitarian aspect of the products offered.

In a similar way, the funding provided by the government in the Cohere project was based on a single presentation; from this the agency was willing to provide a significant amount of financial backing to support the idea. This demonstrates the potential success that they saw in the project. It therefore appears that if a presentation is able to effectively define the problem and demonstrate a route to a potential solution, it offers significant potential in for acquiring aid.

However, in both the Cohere and CookAble projects, the funding provided could not be utilised effectively because the project managers of these ventures did not have open and easy access to the funding. Added to this, the lack of provision for subsistence costs, as well as unclear beneficial outcomes for those involved, shows how motivation may have been diminished. The university's partnership with FDI did create a willingness for the company to assist, but without a consistent driving force and vision they appear not to have developed the project effectively at the time of writing.

5.6 Design Intervention

From the above findings it is possible to identify various aspects of the projects that were either beneficial, detrimental or neutral in their impact on the project development.

The following tables illustrate these principal factors in each of the projects and their respective phases.

Table 10: Cohere Development Analysis

Cohere: Phase 1		
Beneficial factors	Detrimental factors	Neutral factors
<ul style="list-style-type: none"> • Freedom to decide on problem • Passion to develop solution and help others. • Enjoyment of design process • Formal design knowledge • Credible research into problem • Presentation, computer & drawing Skills • Dedicated daily time, space and tools. <ul style="list-style-type: none"> ○ At home (comfort, any time, little interruptions, food.) • Clearly defined goal (Thesis) • Reference material (past projects) • No capital required • Not dependant on external individuals • Mentors (lecturers) • Clear benefit - academic degree • Novel solution 		<ul style="list-style-type: none"> • No physical prototype required • University owns students idea
Cohere: Phase 2		
<ul style="list-style-type: none"> • University facilitation of project being presented to sponsors • Government granting funding • Subsistence provision to inventor by university for 5-month period • Visibility of project • 20% profit share to inventor • 50% ownership share given to company • Company employment <ul style="list-style-type: none"> ○ Appropriate skills ○ Development ○ Plan - invoiced 	<ul style="list-style-type: none"> • No ownership of project for inventor • Lack of subsistence costs • Lengthy procurement process • Location of university TTO office. • Students busy with other projects. • Lengthy procurement of technology by company • Company employment <ul style="list-style-type: none"> ○ Lack of passion 	<ul style="list-style-type: none"> • University keep funds • Incubation space with business mentor • Quarterly reports

(Author, 2015)

Table 11: CookAble Development Analysis

CookAble: Phase 1		
Beneficial factors	Detrimental factors	Neutral factors
<ul style="list-style-type: none"> • Clear understanding of problem • Clearly defined goal • Passion to develop solution and help other • Practical skills to develop solution <ul style="list-style-type: none"> ○ Skill from previous projects. (relates to cohere past projects references) • Dedicated daily time, space and tools. <ul style="list-style-type: none"> ○ At home (comfort, anytime, little interruptions, food.) • Not dependant on external individuals • Free materials, IP assistance and use of tools. • Protected IP of inventions • Enjoyment of design process • Physical, working product • Market testing and feedback • Semi- subsistence costs • Helping others 	<ul style="list-style-type: none"> • Potentially not viably profitable • Reduced capabilities of hearing and strength due to old age • only one arm • Lack of computer skills 	<ul style="list-style-type: none"> • No formal design knowledge
CookAble: Phase 2		
<ul style="list-style-type: none"> • Physical, working products <ul style="list-style-type: none"> ○ Demonstrate ○ Design foundation • Sponsor <ul style="list-style-type: none"> ○ Willingness to help: video and networks ○ Prototype funding ○ Student funding • University <ul style="list-style-type: none"> ○ Link with sponsor ○ Willing professor and students ○ Facilities ○ Visibility • Timeline and list of requirements (brief) • Conceptual exploration • Semi- functional prototype <ul style="list-style-type: none"> ○ Aesthetics ○ Improved modularity ○ Potentially improved functionality and marketability. • Presentations <ul style="list-style-type: none"> ○ What has been done. ○ What is still to do. 	<ul style="list-style-type: none"> • Location and appropriate times for project development • Lengthy university procurement process • Semi-functional prototype <ul style="list-style-type: none"> ○ Further development required • Lack of subsistence costs for students 	<ul style="list-style-type: none"> • University retained and distributed sponsors funding

(Author, 2015)

Table 12: Iwisa Bag Development Analysis

Iwisa bag: Phase 1		
Beneficial factors	Detrimental factors	Neutral factors
<ul style="list-style-type: none"> • Freedom to decide on goal • Not dependant on external individuals to act. • Passion to help ecology through solution. • Enjoyment of design process • Sewing skills • Free materials • Visibility through magazines, pop-up shops, radio and interviews. • Sponsor <ul style="list-style-type: none"> ○ Funds ○ Business Mentor • Dedicated daily time, space and tools. • Location • Iterative testing • Final product • Market testing and feedback • Potentially aids ecological need • Iterative testing • Quality and aesthetic sensitivity of product • Finished final product • Market feedback • Product supports subsistence 	<ul style="list-style-type: none"> • Business potentially harms ecological need • Materials not consistent. 	<ul style="list-style-type: none"> • 25% ownership to the inventor

(Author, 2015)

The Iwisa bag project was not affiliated with the university as were the other two and it was the only product that was completed after one development phase. The other studies reached final developments in their first phases, but were unable to reach completion in their second phase. Thus an analysis of the differences between these two development phases may prove beneficial in understanding how to more effectively reach a finished product.

The most notable beneficial aspects across the first development phases of the projects appear to be the clarity in the definition of goals, the passion of the inventors and, crucially, the benefits that each individual received as a result of their efforts.

The direct benefits for the individuals involved in the initial projects were diverse and notable. The Iwisa bag provided a product to allow subsistence through capital gains; the Cohere product allowed the acquisition of an educational degree; Mr Brink's products allowed the fulfilment of a physical need. It seems logical that the individuals were able to identify the benefits they would receive and thus were motivated to complete their projects effectively. This is similar to what has been identified in open-source projects (Benkler & Nissenbaum, 2006, p. 395). However, the diversity of these benefits suggests that there are multiple ways of ensuring that an individual may be interested in investing their energies in a given project.

In the second development phases, both the direct and long term benefits became less obvious to the individuals involved and correspondingly, their application and daily exertion in the projects waned. The consistent and timely single-pointed focus and intention by individuals with the appropriate skills to complete the tasks was shown to culminate in a successful product in the first phase. Thus, the question of how to ensure that the individuals involved possess these qualities becomes fundamental to evaluating the potential success of a project.

The cost-effectiveness of each initial phase combined with the autonomous capacity of the individuals to complete the tasks independent of external assistance was a contributory factor in the completion of these projects. In the second phase, the projects became reliant on several different actors collaborating to achieve a goal in which the benefits to some of the individuals were neither clear nor defined. The structure of these collaborations and the university's control over their interactions, instead of by the individuals themselves, appears to have stifled their progress. This finding aligns with the trend of emerging power structures in current economies to support laterally oriented structures over hierarchical ones (Heimans, 2014).

The efficiency of interactions and transactions also appears to play a major role in the progression of the projects. With the Iwisa bag project, where there was no fixed protocol for attaining funds from her sponsor, direct communication took place between them on matters regarding relatively large amounts of capital. For smaller amounts she dealt directly with the sponsor's accountant, who had been appropriately informed on how to engage in these matters.

This was not the case with the university's oversight, where direct communication and relations were prevented by protocol and procurement structures that could not be altered. The project manager would communicate with the TTO office, who would communicate with the appropriate procurement office, and so on. The project managers could only process transactions after multiple bureaucratic processes occurred, often ending with no clear outcome. The university was, however, effective at facilitating the initial interactions between the sponsors of both projects, through presentations created by the students. However, once the funding had been acquired appropriate facilitation was lacking. This suggests that a design intervention takes place at this point, to establish the most appropriate method to pursue, depending on the context of each individual project. This would require a fundamental change in the university's way of operating, since it would mean that the currently existing rigid, broad and general protocols could not be followed. Nevertheless some changes that could occur within the current system are explored below, but it seems that a truly effective intervention would require the underlying structure to be changed.

5.7 Interventions within Current System

5.7.1 Road Maps

Within the university there are firms with specific know-how and specialised tools but this knowledge is not readily accessible and the process of acquiring it is opaque. A series of simple information graphics of this technical and embodied knowledge, along with their costing would potentially make decision-making more effective for those involved in projects. A similar graphical intervention for these firms, this time regarding their associated networks, activities and protocols, would also potentially illuminate how project managers could approach matters effectively, as in the explored case studies. An example of one of these graphics is illustrated in figure 69 with respect to understanding an academic procurement system. Templates of the required signatory documents and examples of how to complete them may have helped create a clearer understanding. A well-developed map locating product design actors and industry knowledge in the Cape Town region, including a

materials, processes and a parts and products library for the public, might also have been of benefit to the project managers in the different development phases.

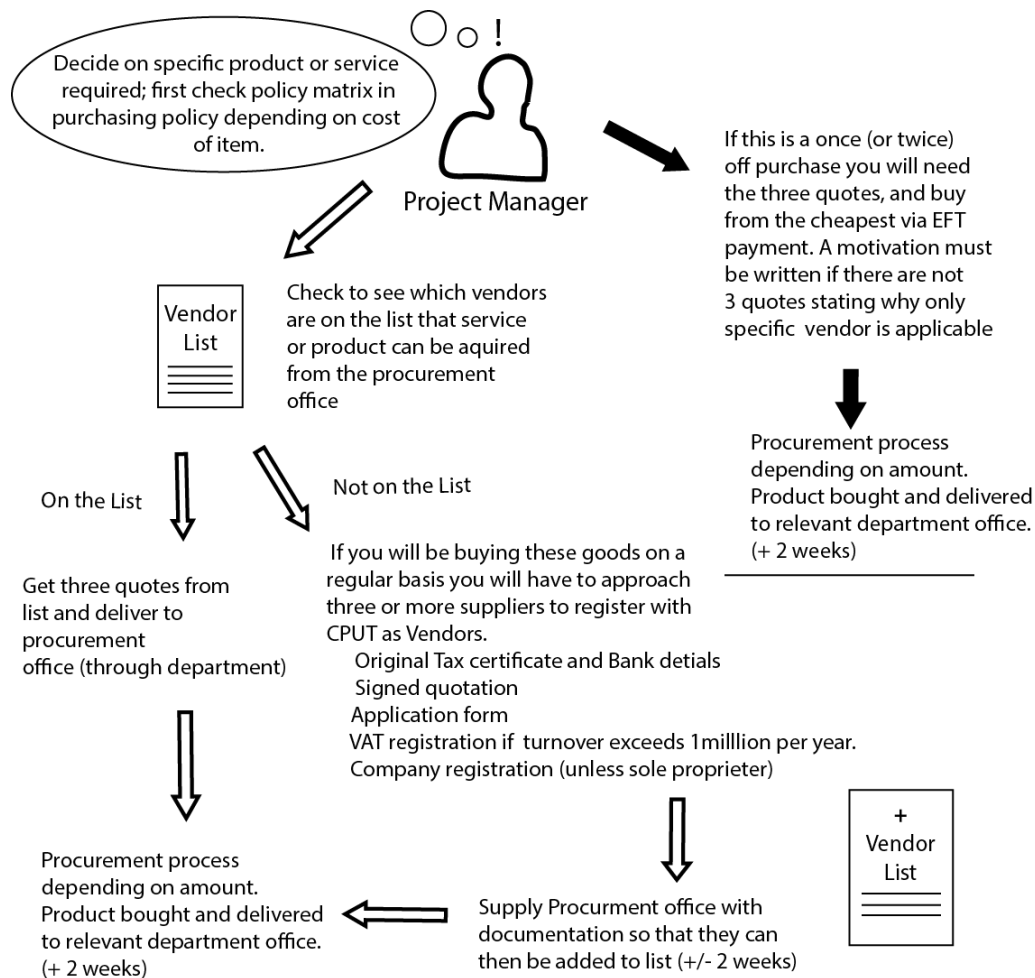


Figure 68: Information graphic example to aid project managers (Author 2014)

5.7.2 Administration

It appears that each university department has its own administration system, which then communicates with the other university divisions regarding matters that need to be attended to. Although these administrative actors may understand the workings within their own departments, this does not appear to be true for their understandings of how each other operates. It may therefore be appropriate for another structure to be put in place that is able to effectively facilitate the interactions between the different divisions. This office would essentially then require an understanding of the different projects being processed, as well as a detailed

understanding of each department's processes. The project managers would then communicate only with this management structure to achieve their objectives (fig 69). This office would also potentially allow for the transparency and distribution of the different departmental activities and protocols, as explored in the *road map* section above, and provide a point of interaction for project managers to communicate with the university.

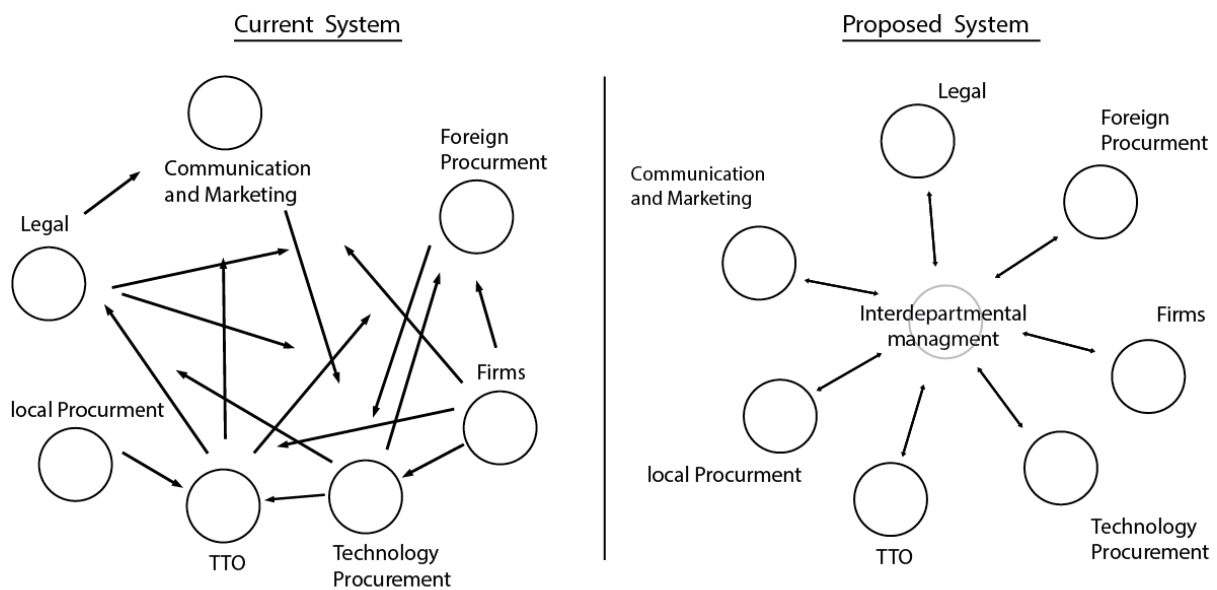


Figure 69: Proposed interdepartmental management model
(Author 2014)

5.8 Interventions within a New System

The following explored scenarios take place under the assumption that the fundamental changes in the universities protocol have occurred. Here one can clearly see the contrast between the conventional system and that of the proposal for a design construction, which relies on the exploration and testing of new systems (Manzini, 2015, p. 32). Through these scenarios, the two areas that appear to have significantly disadvantaged the projects are assessed: the immediate and long term benefits provided to the individuals involved and the management of funding.

Due to the unique nature of every project and the context that it may present, once funding has been acquired for an idea, it is at this point that a design intervention would take place to promote appropriate conditions for that project to thrive. This would be undertaken by a professional designer, following a similar process as the

double diamond design process (University of British Columbia, 2014). It would involve a process of understanding the context of the specific project, such as who is involved, their motivation, which protocols are to be followed and how the funding is to be used. From the list of beneficial and detrimental aspects identified for the above projects, the designer would essentially have a list of requirements to guide and inform the process. These criteria could continue to be refined through future projects, providing a bank of knowledge to be accessed for establishment of parameters of future projects (Manzini, 2015). For example, she or he would need to investigate what the goals of each project are for every actor concerned and how each individual party would be best able to accomplish their roles with autonomy, and through effective interactions.

To use the CookAble project as an example; when the project was initiated, five university students were chosen to develop the product. While there may have been some creative benefits to this collaboration, the organisational difficulty of arranging spaces and times to meet the parties involved stifled the project; meetings were intermittent and for short periods of time. Using the initial development phase of the projects as a guide, however, if only one capable graduate level student who showed interest in the project had been approached, the level of autonomy and responsibility may have been improved. It may have been possible to provide more appropriate incentives, as well as ensure dedicated daily time to be spent on the project, which would have ensured its progression. Ownership or profit shares could also have been established with the project manager to promote long term benefit as well as greater freedom accessing the available funding.

With both of the cases facilitated through the university, the funding was held and facilitated through their TTO office. The project manager (who in these cases was a student) then had to interact with industry to find the appropriate products and services. Once these were identified, the project manager then approached the TTO who had to evaluate the company and decide on their appropriateness. If they were satisfied, a procurement process then took place enabling the use of that company's proposal (fig 70).

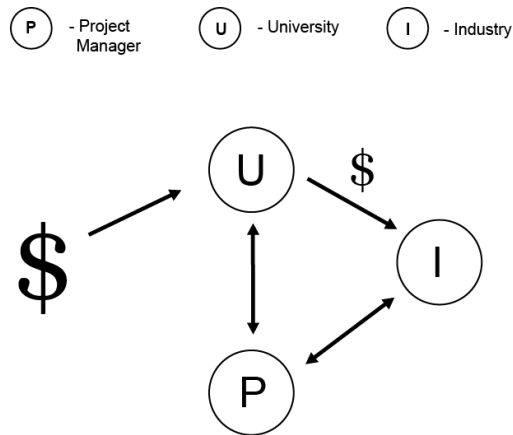


Figure 70: Current procurement process
(Author, 2015)

As already explored, however, delays in the procurement and legal process followed by the university are ineffective. In a different scenario, however, still using the university to facilitate the initial funding transaction, funding could be distributed directly through the project manager. A single appropriate representative from the TTO office would then be the link to this specific project. The initial funding would be distributed directly to the project manager, if not entirely, then in fractional amounts which would allow her or him to complete tasks as and when the need arose. The project manager would have to be able to ensure that all transactions processed were relevant and necessary to the completion of the project. For situations which required more than the approved fractional amount, an interaction with the appropriate university official would then take place to ensure legitimacy in order to distribute the required funding to the project manager. In this scenario the individual involved in driving the project has autonomous capability to act freely and in a timely manner (fig 71).

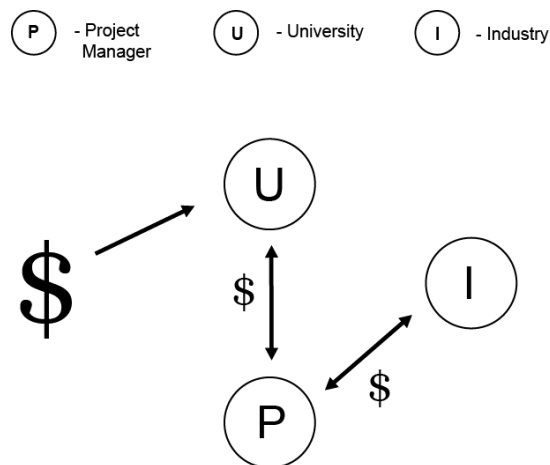


Figure 71: Proposed procurement process
(Author, 2015)

The ease of the transactions and interactions is a primary concern for the success of projects, as is the location of the different actors required to accomplish a task and their availability to communicate effectively.

The TTO's location was not conducive to interactions with the project manager for either of the university involved projects, as it was set outside the city. In the interactions with the Iwisa bag, Mrs Ramofolon's business was situated in town, allowing these exchanges to occur effectively. Her relationship with the sponsor's accountant allowed transactions to occur as and when they arose. This is essentially what has been proposed for the university interactions, to enable and support the capabilities of the project manager. As revealed through the literature review and found repeatedly through the studies, motivation is the most important aspect for driving an idea and the design process cannot rely on protocol and plans (Sirolli, 2012). It is essential to ensure immediate transactions so that this passion is not lost.

5.9 Summary

In this chapter the analysis began with an exploration of the catalysts that initiated and drove each phase of the projects. It was identified that the ideas arose due to the diverse needs and influences of the societal sectors from which they operated within. It was found that the initial ventures were able to succeed without capital being the primary requirement but because of the motivation and capabilities of the individuals involved. These capabilities were the result of the embodied knowledge they possessed in the form of their skills, and their motivation as a result of the perceived benefits. Funding was the catalyst for the initiation of the second round of development of two of the projects, while the lack of capital was a principal motivator for the Iwisa bag.

Initially, each sector (university, civil society and industry) was represented by the different projects, and the requirements of these sectors were shown to have different outputs: knowledge, needs, or profit. It was recognised that as the other project's developed through their second phase, moving towards the industrial sector, their profitability became a key concern. As the ideas transitioned from one sector to another, the driving forces initiating them shifted, and the direct benefits for the initial individuals involved became unclear. The capacity of these individuals to act freely and according to the project's needs was restricted by the university's bureaucratic protocols. This is evidenced by the fact that each of the projects was entirely successful in its first development stage, but this was not the case in their second stage.

The motivation of the individuals directly involved in the progression of these projects was identified as of primary importance; this appears to be affected by the direct perceived benefits offered by the project, coupled with the individual's interest in the topic and crucially, the application of the specialised skills they possessed. Although a formal design process was only practiced by the design students, the other projects naturally followed the same process to varying degrees and was a source of enjoyment in each case. The autonomous nature of the initial projects allowed the inventors the freedom to operate as and when they desired, without delays. The delays and insufficiencies in procurement and transparency created by the university protocols were found to be demotivating for those involved.

Apparently, due to the perceived humanitarian nature of these projects, specific people and institutions were willing to assist the projects where they could, as they recognised the potential for their success. Each actor who was willing to aid the process generally had specific motives for their participation. The willingness of the sponsors to fund the projects was facilitated by convincing presentations by those involved. These funds ensured the willingness of the actors involved in the second phases of the projects to take part, however not with a drive equal to that of the initial inventors.

These cases were analysed to determine the beneficial, detrimental and neutral aspects of each development allowing a cross-case, and cross-phase exploration. Brief design interventions were proposed which could possibly be implemented in the current system, as well as others that would require a different protocol structure. This was undertaken to consider how potentially the impact of the apparent shortfalls – notably the disbursement of funding and the motivation of the involved individuals might be addressed.

In the following chapter, a conclusion of the contextual, methodological and analytical contributions that this thesis may have offered is considered.

Chapter 6: Conclusion

6.1 Contextual Contribution

Design for commercialisation is a broad topic. Only through a thorough understanding of what both of these terms mean is a relevant discussion able to emerge and be investigated. The initial theoretical review of literature was framed in such a way that a systematic appreciation of these terms could be perceived, providing a broad overview of their contexts. The foundational grounding in which this theory was established explored how the free-market capitalist economic system which currently prevails, came into being, and how commerce has evolved to support it. The economic components and organisational structures that support this system have progressed now beyond the industrial economy driven by labour and markets, to a knowledge economy based on information and networks (Hughes, 2013).

The practises of commerce and commercialisation however are still being carried out very much from an industrial-age mind-set, invested principally in cognitive, empirical knowledge above ethical, aesthetic and meaningful knowledge (Walker, 2013). This becomes evident when the current definition of commerce and commercialisation are investigated, revealing that they are based on the principal economic component of the industrial age: capital. This thesis suggests that these definitions therefore require updating such that achieving financial gains is replaced with a new approach, such as achieving a shared goal. This supposition is further supported through literature that recognises a new economic model which is now beginning to emerge in which capital is not the principal determinant for exchange of goods and services (Rifkin, 2014, p. 7). Through a radical technological revolution relying on the internet this change is being made possible. This is ushering in what has been called the third industrial revolution whereby decentralisation and democratisation of knowledge are allowing a new paradigm of commerce to arise: based on communal collaboration and ownership. As a result, the operational structure of the way in which power operates is shifting to a fundamentally new format that supports transparency above all else (Heimans, 2014).

The primary role of the designer throughout the industrial age has been to humanise new technologies so that they could be established within a consumerist society (Walker, 2013). Through the above mentioned technological revolution and democratisation of knowledge through the internet, it is not uncommon that individuals without a professional design background are able to initiate innovative products and services. The role of the designer in this newly emerging economic system has been recognised to require a change. In order to promote sustainability, their professional facilitation is required to stabilise these types of social innovations (Manzini, 2015). The reason that this has become a duty of the designer is due to the appropriateness of the tools and culture for this objective which are possessed by professional designers. The design industry however, due to its affiliation with the industrial activity is currently bound to the current capitalist agenda of generating financial profit first and foremost; as a result, social and ecological imperatives are not prioritised, even though they are the very environment on which an economy depends for survival (Boehnert, 2013, p. 9). A new model of collaborative design is emerging, allowed by the internet, which is not inherently bound by a financial and proprietary agenda: as witnessed by the open source movement (The Open Source Initiative, 2015). It is the freedom and potential benefits that each individual who approaches these projects has, each with their own varied agendas and sets of skills, which has allowed great successes through this model (Benkler & Nissenbaum, 2006, p. 394).

Only after this in-depth investigation into the meaning of commercialisation and design is it possible to justify how a product might be supported for commercialisation. Having clarified that this term requires an updated definition which is not principally associated with financial gain, it is then possible to effectively accomplish this enquiry. In effect, if the principally defining motive of commercialisation is to complete a shared goal rather than gaining finances, the exploration into the dealings between people becomes much more holistic and inclusive. The criteria of social and ecological consequences can then become part of the discussion which may otherwise have been ignored. Other environments such as arriving at a solution through academia can also then be included in the conversation. Products which may not have a large enough market to be feasible in the current commercial sense can also be explored; just because some products

may not be able to make a profit, does that mean they should not be produced? Of course not, therefore it is essential to incorporate this new ideal of commercialisation, to align it with the predicted future economic system. What is interesting is that although the reason for this economic change is required due to the advancement of the system, the orientation is similar to the dated definition of commerce as “the social dealings between people” (Oxford University Press, 2015). Through the mechanisation of labour, new technologies, transport and communication channels, however, these dealings are becoming essentially entirely different.

6.2 Methodological Contribution

The different sectors from which each of the case studies originated from allowed insight into how innovative ideas developed by individuals might be supported for commercialisation through varied means. The governmental sector was specifically not explored as it was considered beyond the scope of this research, however this is an area that may benefit greatly through the application of such investigations. Furthermore, two of these cases allowed an examination into the processes of commerce that takes place when an idea is transferred from one sector to another. Through these exchanges and the analysis of each phase of development individually, it became clear that these different sectors provide specific environments that are supportive for the development of ideas in different ways. These ideas are initiated from the different needs that each sector strives to acquire yet they essentially all followed the same design process. This was made apparent through the division of each project into a formal design model which were then cross-analysed. Although each of them did not follow the same process of research and development due to their circumstances, this progression was still evident, each in a unique way. Essentially they relied on the knowledge and skills of the individuals involved, coupled with their inherent design capabilities and driven by their distinct motivations and interests. The varied approaches and reasons for initiation of the various projects provided a broad overview of the innovation landscape.

The use of the adapted human-machine model proved appropriate in providing a structure and theoretical underpinning for the explored material. Although the

alteration was not a radical one it allowed a distinctive change in perspective from that of the original. The original model focuses specifically on the direct relationship between a human, a machine and the environment that this takes place within, to better understand how each affects and is affected by the other (Bridger, 2003, p. 7). In the adapted version the focus was not directed primarily at this relational context but instead at how the different factors (human, product and environment) related to the process of developing a product idea. By establishing the important topics that then related to the investigation of each factor in the adapted model, significant structured insight into this process was made possible. This way of adapting the model, then appears to be applicable and potentially beneficial in a multiplicity of different scenarios that may require investigation into a specific process.

The hybrid narrative ethnographic and autoethnographic method of investigation into the cases allowed for the unique circumstances of the study to be appropriately uncovered. Through the authors grounded experience of the process under inquiry as well as an in-depth immersion into the actual context, continual reflection and analysis was able to effectively take place. Through the interviews and interactions with other participants involved in the studies, specifically related to the design process, a common understanding and dialogue was able to occur. This may have improved the overall acquisition of found data since a more systematic and detailed examination could take place. The subjectivity of this data was minimised as much as possible through the integration of multiple viewpoints from the other participants and/or a direct representation of stated information. Since the author was only directly involved in half of the subject matter, the other half provided further objectivity to the study.

This research has only explored the commercialisation process related to the development of an idea towards a finished prototype. As such, the social dealings that have occurred within this study do not represent the entirety of the commercial process required to deliver a product to market. Further investigations into these structures would be appropriate to develop a holistic perspective of the progression.

6.3 Scientific Contribution

This thesis established that the principal interests of the civic, university and industry sectors, regarding product development, operate from largely different standpoints yet are potentially capable of aiding and facilitating one another. This facilitation however appears to require specific strategic design initiatives, focused on establishing transparent and effective structures, to engage and inform those individuals involved in the projects, as the ideas are transferred. The successful outcomes of the projects that took place before they were transferred to another sector provides insight into the positive conditions and requirements that each environment supports. Similarly, the unsuccessful nature of the projects after being transferred provides a comprehension of the negative conditions and requirements that they generate. Therefore it is appropriate that to aid the transfer of innovative ideas, the positive aspects in each sector at transferal are enhanced, while the negative aspects diminished, with the aim of maximising the use of their available resources. The principal factors which the findings and analysis have shown to be essential in achieving this objective is ensuring the passionate participation of those involved. To realise this, it was further established that clear goals, connected with definite, direct, short term benefits, as well as potential long term benefits would be required. Lastly it was acknowledged that the lengthy bureaucratic processes of academia which may act as the facilitators for the transfer of such ideas, are not conducive to aiding the design process. Although there are some changes that can take place within the current structures that could assist such projects a systemic restructuring appears to be required if they are to be truly effective. The university could potentially act as an excellent enabler for such ideas if the procurement and legal administration system was redesigned specifically to approach these kinds of objectives. If this were to occur then it is likely that the rate of success of such projects would increase, benefiting the economy. The proposed design interventions conveyed in the analysis, although not developed, highlight the core problems that have been exposed and provide a starting point from which to begin their being addressed.

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Appendices

Appendix A: Ten types of innovation

Innovation Type	Description
Profit Model	<p>Innovative profit models find a fresh way to convert a firm’s offerings and other sources of value into cash. Great ones reflect a deep understanding of what customers and users actually cherish and where new revenue or pricing opportunities might lie. Innovative profit models often challenge an industry’s tired old assumptions about what to offer, what to charge, or how to collect revenues. This is a big part of their power: in most industries the dominant profit model often goes unquestioned for decades.</p>
Network	<p>In today’s hyper-connected world, no company can or should do everything alone. Network innovations provide a way for firms to take advantage of other companies’ processes, technologies, offerings, channels, and brands —pretty much any and every component of a business. These innovations mean a firm can capitalize on its own strengths while harnessing the capabilities and assets of others. Network innovations also help executives to share risk in developing new offers and ventures. These collaborations can be brief or enduring, and they can be formed between close allies or even staunch competitors.</p>
Structure	<p>Structure innovations are focused on organizing company assets — hard, human, or intangible — in unique ways that create value. They can include everything from superior talent management systems to ingenious configurations of heavy capital equipment. An enterprise’s fixed costs and corporate functions can also be improved through Structure innovations, including departments such as Human Resources, R&D, and IT. Ideally, such innovations also help attract talent to the organization by creating supremely productive working environments or fostering a level of performance that competitors can’t match.</p>
Process	<p>Process innovations involve the activities and operations that produce an enterprise’s primary offerings. Innovating here requires a dramatic change from “business as usual” that enables the company to use unique capabilities, function efficiently, adapt quickly, and build market-leading margins. Process innovations often form the core competency of an enterprise, and may include patented or proprietary approaches that yield advantage for years or even decades. Ideally, they are the “special sauce” you use that competitors simply can’t replicate.</p>
Product Performance	<p>Product Performance innovations address the value, features, and quality of a company’s offering. This type of innovation involves both entirely new products as well as updates and line extensions that add substantial value. Too often, people mistake Product Performance for the sum of innovation. It’s certainly important, but it’s always worth remembering that it is only one of the Ten Types of Innovation, and it’s</p>

	often the easiest for competitors to copy. Think about any product or feature war you've witnessed—whether torque and toughness in trucks, toothbrushes that are easier to hold and use, even with baby strollers. Too quickly, it all devolves into an expensive mad dash to parity. Product Performance innovations that deliver long-term competitive advantage are the exception rather than the rule.
Product System	Product System innovations are rooted in how individual products and services connect or bundle together to create a robust and scalable system. This is fostered through interoperability, modularity, integration, and other ways of creating valuable connections between otherwise distinct and disparate offerings. Product System innovations help you build ecosystems that captivate and delight customers and defend against competitors.
Service	Service innovations ensure and enhance the utility, performance, and apparent value of an offering. They make a product easier to try, use, and enjoy; they reveal features and functionality customers might otherwise overlook; and they fix problems and smooth rough patches in the customer journey. Done well, they elevate even bland and average products into compelling experiences that customers come back for again and again.
Channel	Channel innovations encompass all the ways that you connect your company's offerings with your customers and users. While e-commerce has emerged as a dominant force in recent years, traditional channels such as physical stores are still important — particularly when it comes to creating immersive experiences. Skilled innovators in this type often find multiple but complementary ways to bring their products and services to customers. Their goal is to ensure that users can buy what they want, when and how they want it, with minimal friction and cost and maximum delight.
Brand	Brand innovations help to ensure that customers and users recognize, remember, and prefer your offerings to those of competitors or substitutes. Great ones distill a "promise" that attracts buyers and conveys a distinct identity. They are typically the result of carefully crafted strategies that are implemented across many touchpoints between your company and your customers, including communications, advertising, service interactions, channel environments, and employee and business partner conduct. Brand innovations can transform commodities into prized products, and confer meaning, intent, and value to your offerings and your enterprise.
Customer Engagement	Customer Engagement innovations are all about understanding the deep-seated aspirations of customers and users, and using those insights to develop meaningful connections between them and your company. Great Customer Engagement innovations provide broad avenues for exploration, and help people find ways to make parts of their lives more memorable, fulfilling, delightful — even magical.

(From Deloitte Touche Tohmatsu, 2015)

Appendix B: Mr Brinks Products

On behalf of the Cape Peninsula University of Technology

Hand-Disability Aid

Hulp vir Handgestremdes



Hekkie Brink

10 Oleander Street
Mijnerton

Tel/Fax.: (021) 551-1224
082 214-9052

Email heinrich@wcgrb.co.za

I Prof. Mugendi K M Maithe
the undersigned acknowledge receipt of devices as listed below from Mr. Z H Brink owner of Handdisability aid on the 13th Sept. 2013, and shall deal with it according to the contents of the contract between Brink and the C.P.U.T.

The complete range of helpful devices for persons with the use of only one hand consists of the following:

Signed 13/9/2013

For use in the Kitchen

1. Main station – onto which all modular components can be attached
2. Multi purpose cutting/slicing guide
3. Vegetable peeler
4. Thick-skinned Fruit peeler
5. Stabiliser base – inclusive of a chicken de-skinner
6. Gripper/Vice – multipurpose
7. Pot/Pan Stabiliser
8. Jerked meat/Biltong cutting device
9. Long-leg pot stabiliser

For use in Self-care Activities

10. Nail Clipper. [Finger -and Toenails]
11. Adjustable Back Brush
12. Nail Brush with Modular Attachments for Dentures
13. Lady's underarm shaving device

Other Enabling Activities

14. Embroidery Frame holder
15. Hand sewing device
16. Lifting device - to lift heavy objects e.g. pumpkins/watermelons from floor with one hand
17. Long-legged lifting device for boxes
18. Device to do weeding while standing upright - people with back trouble
19. Device to hold one's cards (for card playing)
20. Special ironing board to fit onto a standard ironing board (for easy ironing by the hand-impaired person)
21. Device for cutting green beans, carrots, cucumber, etcetera, as if with two hands
22. Device for changing a baby's nappy in a normal way
23. Device on which all clothes can be washed
24. Special retaining device on which bread / toast can be spread
25. A reaching hand (pick-up) device
26. An alternative long-legged pot stabiliser
27. Special multipurpose scissors
28. Showing how to cut a watermelon (new video clip only)

Z H Brink

I trust you will find our devices to be of great assistance and comfort in executing a variety of daily tasks more independently.

Kind regards

HEKKIE BRINK

Appendix C: Letter of approval



Department of Biomedical Engineering

University of Cape Town Medical School
Observatory - Cape 7925
South Africa
Tel: + 27 21 406 6235
Tel: + 27 21 404 6117
Fax: + 27 21 448 3291

Hyman Goldberg Professor and Chairman: Christopher L. Vaughan

22 September 1998

Mr Hekkie Brink
26 Ocean Village Close
Visagie Street
Bloubergstrand 7441

Dear Mr Brink

Thank you very much for taking the time on Thursday 10 September to come and demonstrate to us your ingenious aids for people with hand disabilities. I have been in the field of biomedical engineering for 20 years, with a special interest in rehabilitation, and the products which you have developed are among the most innovative I have ever seen.

I was impressed by the fact that your devices, both for food preparation and personal hygiene, have wide application. Beneficiaries would include not only amputees such as yourself but also elderly people with arthritis and those incapacitated by a stroke. This is important because it means that there is potentially a very large market for your products.

When I accepted the position of Professor of Biomedical Engineering here at UCT two years ago, one of my goals was to assist entrepreneurs such as yourself in bringing their products to reality. I firmly believe that your aids for hand-disabled people have a market both in South Africa and abroad. With the appropriate investment, it should be possible to manufacture and sell the devices at a price that end-users can afford and yet still be financially viable. I trust that you are successful in attracting and securing the necessary funding and I look forward to hearing of your success in the future.

Yours sincerely

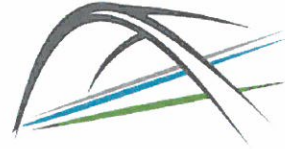
CHRISTOPHER L VAUGHAN
Hyman Goldberg Professor and Department Head
e-mail: kvaughan@anat.uct.ac.za

Appendix D: Innovation Bridge



science
& technology

Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA



Innovation
Bridge

South Africa's Technology Showcase and Matchmaking Event

Private Bag X894, PRETORIA, 0001, RSA. DST Building 53, CSIR Scientia Campus, Meiring Naude Road, Brummeria, PRETORIA, 0184. Tel: +27 12 843 6300, Fax: +27 12 349 1030

10 October 2014

Dear Technology Transfer Colleagues

Innovation Bridge - The South African Technology Showcase and Matchmaking Event

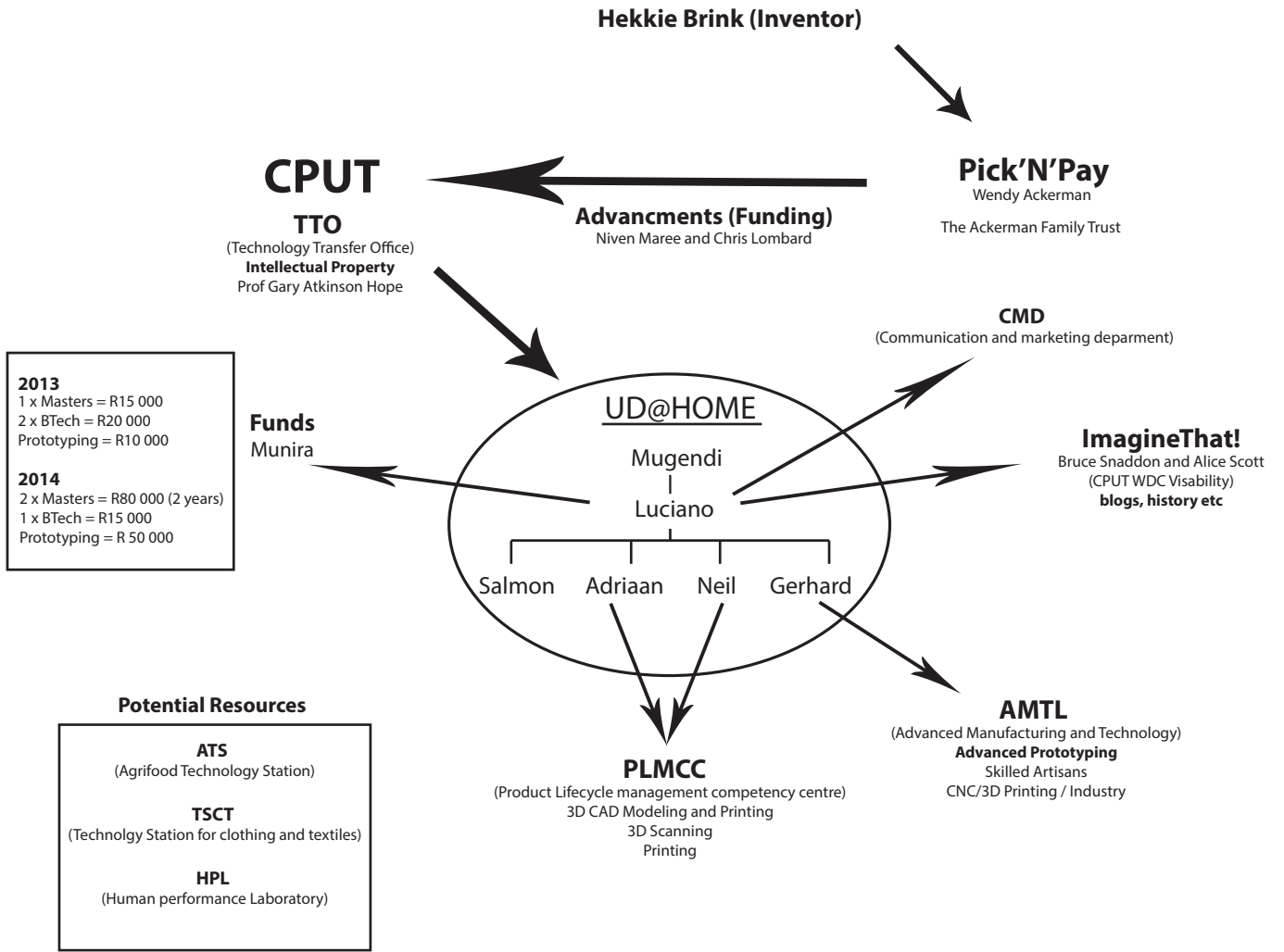
The Department of Science and Technology (DST) in partnership with the Technology Innovation Agency (TIA), the National Intellectual Property Management Office (NIPMO), and the Southern African Research and Innovation Management Association (SARIMA) is organising the inaugural technology showcase and matchmaking event on **2-3 February 2015 at the CSIR International Convention Centre in Pretoria**. The event will be known as ***Innovation Bridge - the South African Technology Showcase and Matchmaking Event*** and will be held biennially. The title of the event is descriptive of its purpose – to match universities, science councils and companies exhibiting publicly funded technologies with potential collaborators, funders and investors to facilitate commercialisation of these technologies.

The organising partners have alerted the community as to the hosting of this event, with the first formal engagement with the technology transfer community held on 9 July 2014 in Gaborone, Botswana at the time of the SARIMA conference. Although this briefing session was well attended, a second briefing session was held in Gauteng on 4 August 2014. The Offices of Technology Transfer (OTTs) that were not represented at the two formal briefing sessions have subsequently been /are being contacted by NIPMO and TIA.

Lefapha la Saense le Thekenoloji • uMnyango wezeSayensi neThekenoloji • Muhasho wa Saintsintsi na Thekinoodzhi • Departement van Wetenskap en Tegnologie • Kgoro ya Saense le Theknolotši • Ndzawulo ya Sayense na Thekenoloji • LiTiko le Tesayensi neThekenoloji • ISebe lezeNzululwazi neTeknoloji • UmNyango wezeSayensi neThekenoloji

Batho Pele - putting people first

Appendix E: Organogram



Appendix F: Innovation competition

IDEA ⇨ CREATE

Student Innovation Competition 2013

Are you the Next **BIG** thing in **Technology** OR **Entrepreneurship** on campus?

In support of innovation and entrepreneurship at CPUT, the Technology Transfer Office and the Office of the DVC: Research Innovation Technology & Partnership have launched a competition to discover innovative initiatives and entrepreneurial skills among CPUT students by encouraging them to showcase their originality and creative ideas.

This challenge aims at unlocking the student's innovation potentials, improving their abilities and discovering their talents and creativity in technological projects OR business ideals with commercial value while still at university.

Enter your project, prototype, engineering or industrial design or Business solution to existing problem by simply completing the form below and you and your team will stand a chance to win up to R20, 000 cash plus access to opportunities to commercialise your idea.

Application criteria

To be able to register for the competition you must:

- Have a valid CPUT Student number
- Submit Proof of Registration
- Complete the form below
- Specify your Entry category

Competition procedures

- A. You must submit a technology project or product or close to working prototype or Unique Business service plan by completing the form below in order to register for the competition.
- B. Registration close 30 August 2013: **NO prototype, products or business plan is required to register.**
- C. Once you have registered you will be invited to attend two workshop sessions in end August and September 2013, presented by a well-known business coach and specialist on entrepreneurship and Intellectuals property management.
- D. After the workshops you will be required to submit a simple project plan and presentation of your prototype and based on what you have learnt at the workshops.
- E. The deadline for project or business plan submission is end September 2013. A panel will evaluate the entries and ten undergraduate and ten postgraduate finalist projects will be selected for the final idea presentation.
- F. The selected group(s) will be invited to develop their project plan/pitch in preparation for the final evaluation that will involve presentation to a panel of judges by end October 2013.
- G. The Outstanding prototypes, product or designs from each category will be selected by the panel of judges and rewarded with a cash prize plus ideas protection and commercialization assistance in October.

Appendix G: Commercialisation course



TECHNOLOGY COMMERCIALISATION AND ENTREPRENEURSHIP COURSE

JOIN US TO LEARN MORE ABOUT TECHNOLOGY INNOVATION & ENTREPRENEURSHIP.

The four universities in the Western Cape are collaborating to offer a 5-day course in Technology Commercialisation and Entrepreneurship.

Targeted at: science/engineering/technology-based postgraduate participants, postdocs, researchers, and those interested in the process of commercialising new technologies.

To enhance your knowledge on: intellectual property, licensing of technologies, industry and market research, business plan development, valuation models and the process for new business development, inter alia.

WHERE: TBA – venues will be alternated between all the university campuses (transport will be provided)

WHEN: Every Friday, from 27 February 2015 to 27 March 2015: 09h00-16h30

COST: R550 per person

The top 10 delegates nationally will be selected to attend a 5-day Advanced Entrepreneurship workshop in Switzerland, sponsored by the Swiss South African Joint Research Programme.



UNIVERSITEIT
STELLENBOSCH
UNIVERSITY



UNIVERSITY of the
WESTERN CAPE

For registration and further information contact Johnathan Smit:
johnathans@sun.ac.za, Tel: 082 353 8427.



INNOVUS

Appendix H: Consent form

Consent Form for Participation in a Research Study Cape Peninsula University of Technology

Title of Study: Design for Commercialisation: Enabling innovative product ideas through supportive creative environments.

Description of the research and your participation

You are invited to participate in a research study conducted by Luciano Wegmershaus. The aim of this study is to aid the enabling innovative product ideas through supportive creative environments through design so they may become commercially viable. To accomplish this, three case studies of entrepreneurs and their environments will be assessed and the information mapped to provide a better understanding of the innovation ecosystem for both the entrepreneurs and the institutions they are involved with.

Your participation will involve informal observations, interviews and discussions.

Risks and discomforts

There are certain risks or discomforts associated with this research. They include exposing institutional and/or personal blockages of the system concerned; these will be managed such that minimal conflict arises. Any material that appears volatile will be processed through the appropriate channels to be filtered and reviewed such as supervisors and operational managers.

Intellectual property of any products will be kept confidential to the best of our ability and only general information will be publicized, unless otherwise agreed.

Potential benefits

These include exposing institutional assistance such that the systems are able to function and advance more effectively. This research may help us to understand how the different actors involved within the system can communicate and function more successfully due to improved transparency and openness.

Protection of confidentiality

Each participant's information will be kept completely confidential within the research and any shared information will be explicitly agreed upon by participants. We will do everything we can to protect your privacy. Your identity will not be revealed in any publication resulting from this study unless you desire it.

Voluntary participation

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

Contact information

If you have any questions or concerns about this study, or if any problems arise, please contact Luciano Wegmershaus at 079 350 6331. If you have any questions or concerns about your rights as a research participant, please contact the Cape Peninsula University of Technology University Institutional Review Board at engelhillsp@cput.ac.za.

Consent

I have read this consent form and have been given the opportunity to ask questions. I give my consent to participate in this study.

Participant's signature _____ Date: _____

A copy of this consent form should be given to you.