Enabling Grassroots Innovation by Youth in Cape Town's Townships

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Abstract

Grassroots innovation has been recognized as a valuable means to empower local communities to address developmental issues. Enabling youth in townships to solve local problems is of particular interest in South Africa due to the poor socioeconomic conditions in these areas. These conditions include high unemployment rates amongst youth, which leads to youth disenfranchisement. There is a lack of support for grassroots innovation because it falls outside of mainstream support structures for innovation. Standard market incentives are less relevant for this socially driven form of innovation. Innovation competitions are a potential alternate mechanism to incentivize grassroots innovation. However, the danger with external incentives is that they can crowd out intrinsic motivation through the overjustification effect. Intrinsic motivation is necessary to increase creativity, performance and long-term engagement in an activity. Therefore, this study seeks to understand what motivates youth to take part in grassroots innovation activities, and how to use an innovation competition to provide appropriate incentives for these motivations. A gamification framework is used to analyse these motivations and the effects of incentives. This is an empirical study that focuses on *Innovate the Cape*, a high school innovation competition in Cape Town. Furthermore, given that this form of innovation in this developmental context is poorly understood, the learning processes are analysed. An innovation systems approach is used to explore the motivations of the actors and analyse their interactions within this institutional context. A qualitative study was conducted with 18 semi-structured interviews and 9 focus groups. The analysis revealed that participants had a broad range of motivations beyond the competition prize, which was seen more as a means to an end. Dominant motivations included making a social impact, social influence, personal development and the desire to learn. By taking these motivations into account, competition incentives can be used as a means to empower participants through rich learning experiences. Diverse interpersonal interaction and experiential learning were found to be vital components of the learning process. These components are sorely lacking in the local school system. There is a lack of accessible and relevant formal institutional support for early stage grassroots innovation. Furthermore, informal institutional factors underpinned many of the findings on the motivations and learning processes of the participants. On a systems level, it was shown that facilitating innovative behaviour on the grassroots level resulted in institutional building.

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Glossary

The following are terms and acronyms used repeatedly throughout this paper.

Codified knowledge: Formally documented knowledge that enables the user to learn and apply the knowledge directly from the documentation (Foray, 2013).

Development: Development can often be associated with industrialization and economic growth. Here, development includes growth that is sustainable and increases human potential (Redclift, 2002).

Grassroots innovation: innovative solutions to local problems created by individuals and organizations outside of formal research and development departments (Bhaduri & Kumar, 2011; Seyfang & Smith, 2007).

Innovation competition: an incentive mechanism for innovation involving organizers setting a challenge to participants for a reward for the most innovative solutions. Note that sometimes in the literature the term ‘contests’ is used to differentiate between general competition and a specific competition with prizes. The term competition is used here for simplicity. It will be made explicit when referring to competition in general.

Innovation system: the various agents involved in an innovation process interacting within an institutional context that affects their behaviour (Arocena & Sutz, 2002).

Tacit knowledge: something that is tacit is “implied or inferred without direct expression” (“tacit, adj.”, 2015). Tacit knowledge comes through observation and trying something oneself. An example is learning how to ride a bicycle.

Townships: a South African term for low-income urban areas that were designated in the Apartheid regime to non-whites. They usually exist on the urban periphery outside of the main economic hubs, such as central Cape Town, referred to here as ‘town’. Income levels within theses areas vary, but are generally far lower than in the economic hubs.

Youth: the term ‘youth’ can have various interpretations (Sebba et al., 2009). The South African National Youth Development Agency Act (2008) defines youth as persons from the

age of 14 to 35. In this research context the youth referred to here are high school learners between the ages of 16 and 20 years of age.

Acronyms

ANDE	Aspen Network of Development Entrepreneurs
CCDI	Cape Craft and Design Institute
CDW	Community Development Worker
DEDAT	Department of Economic Development and Tourism
DST	Department of Science and Technology
DUI	Doing, Using, Interacting
GEM	Global Entrepreneurship Monitor
HBN	Honey Bee Network
ICT	Information and Communications Technology
ITC	Innovate the Cape
IPR	Intellectual Property Rights
MIT	Massachusetts Institute of Technology
NGO	Non-governmental Organization
NIS	National Innovation System
NPC	National Planning Commission
OECD	Organization for Economic Co-operation and Development
R&D	Research and Development
SDT	Self-determination Theory
SME	Small and Medium-sized Enterprises
SOIS	Sustainability-oriented Innovation System
STI	Science, Technology and Innovation
TEA	Total Early-stage Entrepreneurial Activity
TIA	Technology Innovation Agency
UCT	University of Cape Town

1 Introduction

1.1 Background

Grassroots innovation refers to individuals operating in civil society outside of formal legally constituted organizations (Bhaduri & Kumar, 2011). They are positioned to directly respond to the local situations, values and interests in their communities (Seyfang & Smith, 2007). This creates the potential for innovations addressing social and environmental issues, often involving green technology (Seyfang & Smith, 2007). Grassroots innovation differs from mainstream innovation in that it primarily has a social purpose as opposed to making profit. It also differs from mainstream innovation in terms of the types of actors involved, the informal interactions and the bottom-up, demand-driven nature of the innovations. Innovation that is socially oriented and takes a bottom-up approach is increasingly seen as having the potential to address issues of a developmental nature that are not being addressed adequately by top-down approaches by government and large foreign aid organizations (Fowler, 2000).

Grassroots innovation can play an important role in inclusive development by including peripheral actors into the innovation process as knowledge producers and beneficiaries of social solutions. The need for inclusive development is evident in that although absolute economic development is desirable, it does not necessarily benefit all members of society (Paunov, 2013). With high global youth unemployment rates there is the danger of youth disenfranchisement (Paunov, 2013). Due to high population shifts to urban areas in Africa, many people end up living in informal urban-fringe areas, such as townships (Costello, 2009). It is abundantly clear that local municipalities cannot adequately provide essential services given the magnitude of this population shift to the cities. It becomes imperative to explore an alternative developmental methodology to relieve the dismal socio-economic reality within these areas.

Inclusive development is high up on the agenda of South African policy (RSA, 2011). South Africa is one of the most unequal societies in the world with a Gini coefficient of 0.69 (in 2011) (Stats SA, 2014). The highest unemployment rate is amongst youth between 15 and 24 (46.6 % in 2008) and 65 % amongst Black African youth (RSA, 2011:106). The National Planning Commission (NPC) states that these unemployment trends are the single greatest risk to social stability in South Africa and results in rebellion amongst youth (RSA,

2011:106). Significant areas of concern are urban areas with urbanization predicted to increase significantly over the coming decades (RSA, 2011:266).

There are many institutional instruments to support innovation in South Africa and there are sectors of high innovative activity. However, even thought there are pockets of high innovative activity, the majority of the population does not enjoy the benefits of these innovations. Mphahlele (2012) argues that the reason that mainstream innovation does not translate into benefits for the majority of the country is that South Africa is stuck in a technology-dominant paradigm with regards to innovation. This does not allow for a more inclusive model of innovation, which includes more socially oriented forms such as grassroots innovation.

Grassroots innovation also has many direct and indirect benefits. Direct benefits include the fact that grassroots innovation can be more responsive to local situations. Many areas can be reached that are not reached by mainstream development processes (Bhaduri & Kumar, 2011; Seyfang & Smith, 2007). Grassroots innovators can make use of their local knowledge to understand contextualized problems. This can be an empowering process for local actors. It results in increased civic engagement and builds social capital (Hielscher, Seyfang & Smith, 2011). Other benefits include job creation and the personal development of the actors involved. An indirect benefit is that grassroots innovators are not bound by the same constraints as with mainstream innovation. This allows for radical new approaches, which makes grassroots innovation a source of innovative diversity (Seyfang & Smith, 2007). These locally rooted activities can be embedded into society and have the potential to change production and consumption patterns in the mainstream (Seyfang & Smith, 2007). Finally, van Heyningen and Brent (2010) argue that there are opportunities to bring about systemic shifts in South Africa's innovation system, making it more sustainability-oriented. Both bottom-up and top-down forms of innovation play a large role in this process.

1.2 Research Problem

Given that grassroots innovation is characterized by informality and is performed outside of mainstream institutions, there is the challenge of finding suitable support for such initiatives. Grassroots innovation is significantly different to mainstream innovation in that the primary purpose is for social impact as opposed to generating profit. Within this context, this lack of the profit incentive creates a demand for alternative incentives to encourage participation. Therefore, an important question is how to incentivize this form of innovation if market

instruments such as fiscal incentives and Intellectual Property Rights (IPRs) cannot be utilized as the primary motivational factors. However, this form of innovation is generally not well understood and not well researched (Foster & Heeks, 2013). Consequently, there is a need to explore appropriate mechanisms for supporting grassroots innovation processes.

Innovation competitions have been shown to be an effective mechanism to incentivize innovation (Bullinger et. al., 2010), including grassroots innovation (Bhaduri & Kumar, 2011). Some competitions have drawn a level of participation that exceeds expectations if analysed with conventional economic rationality. An example was the X prize where the total investment by participants far exceeded the prize money. MacCormack, Murray and Wagner (2013) suggest that the prize is not always the main motivation for participation in innovation competitions. Therefore, there is a need to understand the motivation participants need in order to design appropriate competition incentives. Self-determination theory states that in order to have long-term engagement with improved creativity, performance and well-being, one needs to be intrinsically motivated (Ryan & Deci, 2000a). It has been shown that external rewards can have a negative effect on intrinsic motivation over time, called the 'overjustification effect' (Lepper, Greene & Nisbett, 1973). On the other hand, external rewards have been successfully used in processes to engage people in a highly motivated state (Blohm & Leimeister, 2013). This implies that competition incentives could be used to motivate participants and enable innovation. This leads to the question of how to design appropriate innovation competition incentives in order to enhance intrinsic motivation, hence ensuring innovative activity by the participants in the long term.

1.3 Research Context

Innovate the Cape

This research involves a case study of a competition for grassroots innovation called *Innovate the Cape* (ITC). The purpose of the ITC competition is to inspire and empower young innovators to solve challenges in Cape Town. The competition is run by an NGO called *Innovate South Africa*. The team is predominantly made up of young volunteers. ITC has run annually since 2013. A broad challenge is set for participants: to solve a challenge in their community in a new way. This challenge is open to any pertinent developmental need that a community has which is identified by participants. However, certain categories are suggested including energy, water, health, education, transport, agriculture and the natural environment. ITC is open for applications from any group of high school learners in the Cape

Town area in a group of two to five learners. Although the marketing of the competition is aimed at township communities, the competition is open to all high school learners in Cape Town. This ensures a representative group of finalists. The prize is R15,000 in seed funding, mentorship and the opportunity to attend collaborative design thinking workshops.

The competition process begins with an ignition phase where volunteers go out to schools and do creative brainstorming exercises with learners. Groups of learners apply with their own problem statement and solution. A group of up to eight finalists are selected to go through a 10-week prototyping phase with access to R5,000 per group in seed funding. All finalists then showcase their prototypes and future plans before a panel of judges for the final prize of R10,000.

Cape Town's Townships

Townships are urban periphery areas that were demarcated for non-whites during Apartheid. They are often situated far away from economic hubs such as the city centre and lie on infertile land, making local agriculture difficult. The townships in this study include Khayelitsha, Philippi and Imizamo Yethu, which are predominantly Xhosa speaking. Imizamo Yethu is an exception in that it is well situated near economic activity in Hout Bay. There are poor socio-economic conditions in townships such as high unemployment rates and poor service delivery. The housing is dense and includes a lot of informal settlements with poor basic infrastructure. There are high crime rates and gangsterism. This is especially the case in Cape Town's townships, which have a very high homicide rate (RSA, 2011:103).

1.4 Research Purpose

As discussed above, grassroots innovation has several direct and indirect benefits as a means to inclusive development, especially for youth in low-income urban periphery areas. However, there are challenges in supporting and incentivizing early stage grassroots innovation. This study examines how an innovation competition could be used as a means to do so. This requires gaining empirical insight into what motivates competition participants and what the learning processes are.

Therefore, the first purpose of this study is to determine the motivations of youth to enter an innovation competition and explore the dynamic between the external rewards of the competition and these motivations. The second is to gain a deeper understanding of the

early stage learning processes of grassroots innovation by youth and to investigate the enabling factors for facilitating this learning within the context of this case study: township communities in Cape Town.

This understanding will give insight into individual innovative behaviour which can be used to create favourable germination conditions for grassroots innovation by township youth, thus empowering them to be producers of knowledge and increase their civic engagement. This will ultimately serve to build the innovative capacity of South Africa for inclusive development.

1.5 Research Objectives

Given the purpose above, the aim of the research is to determine appropriate incentives in an innovation competition for grassroots innovation by youth in Cape Town's townships. Furthermore, the aim is to explore how to create an enabling environment for early stage learning in the innovation process. This leads to the following objectives.

1. Determine the personal motivations for youth to initiate grassroots innovation projects.
2. Determine which competition incentives are appropriate to match the motivations.
3. Determine the enabling factors of the early stage learning processes.
4. Determine the influence of the institutional context on all of the above motivations and learning processes.

1.6 Research Relevance

As a case study this research is important for gaining a better understanding of grassroots innovation on the ground level where it occurs. It is of interest to local policy makers in terms of gaining insight into incentivizing and enabling grassroots innovation through identifying weaknesses in top-down support for local innovation in order to build the innovative capacity of South Africa. There is the potential for these learnings from the grassroots to be transferred into the mainstream in terms of individual motivation and behaviour. This research is also relevant to educators, youth organizations and competition designers in terms of creating a supportive and engaging environment for youth innovation.

1.7 Research Method

This research is a qualitative empirical study given that the subject is a poorly understood form of innovation on the grassroots level (Seyfang & Smith, 2007). This aligns with the theoretical framework of innovation systems used in this study, which is empirically and qualitatively oriented (Carlsson, 2007:858). The approach is subjective interpretivist, as the research seeks to explore the perceptions of in-depth drivers of human behaviour and their interactions. The research strategy included semi-structured interviews and focus groups with the ITC competition participants and mentors. The researcher, who is also the competition director, took research notes. A thematic analysis was done on the data using the qualitative coding software, NVivo.

1.8 Outline

The dissertation consists of six chapters. In Chapter 2 the literature on grassroots innovation and innovation competitions is reviewed and the theoretical framework of innovation systems is described. This is followed by the research questions and objectives. In Chapter 3 the research methodology is described. In Chapter 4 the analysis is presented with some discussion in relation to the research questions after each section. In Chapter 5 the analysis is discussed from a systems perspective. Finally, Chapter 6 concludes the thesis by stating what has been achieved in relation to the aims and suggests further research directions.

2 Literature Review

2.1 Grassroots innovation

In the following section grassroots innovation is defined and positioned within the innovation literature; an argument is given for why grassroots innovation is needed, particularly for township youth in Cape Town; challenges to grassroots innovation are presented; finally mechanisms to enable grassroots innovation are reviewed.

2.1.1 Defining grassroots innovation

Much of the modern literature on innovation begins with Schumpeter who was one of the pioneers of recognizing the significance of innovation as a driver of economic growth. He describes innovation as ‘new technological combinations’, which allows an economy to progress out of a circular flow of income (Schumpeter, 1934). Bower and Christensen (1995) describe this kind of innovation, which results in a new form of market, as ‘disruptive’ or ‘radical innovation’. Subsequently, minor technical combinations have been recognized as ‘incremental innovation’. The early definitions of innovation were focused on technological innovation that results in greater profit for firms. However, broader definitions of innovation have been given which include services and organizational innovation. An example of this is the definition given in the Oslo Manual (2005), “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.” (OECD/Eurostat, p. 46). Lundvall (2007a) recognizes that these other areas of innovation, including human resources, organizational forms and social capital, have a strong influence on how technical innovation will affect economic performance.

Another deviation from narrow technological definitions of innovation is social innovation, which has a primary focus on making a social impact as opposed to making profit. Although the use of the term ‘social innovation’ has been common in recent years, definitions vary. Moulaert et al. (2005) discuss how the concept of social innovation came out of a need to find alternate means to local development from top-down structures. They give an overview of definitions and conclude on two senses of the definition that should be included. These are that social innovation should fulfil “unsatisfied or alienated human needs; and innovation in the social relations between individuals and groups in neighbourhoods and the wider territories embedding them.” (Moulaert et al., 2005:1973) Therefore, innovation could

broadly be defined as “anything new successfully introduced into an economic or social process” (Spielman, Ekboir & Davis, 2009:400).

Grassroots innovation is a form of the broad definition of social innovation in that it driven by local need as opposed to a profit motive. In contrast to the focus in the Oslo Manual, which describes innovation as being centred around firms that use innovations as a source of market advantage (OECD/Eurostat, 2005, p. 29), grassroots innovation refers to individuals operating in civil society outside of formal organizations such as firms or research institutes. There is thus a similar focus to Schumpeter’s focus on the individual. These individuals respond to the local situations, values and interests in their communities by creating social innovations, often involving green technology (Bhaduri & Kumar, 2011; Seyfang & Smith, 2007). Grassroots innovation involves informal, bottom-up processes that are demand-driven as opposed to supply-driven. It often includes marginalised actors both as users and producers of knowledge. Therefore, grassroots innovation is also innovative in that it can result in changing societal norms and values (Seyfang, 2006).

Grassroots innovation exhibits attributes of many emerging forms of innovation in the literature that differ from mainstream innovation. Common departures from the mainstream are the social purpose, the actors involved, the informal interactions and the bottom-up, demand-driven nature of the innovation. One broad category of innovation is innovation for inclusive development. As the name suggests, this refers to innovation that is for or by the poor. These innovations primarily have a goal of having inclusive benefits for those who are usually excluded from the economic mainstream. Synonymous terms include bottom of the pyramid innovation, below the radar innovation, and frugal innovation. In the case of grassroots innovation the innovators are typically local actors who are driven by local needs, as opposed to foreign aid organizations. In that sense grassroots innovation involves a lot of user innovation, i.e. the knowledge creators are not typical producers such as large firms. These users are often hobbyists who are motivated to innovate in order to solve a problem that affects them. To show the significance that user innovation has in general, examples include the mountain bike and the personal computer. Hobbyists were mainly responsible for developing both innovations out of a personal interest. Mountain bikers transformed road bikes so that they could be used off-road. Computer hobbyists created cheaper and smaller computers, as opposed to the original large and expensive computers, thus making them far more affordable and accessible. The importance of the cyclical nature of the innovation process, which includes users, is therefore increasingly being acknowledged (von Hippel, 2005). A common feature of user innovation is the collaborative process of product development that often involves open innovation, i.e. innovation that is open to contribution

from the general public. Open innovation is closely linked to concepts like open source, wikis and crowdsourcing. It is particularly interesting in terms of how it is driven because the common mainstream incentive of IP is often not possible. IPR is a contentious issue with open innovation, and emerging forms of innovation in general, in terms of whether it is a barrier or an enabler of innovation given the use of patents to stall innovation (Bhaduri & Kumar, 2011). Therefore, the question how to incentivize these forms of innovation is not straightforward.

2.1.2 Why Grassroots Innovation?

Due to the fact that grassroots innovation falls outside of the mainstream and can have limited support, it may be argued that the potential impact is not substantive enough (Paunov, 2013). However, there are many counter-arguments given in the literature on the value of grassroots innovation. These arguments state how grassroots innovation provides appropriate solutions within local contexts with several direct and indirect benefits. This plays an important role in inclusive development and has relevance to mainstream innovation. The emerging forms of innovation mentioned above are increasingly seen as having potential to address issues of a developmental nature that are not being addressed adequately by top-down approaches by government and large foreign aid organizations (Fowler, 2000). In this section an argument for the need for inclusive development is presented, specifically for township youth in South Africa, and the benefits of grassroots innovation as a developmental approach are discussed.

It may be argued that absolute growth has more of an impact on poverty reduction than inclusive growth. One cross-country study states that a rise in average incomes can account for up to 97% of poverty reduction in the long run (Kraay, 2006). However, Paunov (2013) gives several reasons why this is not necessarily the case. Although absolute economic growth is desirable, it cannot be proved that there will be a trickle down effect for those outside of the economic mainstream. Unbridled economic growth, often technologically focused, in a developing context often results in islands of excellence without productivity for the general population. Another effect of exclusivity is the effect that it has an alienating effect on the excluded, resulting in civic disengagement. With rising global youth unemployment rates there is a particular problem with youth disenfranchisement (Paunov, 2013). Also, some informal contexts aren’t reached by formal development mechanisms. The high rates of global migration to urban areas lead to growing informal settlements on the periphery of cities. It is already estimated that over 70% of the urban population in Africa live

in slums (Costello, 2009). The burden of these population shifts on local municipalities makes informal urban-fringe areas, such as townships, an important aspect of the developmental agenda.

Inclusive development is high up on South Africa's policy agenda as seen in this quote from the National Planning Commission (NPC):

> To build a socially cohesive society, South Africa needs to reduce poverty and inequality by broadening opportunity and employment through economic inclusion, education and skills, and specific redress measures; promote mutual respect and inclusiveness by acting on the constitutional imperative that South Africa belongs to all who live in it, and that all are equal before the law; and deepen the appreciation of citizens' responsibilities and obligations towards one another. (RSA, 2011:35)

South Africa is one of the most unequal societies in the world with a Gini coefficient of 0.69 (in 2011) (Stats SA, 2014). This unequal distribution of wealth is seen in how dominant certain cities are economically. Cape Town, which has under 8% of the national population, produces 20% of the GDP (Paunov, 2013). However, even though Cape Town is a wealthy city within South Africa, it faces high inequality and poor conditions, especially in township areas. Geographic exclusion still exists and urban areas are still shaped according to the Apartheid regime (RSA, 2011:267). In Khayelitsha, the largest township in Cape Town, 74% of households have a monthly income of R3,200 or less, only 45% of households live in formal dwellings and service delivery is poor (City of Cape Town, 2013). Urbanization is predicted to increase significantly over the coming decades, particularly among young and mostly poor working-age youth (RSA, 2011:266). This increases the burden on municipalities to deliver services. It also means that urban areas are not productive enough, further exacerbating youth disenfranchisement (RSA, 2011:267).

South Africa is characterised by a high unemployment rate as well as a very low informal employment rate for an African country (Heintz & Posel, 2008). The highest unemployment rate is amongst youth between the ages of 15 and 24: 46.6% in 2008, and 65% amongst Black African youth (RSA, 2011:106). The unemployment rate in Khayelitsha is 38.32% (City of Cape Town, 2013) compared with an average of 23.88% in Cape Town (City of Cape Town, 2012). The NPC states that these unemployment trends are the single greatest risk to social stability in South Africa and results in rebellion amongst youth (RSA, 2011:106). Entrepreneurship and SMEs have been identified as one of the biggest drivers of economic growth in South Africa (Herrington & Kew, 2016; RSA, 2011). However, South Africa's total

early-stage entrepreneurial activity (TEA) rate is 2.4 times lower than the African average (Herrington & Kew, 2016). There has also been a drop in Black African entrepreneurship activity from 85% of the national total in 2013/2014 to 68% in 2015 (Herrington & Kew, 2016). According to the Global Entrepreneurship Monitor (GEM) report (2016), the three biggest factors affecting unemployment are government policy, access to finances and education and training. Social and cultural norms are also highlighted as important factors (Herrington & Kew, 2016). Heintz and Posel (2008) suggest that labour market segmentation can largely explain South Africa's low informal employment rate. Some suggested causes of this segmentation include a lack of capital and business experience, crime, a lack of knowledge of English and Afrikaans, and social capital. This low informal employment rate in South Africa is accompanied by a dropping rate in motivation for entrepreneurship as opportunity-driven entrepreneurship and a rise in needs-based entrepreneurship, which increases the likelihood of these businesses failing as shown by the low SME success rate (Herrington & Kew, 2016). Therefore, there is an urgent need to create conditions, especially for Black African township youth, where people are empowered and motivated to develop businesses.

As mentioned, education and training has been identified as a major factor for unemployment in South Africa. South Africa has one of the poorest performing statistics for education for a middle-income country (Spaull, 2013). There are several high performing schools, however there is a gross divide in performance between these schools and the majority. Currently, of all students entering the school system in South Africa, 50% will make it to matric and only 12% will have a good enough qualification to go to higher education (Spaull, 2013). The quality of knowledge transfer in terms of what is learnt and what should be learnt is therefore brought into question. In Khayelitsha only 36% of those aged 20 years and older have completed their secondarly education (City of Cape Town, 2013). According to the GEM report (2016), most entrepreneurs do not have more than a secondary education; meaning most people rely on school education for skills development. Therefore, unfortunately both the quantity of school leavers and the quality of their education leaves a small percentage of well-equipped entrepreneurs, especially in townships.

With regards to civic engagement, the NPC (2011) states, "in many respects, South Africa has an active and vocal citizenry, but an unintended outcome of government actions has been to reduce the incentive for citizens to be direct participants in their own development" (p. 37). This results in many protests and a "sit back and the state will deliver" attitude that needs to shift (RSA, 2011:37). This can result in 'learned helplessness', i.e. an individual has reduced motivation to voluntarily initiate tasks because they have come to expect that the

outcomes are uncontrollable (Abramson, Seligman & Teasdale, 1978). The NPC goes on to say that in order to achieve this there is a need for civic engagement incentives and the participation of youth in community development initiatives. The NPC also stresses that entrepreneurship is an important means to creating a more inclusive economy and that there is a need for youth entrepreneurship training programs. Therefore, grassroots innovation and entrepreneurship programs for youth that incentivize civic engagement are needed.

Grassroots innovation has many direct and indirect benefits. A direct benefit of grassroots innovation is that it is able to utilize local knowledge and existing social capital in order to provide efficient bottom-up solutions that are responsive and reflexive (Bhaduri & Kumar, 2011; Seyfang & Smith, 2007; Marquardt, 2013a). Social capital is augmented through the interactions that result in grassroots solutions and increases trust, a sense of community, common ownership and civic engagement (Hielscher, Seyfang & Smith, 2011). The main actors are immersed in the problem space and are thus able to use their personal knowledge and relationships as a good starting point to effect change (Bhaduri & Kumar, 2011). Grassroots innovations are able to reach areas of informality and include actors on the periphery to provide localized solutions that are not reached by mainstream development means (Bhaduri & Kumar, 2011;Seyfang & Smith, 2007). Haugh argues that innovation with a social purpose can be more efficient because of lower input costs (Marquardt, 2013b). This is because organizations founded on shared values can take advantage of civic energy and volunteers. Other direct benefits include skills development, job creation as well as personal development for the innovators (Seyfang & Smith, 2007).

The indirect benefits of grassroots innovation have relevance for inclusive development and mainstream innovation. It has been argued by Nicholls that even if the direct impact of grassroots innovations on communities may be limited, the greatest value for development is creating ethical, morally-sound, publicly-minded young individuals through grassroots activities who will then enter mainstream structures to effect substantive change (Marquardt, 2013a). Furthermore, it has been acknowledged that there is a need to tackle global challenges as well as have local activities in order to improve communities (Seyfang & Smith, 2007). These local activities can become embedded into society and effect behavioural change (Seyfang & Smith, 2007). An example if this is a change in community values that can result through the creation of community currencies such as Local Exchange Trading Schemes, the cashless exchange of local goods, and Time Banks, which rewards unpaid work according to time spent on an activity (Seyfang, 2006).

As mentioned above, grassroots innovation provides a bottom-up approach to development that includes more actors and reaches more areas than may be possible with top-down approaches. Bhaduri and Kumar (2011) speak about the importance that Gandhi placed on empowering local communities to solve their own challenges in terms of bringing better distributive justice. There is even a term used in India, ‘swadeshi’, to describe self-reliance by using local knowledge. Therefore, Bhaduri and Kumar (2011) state, “grassroots innovation is a symbol of empowerment through self-help” (p. 30). Mphahlele (2012) agrees that grassroots innovation increases self-reliance and reduces exploitation in the South African context. Seyfang and Smith (2007) argue that grassroots innovation is of interest as a source of innovative diversity. Being on the periphery, outside of formal sectors, the rules that apply to the formal sector don’t necessarily apply. This provides innovators with further scope for experimentation. Grassroots solutions are needs based and have an approach of exploring problem framings for solutions rather than pushing tight technologically focused solutions onto communities from the outside. Furthermore, Seyfang and Smith suggest that the embedded effects of grassroots innovation in communities have the potential to change production and consumption patterns towards more sustainable practices.

This potential to bring about substantial change within society is believed by some to go so far as to have the potential for systems change. Van Heyningen and Brent (2010) discuss the potential to bring about a systems change in South Africa’s innovation system to become a sustainability-oriented innovation system (SOIS). They argue that South Africa is well placed to leapfrog sustainability issues faced by developed countries through a two-way systems change. This involves an interaction between both bottom-up movements (such as grassroots innovation) and top-down structures in order to achieve this change. Grassroots innovation can inform top-down structures on how to be relevant within a localized context. Therefore, understanding how to enable grassroots efforts is an important part of realizing systemic change in South Africa’s innovation system.

2.1.3 Challenges for Grassroots Innovation

Although grassroots innovation does have a lot of benefits to society, it does also face several challenges and limitations. Grassroots innovation often lies at the intersection of the public, private and third sectors. This leads to a lack of support because of a lack of responsibility falling to any particular sector (Seyfang & Smith, 2007). Furthermore, Mphahlele (2012) argues that grassroots solutions are seldom included in formal innovation systems. Given that grassroots innovation often falls outside of the mainstream, even though

this means it is a source of innovative diversity as mentioned above, it also means that the solutions can be somewhat rebellious and inherently different to the mainstream, leading to low acceptance of the innovations (Seyfang, 2009). Another issue relating to the, at times, radical nature of grassroots innovation is that it is very experimental. This can mean that it is difficult to fund projects if there is too much uncertainty about the outcomes (Seyfang, 2009). The solutions can be too localized, making it difficult to scale by translating the solutions to other areas. Kumar (2013) argues that this point is not strong enough to discount grassroots innovation, because sometimes innovation does need to be localized to meet a particular local need, making it valuable nonetheless. The NPC reiterates this stating that location-specific solutions are needed to address certain challenges in South Africa (RSA, 2011: 266). Grassroots innovation is often not acknowledged as a source of innovation (Esders, 2013). Because of the lack of acknowledgement, and the often informal nature of grassroots innovation, the learning is not documented. This informality and lack of documentation also makes the link between grassroots innovation and policy makers weak (Bhaduri & Kumar, 2011). This is unfortunate given the potential value that grassroots innovation can bring to top-down governance structures. Finally, the common incentives for mainstream innovation such as IPR and fiscal incentives are less of a driving factor for grassroots innovation because of the primary social goal versus making profit. This leads to the question of what kind of mechanisms can be used to support and incentivize innovative grassroots behaviour.

2.1.4 Grassroots innovation literature gaps

There are various gaps in the literature on grassroots innovation. There is a need for understanding of the grassroots innovation processes in general given that few empirical studies have been done (Foster & Heeks, 2013). In order to support grassroots initiatives and create an environment where they are encouraged, Seyfang and Smith (2007) recommend that qualitative analysis be done on the conditions required for their germination. Documenting innovation processes and learning from grassroots innovation presents a large gap as well (Gupta, 2013a; Seyfang & Smith, 2007). This is necessary to support grassroots innovation, but also to take the relevant learning and transfer it to the mainstream (Seyfang & Smith, 2007).

In terms of incentivizing grassroots innovation, given that the actors are passionate individuals, their personal motivations are an important consideration. The actors often exhibit economic agent failure, i.e. do not maximize their utility (Iizuka, 2013). Therefore, market incentives are not as influential in driving grassroots innovation. This has been a

point of confusion for economists. Given this significant deviation from mainstream innovation, an important question is how to incentivize grassroots innovation according to these alternate motives. Schumpeter places a lot of emphasis on the entrepreneurial aspect of innovation and the personal drive to create new things (Hagedoorn, 1996). Schumpeter (1934) speaks of innovation being motivated not simply by the desire for private wealth, but rather for the “joy of creating of getting things done” (p. 94). This behaviour that seeks out challenges and “delights in ventures” is argued to be the most independent factor explaining innovative behaviour and economic development (Schumpeter, 1934:93-94). Even though Schumpeter makes these claims, studies on personal motivation within the innovation literature are usually done within an organizational management framework, and often focus on incentives. However, motivating individuals within large organizations is not necessarily effective only using external rewards (Ahmed, 1998). Therefore, understanding the motivation of individual innovators has relevance to mainstream innovation as well.

2.1.5 Mechanisms to Enable Grassroots Innovation

Examples from India

Grassroots innovation has been a significant subject of study in India, which, like South Africa, is an emerging economy. Anil Gupta is one of the main proponents of grassroots innovation in India. He has been involved in many initiatives to support what he sees as an invaluable form of innovation. One mechanism is a network called the Honey Bee Network (HBN). The network consists of thousands of grassroots innovators from all around the country. Their innovations are documented and shared online. The HBN has spread to other countries as well, including China. The focus of the network is to share grassroots knowledge and, especially, to acknowledge indigenous knowledge systems as an excellent source of innovation (Gupta, 2003). A good example of this is a clay pan that works very well as a non-stick pan. It costs very little to make and does not wear out, like modern Teflon pans can do, therefore reducing the risk of ingesting harmful materials (Kumar, 2013). Gupta emphasizes the importance of developing networks for knowledge sharing in order to enable grassroots innovation. He also emphasizes the need to protect local knowledge through innovation funds and IPR support. Other effective mechanisms include innovation competitions for youth (Gupta, 2013b).

South African Interventions

South Africa does have strong institutional support for mainstream innovation. South Africa performs fairly well globally, scoring 54th out of 141 countries in the Global Innovation Index (Dutta, 2012). The Department of Science and Technology (DST) direct much of the institutional support. These include the Technology Innovation Agency (TIA), the South African Agency for Science and Technology Advancement, the Council for Scientific and Industrial Research and the National Intellectual Property Management Office. The Department of Trade and Industry has various initiatives to provide venture capital stimulation and fiscal incentives for private sector participation. The Department of Small Business Development is another government department that supports SMEs. Other instruments include funding agencies such as the National Research Fund, advisory bodies such as the National Advisory Council on Innovation and innovation networks such as South African Innovation Network. Youth-focused initiatives include the Youth Enterprise Development Strategy and the Youth Technology Innovation Fund made available through the TIA.

The need to take a multidisciplinary approach to support innovation for inclusive development in South Africa in order to create an inclusive society is clearly stipulated in policy documents such as the White Paper on Science and Technology (1996). The DST does also have a Chief Directorate on Innovation for Inclusive Development that focuses on technology transfer in rural areas and natural resource sectors. However, South Africa still faces a high level of inequality. Mphahlele (2012) addresses this issue in his thesis entitled, *Innovation Agenda for South Africa in the 21st Century: Towards an alternative inclusive and integrative model*. Mphahlele argues that the reason that South Africa's good innovation performance does not translate into benefits for the majority of the country is that South Africa is stuck in a technology-dominant paradigm with regards to innovation. This is evident in that many of the enabling instruments mentioned above are directed by the DST and have a technology focus. Mphahlele states that this problematic restricted paradigm has resulted in a lack of strategy to promote broader forms of innovation such as grassroots innovation.

The South African government does have a specific program aimed at supporting grassroots innovation that falls under the Department for Public Services and Administration. However, these projects are initiated externally by Community Development Workers (CDWs) and not by individuals at the grassroots. This would be an important difference in terms of the potential to truly empower community members according to Gandhi (Bhaduri & Kumar, 2011). The recommendations on the department's documented cases of grassroots

innovation revolve around the role that CDWs play in enabling grassroots innovation. Therefore, this program has a limited scope in supporting existing grassroots innovation.

The Aspen Network of Development Entrepreneurs (ANDE) created an *Entrepreneurial Ecosystem Map*, which gives a comprehensive list of support organizations for entrepreneurship in South Africa (ANDE, 2015). This includes support for social innovation and social entrepreneurship, and lists several NGOs. The gaps that are presented by ANDE include a lack of coordination between actors, making it a fragmented system; a mismatch between capacity support and funding; and an early stage-funding gap. It can be seen that there are many support programs for start-ups, but there are a limited number of organizations that support early stage ideation activities, only 12 out of a total of 214. A further gap for youth innovation is that the ideation programs that do exist do not include secondary education actors.

In the Western Cape one of the main support instruments for innovation is the Cape Craft and Design Institute (CCDI), which falls under the Department of Economic Development and Tourism (DEDAT). DEDAT has identified design as a means to unlock innovation and drive economic growth (CCDI, 2013). The department created the *Western Cape Design Strategy,* the first design strategy on the continent aimed at achieving this goal (CCDI, 2013). Although the strategy sees innovation as a key link between design and economic development, it also acknowledges design as a tool to solve local problems. The following challenges facing design in the Western Cape with regards to support, collaboration and education are given.

The support challenges include the finding that firms have a poor understanding of sustainability with regards to social challenges and have a perfunctory approach in solving them. There is also limited engagement with the low-income market to determine what local needs are. Therefore, there is an import-led approach as opposed to the potential production of local products and services (CCDI, 2013). This shows that grassroots innovation could play an important role in the Western Cape in providing local solutions that are demand-driven, engage local low-income communities, are locally produced and provide insight to the mainstream on approaches to sustainable development. The strategy states that there is a lack of incentives to support collaboration amongst actors in the design industry. Furthermore, the education system produces graduates with insufficient skills and that design is often not recognized as a viable career option for students and learners. Another issue is that the local design industry is at a low maturity level of design, and has a poor value for design, according to a local design survey within the strategy. The strategy

proposes a four stage ‘design ladder’, with innovation being the highest level of maturity. The conclusion of the study is that the maturity level is between stage 1: perceived non-design[1], and stage 2: design as styling[2], whereas stage 3 is design as process[3]. Therefore, there is a maturation process required for innovation to be recognized and integrated into the design industry in the Western Cape.

In this section, grassroots innovation has been described within the innovation and development context. The need for grassroots innovation has been discussed, specifically within the context of youth in Cape Town’s townships. The gaps in the grassroots innovation literature have been discussed and the need for mechanisms to support grassroots innovation in South Africa has been shown. The theoretical framework that is used in this study to explore how to enable this form of innovation will now be presented.

2.2 Theoretical Framework: Innovation Systems

The theoretical framework used in this study is innovation systems, a common framework within innovation literature. Firstly, a background to innovation systems within complexity science is given, along with a discussion on the relevance of a systems approach for this study. This includes a description of the complex systems theory constructs used. This is followed by an explanation of the gaps in the innovation systems literature. Finally, a description of the components of an innovation system is given.

2.2.1 Background to Innovation Systems

The innovation systems concept was introduced in the 1980s by scholars such as Freeman, Nelson and Lundvall (Lundvall et al., 1994). Innovation systems are used to analyse the creation, diffusion and flow of knowledge (Carlsson et al., 2002). These systems can be within a national, regional, sectoral or technological grouping (Carlsson et al., 2002). It became increasingly evident that the knowledge flow that resulted in innovation was a result

[1] “No special attention to design is paid, with product development being done by company staff who usually lack expertise in the field of design. The opinions and views of the end-user also only play a negligible role in the composition of the product.” (CCDI, 2013)

[2] “Companies at this stage are slightly more aware of the role of design in business, but only on a very superficial level, with design being considered only as part of the aesthetics of the final product. Companies have some engagement with professional designers.” (CCDI, 2013)

[3] “Design of the product is adapted to the task at hand and is more focused on the needs of end-user. It will also typically require a multidisciplinary approach and therefore more resources.” (CCDI, 2013)

of the interaction of various actors within economic systems such as customers and marketers (Lundvall et al., 1994). The understanding of innovation began to move away from the old model, which had a linear, reductionist framework, toward a complex, process-based systems approach (Godin, 2006; Spielman, Ekboir & Davis, 2009). This systems approach began being adopted by policy makers and students of innovation in order to understand the broader contributions of actors outside of R&D departments to the process of innovation (Lundvall et al., 1994). Therefore, it is an appropriate framework for grassroots innovation where the main actors are not necessarily formal researchers and producers. Actors gain knowledge through their own efforts and through complex interactions with other actors. These results in 'knowledge spillovers' provided they have enough absorptive capacity (Carlsson, 2007:859; Fischer & Fröhlich, 2013). As the word suggests, 'spillovers' are unintended flows of knowledge between actors, which suggests that knowledge flow is often the cause of non-market related interaction (Carlsson, 2007:859). These non-market related interactions, which add value to the economy, are shaped by institutions (Fischer & Fröhlich, 2013). Therefore, innovation systems can be described as "institutional arrangements to facilitate spillovers (provide connectivity) among economic actors" (Carlsson, 2007:859).

2.2.2 Innovation as a Complex System

Innovation systems theory is founded in complexity science (Spielman, Ekboir & Davis, 2009). Therefore, in order to give a theoretical background to innovation systems, the concept of complexity is introduced here. Complexity is difficult to describe concretely. It could be described as a worldview as opposed to a theory. The word, complexity, is not synonymous with being complicated, in that it is something that can be resolved to be made simple, but rather has many layers and interconnected parts (Goldstein, 2008). Complexity science arose in the 1970s as a departure from the Newtonian linear, reductionist framework, which is the basis of most scientific inquiry. The complexity approach came out of a need to understand complex non-linear natural systems, such as the weather and ecosystems, to human systems, such as the world wide web, economics and innovation. Complex systems have a large number of interconnected actors. The systems cannot be described accurately by the sum of attributes of the individual parts, but must be described by their interactions within a specific context and the resultant emergent structures. Therefore, there is an interest in the dynamics of these systems in terms of how these processes happen. Complex systems cannot be fully known and so there is no means to control or to accurately predict their future states (Goldstein, 2008).

Innovation processes resemble a complex system (Balzat & Hanusch, 2007; Katz, 2006). New knowledge combinations are a result of the interactions between actors within an institutional context. In order to enable this transfer of knowledge one needs to have a good understanding, not only of the actors, but also of their interactions and the learning processes that result. In complexity science the learning process for innovation could be described as an evolutionary process. This includes variation, selection and retention. Innovation is similar to these principles of evolution in that a large variety of sources of knowledge results in new knowledge, but only becomes economically or socially valuable once it is implemented over a period of time, i.e. retained. Complexity helps to provide a deeper understanding of innovation systems and the processes of change within these systems (Fischer & Fröhlich, 2013). Spielman, Ekboir and Davis (2009) argue that the innovation systems approach can miss some of the significance of a systems approach without a good understanding of complexity. Therefore, in order to have a deep understanding of how to enable grassroots innovation, certain complexity constructs will be described.

Goldstein (2008), in his paper, *Complexity Science Applied to Innovation,* gives the following four complexity constructs as essential to understanding complexity: networks, differences, emergence and attractors.

Networks

A network is a pattern of relationships between many interdependent actors (Morçöl & Wachhaus, 2009). Networks are comprised of nodes (actors), which have edges (connections) between one another with a certain amount of connectivity to form structures (Goldstein, 2008). A highly connected network will have a high ratio of edges to nodes. An important aspect of networks is the network structure and how centralized it is, i.e. how dependent it is on a few nodes. The more decentralised a network is, the more resilient it is, because it does not depend on a few nodes functioning. An example of a centralized structure is an airport network, whereas a decentralised structure example would be the world wide web. Decentralised structures are more resilient because of a lack of dependency on a few nodes. Highly centralized network structures can reach a critical state if enough dependent nodes are compromised, which can result in a runaway effect. The study of networks is therefore interested in not only attributional data, but also relational data (Spielman, Ekboir & Davis, 2009).

Differences

Differences are necessary in order to transfer anything between nodes in a network. This is because if there were no differences, the nodes would be similar and there would be no need to transfer anything (Goldstein, 2008). This concept can also be broadened to systems as a whole. There can be differences between systems, which require a transfer of something between them in order for them to interact. If there is an interaction between systems they are known as open systems. If there is no interaction they are known as closed systems. In the case of innovation the main thing transferred between nodes or systems is new information. Differences also create diversity for learning processes. It has been shown that differences in perspectives, interpretations and conceptual representations make a huge difference in creative idea generation for problem solving (Page, 2007). These differences often come from the periphery, both in the literal geographic sense, and in the metaphoric sense of being outside business-as-usual (Goldstein, 2008). This gives further reason for why the grassroots is a relevant source of innovation. Complex systems need the means to exchange information across differences in order for knowledge transfer to take place (Goldstein, 2008). This corresponds to spillovers and absorptive capacity in an innovation system. On the one hand, differences contribute to the complexity of a system and make it difficult to predict and control. On the other hand, they result in variation for the evolutionary learning process. Differences also give rise to the potential for self-organization and emergence, which will be described next.

Emergence

Emergence is when new structures, patterns or processes arise within a complex system. These emergent phenomena result as a combination of micro level elements that make up a new macro level element. These macro level elements have new rules and structures compared with the micro level components (Goldstein, 2008). Therefore, the capacity of complex systems is greater than the sum of its parts (Manson, 2001). Emergence is closely linked with self-organization, i.e. where these macro phenomena occur spontaneously without external influence. In other words, they are bottom-up versus top-down processes. This is what makes emergent phenomena difficult to predict and control. Grassroots innovations, therefore, often resemble self-organized systems. Since these emergent phenomena are not controlled externally, the question is how to facilitate an environment that encourages their materialization.

Attractors

The evolution and development of phenomena within a complex system are constrained by attractor states. These are the values that system variables will tend towards in the long term (Manson, 2001). Therefore, within society, institutions could be considered to be attractors which behaviour will tend towards (Byrne, 1998:128). Attractors are important to consider with regards to system changes. Intra-attractors are changes within a system that will conform to the ruling attractors. Inter-attractors, on the other hand, result in a phase transition of the system (Goldstein, 2008). This happens when there is a significant enough change in a system parameter that it overcomes a threshold and brings the system into a new state. Innovation includes both intra- and inter-attractor change. The more radical the innovation, the more likely it will result in new attractor regimes (Goldstein, 2008). Grassroots innovation represents an opportunity to bring about these radical changes given that it comes from the periphery and is not constrained by mainstream rules.

2.2.3 Why Innovation Systems?

In essence, the innovation systems framework offers an interdisciplinary, holistic approach that studies the interactions between many actors and the contextual factors which shape those interactions (Arocena & Sutz, 2002). This relational analysis is done in order to understand how knowledge is transferred, resulting in innovation. Understanding innovation as a complex system is vital in order to take the interdependencies between system components into account. To only focus on single variables or actors without taking into account how they are connected to others can be misleading (Lundvall & Johnson, 1994). There has been a rapidly increasing use of the framework for developing countries (Lundvall et al., 2002), making it relevant to this study. Given the institutional focus of innovation systems, the research has an empirical focus and is qualitatively oriented (Carlsson, 2007:858). Therefore, the framework is relevant for studying innovation within new contexts. This focus allows for an actor-oriented understanding of factors such as the actors' motivation, which affects participation and learning. In order to do so there is a need to understand ground level perspectives, i.e. do empirical research. Since innovation systems analyses linkages between actors it can be used to identify weaknesses within the system that require attention, making it a useful policy tool. Another reason for a systems approach, which is useful to policymakers, is that one can analyse the micro and macro level structures. This allows one to investigate attractor states and the factors that can cause change on a systems level. Such a systemic change could include a shift towards an SOIS.

2.2.4 Innovation Systems Literature Gaps

Although the field of innovation systems is fairly new, the literature on innovation systems has boomed over the past few decades. A survey on innovation systems literature states that over one thousand studies have been done from 1987 to 2002 (Carlsson, 2007:860). By the time of this study, a Google scholar search returned 19,300 hits for “innovation systems” (11 March 2016). About one third of the studies on national innovation systems (NIS) in this survey deal with developing or transition economies (Carlsson, 2007:861). Only about 16% of the studies could be considered dynamic in the sense that they look at development within a historical context. Carlsson (2007) points out the need for more micro level studies in the survey (p. 863). Therefore, a criticism of innovation systems is that it is too static and has too much of a macro focus (Capello & Fagian, 2005; Hekkert et al., 2007). Furthermore, Carlsson (2003) emphasizes the need for empirical studies to affirm innovation systems theories (p. 866). There is also interest in empirical studies in terms of how ground level innovation processes work and how new systems form (Heyningen & Brent, 2010; Seyfang & Smith, 2007; Arocena & Sutz, 2002). In terms of creating an SOIS, there is a question of how such paradigm shifts occur (Heyningen & Brent, 2010) and the role that learnings from grassroots innovation can play in these shifts (Seyfang & Smith, 2007). Therefore, this empirical study is well positioned to address many of these gaps in the literature.

2.2.5 Innovation System Components

Innovation systems are comprised of certain components. These usually include actors, drivers, interactions and learning, and institutions. These components will be discussed below in terms of the mainstream innovation descriptions, the differences in the components when comparing mainstream innovation with grassroots innovation, and the focal points that this study will have using this framework.

Actors

The primary actors in mainstream innovation are formal R&D departments within firms and research institutes. Besides these, other influential actors in the innovation process are competing firms, public sector actors, academia, legal entities, science councils and innovation networks.

The primary actors in grassroots innovation are informal individual community members. Other actors include the community itself, funders, informal networks and intermediaries. The importance of intermediaries for innovation in an informal setting is given particular focus in the literature (van der Hilst, 2012; Cozzens & Sutz, 2012; Szogs, Cummings & Chaminade, 2009). These intermediaries can include NGOs, the media and corner shops. Intermediaries are important in terms of providing funding, exposure through sharing stories and sharing knowledge (Cozzens & Sutz, 2012; Szogs, Cummings & Chaminade, 2009).

In this study the primary actors are the participants in the ITC competition. A list of the other main actors in this system study is given in the methodology chapter.

Drivers

The drivers of mainstream innovation are centred on formal firms that are profit-oriented. Innovation is seen as a necessary business process for adapting to the market and staying ahead of competitors in order to increase profitability. It relies on technological advancement through R&D in order to do so. Therefore, the main drivers are the firms themselves, science and technology, and market instruments such as fiscal incentives and IPR.

As has been discussed, grassroots innovation differs significantly on this point. It is primarily driven by creating social impact. This is the personal motivation of the individual civil society actors. Therefore, alternative drivers to market incentives are involved. Competition is a strong driver of innovation in terms of firms competing (Bullinger et. al., 2010). Therefore, an innovation competition, where competition is made clearly manifest, is a promising alternative incentive mechanism. Competitions have been shown to be effective for being motivating beyond the monetary prizes (MacCormack, Murray & Wagner, 2013). Therefore, investigating these alternative motivations to participate in an innovation competition may give insight into what incentives are more appropriate for grassroots innovation in general. Given that this is the central question of this study, the literature on motivation and competitions will be discussed in detail at a later stage.

Interactions and Learning

Innovation is essentially a product of the interaction and learning between actors, i.e. it is a relational product (Lundvall & Johnson, 1994). Foray (2007) discusses the role of knowledge transfer in the innovation process. An important differentiation between information and knowledge is made. Information is structured data, which is inert, whereas knowledge

“empowers its possessors with the capacity for intellectual or physical action” (Foray, 2007:235). Information can easily be reproduced, however knowledge is more challenging to reproduce because it is made up of both codified and tacit knowledge and needs to be learnt. In the past, knowledge transfer required interpersonal interaction, often in a master-apprentice style of learning. However, now it is possible to codify or document knowledge and create learning materials and programs that are not dependent on the possessor of knowledge. The challenge in this process is that tacit knowledge can be mutilated in the codifying process. This is because not all of the tacit knowledge is necessarily conveyed when it is codified, and part of the learning must come through an experiential aspect. Therefore, training often needs to be accompanied with manuals. An important aspect of codifying knowledge is that it changes the power dynamic in institutions, because one is no longer dependent on masters to share knowledge, i.e. the knowledge is democratized. Importantly, whoever codifies and licenses knowledge possesses the potential economic power which that knowledge has (Iizuka, 2013). Therefore, codification is an essential part of economic activity (Foray, 2007).

In the literature on mainstream innovation, knowledge transfer has to do with knowledge spillovers and boundary spanning. Knowledge spillovers have already been defined. Boundary spanning is the degree to which one interacts outside of one’s group so that interaction and learning can take place (Bullinger et. al., 2010). However, even if new information is made accessible, the receiving party needs the capacity to be able to learn in order to make use of it, i.e. have absorptive capacity. Therefore, learning capacity, i.e. the extent to which knowledge is transferred, is dependent on the boundary spanning and the absorptive capacity of actors. Building learning capacity is considered to be the central question of innovation systems (Lundvall et al., 2002).

In the case of grassroots innovation, the learning processes can be less formal and more hands-on than in mainstream innovation. The literature contrasts learning in this context as ‘doing, using and interacting’ (DUI) as opposed to the science and technology (STI) focused paradigm of learning in a formal context (Szogs, Cummings & Chaminade, 2009). Lundvall (2007a) emphasizes that the two modes of learning can be highly complementary and that there is an unnecessary association of DUI with low technology sectors and STI with high technology sectors. The DUI form of learning involves a lot of tacit knowledge that can be difficult to codify. Consequently, documentation is more of a challenge than in a formal context, where documentation is common. As with mainstream innovation, absorptive capacity is an important part of the knowledge transfer process in a developing context. Even if innovators are able to access new information, which may be less accessible in

under-resourced contexts, there is the challenge of making use of this information to learn. Absorptive capacity is needed to generate usable knowledge, i.e. not just knowledge about the world, but knowledge on how to change the world (Lundvall, 2007a). If the absorptive capacity is a lot lower than in developed contexts this may result in a knowledge divide will most likely result in a benefit divide (Iizuka, 2013). Therefore, building learning capacity in local actors is also of central concern for inclusive development to take place.

Absorptive capacity is dependent on the skills and motivation of actors as well as the relationships between them (Lundvall, 2007b:878). In order to facilitate the DUI form of learning specifically, it is also important to create opportunities for people to learn in this practical manner. A learning theory that underpins the DUI mode of learning is constructionism. A simplified description of constructionism is ‘learning-by-making’. Papert and Harel (1991) from MIT put forward that constructionism goes deeper than this. Learning is “building knowledge structures” (Papert & Harel, 1991:1), which is most enjoyable and effective when done through the learner constructing a public entity, whether it is a physical product or a theory. Consequently, in order to accumulate knowledge it is necessary to go through the practical steps of doing, using and interacting. There is, therefore, a need to understand how to facilitate these DUI learning processes in order to support the learning that takes place in grassroots innovation.

The literature on innovation suggests that building social capital, which encourages quality interaction is an essential part of facilitating learning (Cuevas-Rodríguez, Cabello-Medina & Carmona-Lavado, 2014). Social capital has varying definitions in the literature, but there are common aspects. Putnam (1996) describes social capital as “features of social life - networks, norms, and trust - that enable participants to act together more effectively to pursue shared objectives” (p. 34). Social interactions result in externalities, such as trust and knowledge, which can be of economic or social value. Collier (2002) emphasizes that social capital is only ‘capital’ if the externalities are durable (p. 24). Therefore, even though social interactions can be transitory, there can be an embedded effect within society. From a complex systems perspective, social capital is a means to overcome differences between unfamiliar actors and cooperate in order to self-organize. This provides a greater variety of sources of knowledge, thus increasing the potential for an evolutionary learning process. The social capital concept is closely linked to the concept of institutions in terms of involving societal norms that govern behaviour. A discussion on institutions will be given next.

Institutions

There are varying understandings of what an institution is in the innovation systems literature. Often the differentiation between organizations and institutions is not made (Balzat & Hanusch, 2007). Some understandings are restricted to formal organizations and laws that relate to innovation. However, a broader definition is that institutions are “systems of established and prevalent social rules that structure social interaction” (Hodgson, 2006:2). Therefore institutions are made up of both formal and informal aspects governing human behaviour. The informal aspects include behavioural norms, rules of conduct, business routines, and language (Balzat & Hanusch, 2007). These are influenced by historical and cultural factors such as social capital (Tabellini, 2010). These less formal elements are increasingly being recognized as factors that influence development (Tabellini, 2010; Fukuyama, 2002; Grootaert & van Bastelaer, 2002). The broader definition is presumed in this study.

Both formal and informal institutions play a large role in affecting innovative behaviour. The purpose of formal institutions is to ensure that the constitutive and regulatory goals with regards to innovation are achieved (Mphahlele, 2012). These formal institutions include government institutions, innovation agencies, science councils and IPR. These institutions support innovation systems through increasing learning capacity. IPR plays an important role in mainstream innovation to incentivize innovation by protecting the knowledge creation process, which has inherent uncertainties. However, in the case of grassroots innovation, IPR can have less relevance because of the lack of a profit motive. Also, as shown above, there is a lack of support for early stage innovative processes in South Africa. Therefore, it is important to understand the institutions that have relevance to grassroots innovation, especially at an early stage. Even though there are some strong institutions supporting innovation in South Africa, there exists an institutional void with regards to grassroots innovation because it falls outside mainstream innovation activities. An institutional void is where institutions are absent or weak, which impacts market formation and development (Mair, Martí & Ventresca, 2012). Therefore, in order to enable grassroots innovation it is important to understand how institutional voids affect innovation processes. Furthermore, in order to form functional innovation systems it is important to understand what factors result in institutional building. Note that in this study, institutional building includes both the formal and informal sense of institutions.

Fukuyama (2002) states that social capital is necessary for institutional building to take place. He goes on to claim that social capital is the reason why similar formal institutions can

have completely different impacts on different societies. Therefore, the different amount of social capital in different communities could partly explain why economic activity can vary significantly within a country, such as is the case in South Africa. On a global level, a study by Cheng and Mittelhammer (2008) suggests that both social capital and the quality of public institutions play an important role in allowing countries to benefit from economic integration. Therefore, both formal and informal institutions are important considerations for inclusive economic growth on a local and global level. However, it is difficult to create policy to generate social capital because of how linked it is to religion, historical context and deeply embedded cultural traditions (Fukuyama, 2002). This is especially the case in townships in Cape Town, which still clearly show the influence of the Apartheid legacy in terms of geographical segregation and poor socioeconomic conditions. This is exacerbated by an influx of people from rural areas, as well as immigrants from other African countries, resulting in fragmented communities with many social ills.

From a complex systems perspective, institutional building can be seen as an instance of emergence. The interactions of actors on the ground level result in norms that govern their behaviour and result in higher-level structures. Therefore, grassroots innovation, as a bottom-up process has the potential to influence institutional development. Scholars note that if the actors within a system can have significant enough influence on the surrounding institutional arrangement that they can be termed institutional entrepreneurs (Goldstein, Hazy & Silberstang, 2010; Battilana, Leca & Boxenbaum, 2009). In other words, institutional entrepreneurs can create new attractor states within an innovation system. Consequently, there is a two-way influential relationship between the institutional context and innovation systems actors.

In summary, the innovation systems framework is an appropriate approach to analysing grassroots innovation in this context. A systems approach allows one to analyse the attributes of actors, such as their motivation, and the interactions between actors within an institutional context. This can give insight into the micro level processes that result in system level phenomenon, which is helpful for understanding how to bring about system changes. The innovation systems approach is appropriate for this study in particular because of its use in qualitative research on innovation and empirical studies. It is evident from the literature review on innovation systems that there is a need for drivers of grassroots innovation other than market incentives. One potential mechanism already alluded to is innovation competitions, which is the next topic of discussion.

2.3 Innovation Competitions

In this section the background to innovation competitions is given. This is followed by the important link between competitions and motivation. Finally, the concept of gamification is introduced. Gamification provides a framework for analysing motivations to design processes such as competitions using game-mechanics in order to incentivize and engage people in innovation activities.

2.3.1 Background to Innovation Competitions

Innovation competitions have a long history and were in fact the main way to induce innovation before patent laws (Brunt, Lerner & Nicholas 2012). One of the first recognized sets of innovation competitions - the Longitude Prizes - took place from the 16th to the 18th century. The rulers of various European countries offered prizes for the means to calculate the longitude of a ship at sea. The British John Harrison finally developed the solution, a marine chronometer, in the late 18th century. This gave the British Empire a significant seafaring advantage (Morgan & Wang, 2010). Another well recognized innovation competition was set up by Napoleon in 1795. The challenge was to develop a means to preserve food for war. The solution was tinned food, a useful product to this day. Subsequently competitions have continued to be utilized to effectively induce innovation (Brunt, Lerner & Nicholas 2012).

Often competitions can be so effective that they induce behaviour that goes beyond what would make economic sense. This gives rise to economic agent failure, which has been a point of confusion for economists (Brunt, Lerner & Nicholas 2012). A famous example of this is the X prize where a $10 million prize was made available to which NGOs could create the best reusable manned spacecraft to make a trip to space twice within two weeks. The cumulative amount that companies invested into the project was estimated at $100 million, far beyond the prize money. The interest garnered by this competition resulted in government and private entities launching similar competitions (Murray et. al. 2012). This behaviour has been explained through how competitions tap into something deeper than a person’s drive for economic reward and produces other motivations (Brunt, Lerner & Nicholas 2012). An MIT study titled, *Spurring innovation through competitions* discusses the value of running an innovation competition in terms of being a cost-effective solution that can draw upon a larger participation group to develop a greater variance in ideas (MacCormack, Murray & Wagner 2013). It is argued in this study that competitions are effective in that often

the motivation to win the prize is not the strongest motivator. Alternate motivations include the enjoyment of competing, the love for one's hobby, passion for a cause, an opportunity for networking and skills development, building a participant's reputation and legitimizing the pursuit of a problem. Furthermore, having a special prize such as a gold medal rather than prize money has been shown to be more effective than doubling the prize money. Therefore it is evident that the motivations of participants in competitions are complex and require closer examination.

2.3.2 Innovation Competitions Literature Gaps

The literature on innovation competitions points out several areas of interest for further research. A study by Bullinger et al. (2010) on the relationship between collaboration and competition in innovation competitions shows that individuals in a competitive environment are more creative, especially if it is in an informative and not a controlling setting. The study also shows that knowledge transfer increases in a collaborative environment where there is boundary spanning. Therefore, the question arises on how to create an environment that is both competitive and collaborative in order to drive knowledge transfer for high quality innovation. Another question raised by Carvalho (2009) is how exactly innovation and innovation competitions are linked. This question involves understanding what motivates participants in order to attract them to competition, what benefits they get from participating, and how exactly competitions potentiate innovation.

2.3.3 Innovation and Motivation

Motivation is "to be moved to do something" (Ryan & Deci, 2000b). It involves the multifaceted "psychological processes that causes arousal, direction, and persistence of voluntary actions that are goal directed." (Mitchell, 1982:81) As discussed above, some extrinsic motivations, such as market incentives, have less relevance for grassroots innovators. However, extrinsic mechanisms have been the major focus of the innovation literature on motivation. A study on grassroots innovation in India has shown empirical evidence that intrinsic innovation was indeed the greater form of motivation in that study (Bhaduri & Kumar, 2011). Therefore, it is necessary to have a greater understanding of intrinsic and extrinsic motivation in order to understand what drives grassroots innovation.

Intrinsic and Extrinsic Motivation

Intrinsic motivation can be defined as motivation to do something for the inherent joy and satisfactory experience of it, whereas extrinsic motivation is motivated by some other separable outcome as opposed to the experience itself (Ryan & Deci, 2000a). These goals of motivation can be tangible rewards such as monetary incentives and prizes, as well as intangible rewards such as social approval or a sense of conscientiousness. They can also include the avoidance of punishment such as missing deadlines or scolding. On the other hand, intrinsic motivation will occur when an activity interests the individual, i.e. has the potential for novelty, is an appropriate challenge, or has aesthetic value (Ryan & Deci, 2000a). It has been shown that individuals who are intrinsically motivated will be motivated for the long term, perform better, be more creative and have better well-being (Ryan & Deci, 2000a). Intrinsic motivation also increases an individual's sense of authenticity and decreases alienation (Ryan & Deci, 2000a). Therefore, understanding what affects intrinsic motivation is important in terms of keeping an individual engaged and performing well in an activity such as innovation.

Self-determination theory (SDT) is a motivation theory that looks at the degree to which motivation is self-determined or authentic. The originators of the theory, Ryan and Deci (2000a), propose that all individuals have innate intrinsic motivation, but this is undermined by environmental conditions. In order to maintain self-determined motivation the basic psychological needs of competence, autonomy and relatedness must be satisfied through the individual's environment (Ryan & Deci, 2000a). If these are not met, extrinsic motivations need to be used. The extent to which motivation is self-determined goes along a continuum from amotivation to extrinsic motivation to intrinsic motivation. Within the forms of extrinsic motivation there is a process of internalization that occurs. This is where an externally imposed motivation can be taken in until the individual has a perceived internal locus of causality. Eventually the motivation can become integrated into the individual's sense of self. Therefore, an individual can be extrinsically motivated, but still have a sense of autonomy. This shows that an individual can be extrinsically motivated, such as through a competition, and still be committed and authentic (Ryan & Deci, 2000a). As with intrinsic motivation, the more internalized an extrinsic motivation is for an individual the better they will perform, be creative and so on. Also, the more the basic psychological needs of competence, autonomy and relatedness are satisfied within the individual's environment, the more internalized the motivation will be (Ryan & Deci, 2000a). Therefore, ensuring environmental conditions satisfy these basic psychological needs is of vital importance. It must be noted that these innate psychological needs are universal, only the way in which they are fulfilled may differ

(Ryan & Deci, 2000a). Therefore, they are still applicable to this empirical study. The need to consider the environmental factors that affect these needs reinforces the importance of the institutional context.

The relationship between external rewards and intrinsic motivation is important to understand because of the effect that competition rewards can have on intrinsic motivation. This is a contentious issue within various motivation theories. What is generally agreed upon is a well-studied effect called 'overjustification'. The effect causes the intrinsic motivation of an individual to be undermined, or crowded out, if expected rewards for performance are used over time (Lepper, Greene & Nisbett, 1973). This is because the individual has a more perceived external locus of causality, i.e. less autonomy (Ryan & Deci, 2000a). However, as shown above, it is possible for an individual to be extrinsically motivated and have a perceived internal locus of causality under the right conditions. There is no universal effect that external rewards have (Lepper & Henderlong, 2000). It can be deduced from SDT that the effect depends on how the reward is perceived in terms of whether it affects the individual's locus of causality. Intrinsic and extrinsic motivation can work in conflict, orthogonally or in tandem (Lepper & Henderlong, 2000). On the one hand, external rewards will have a negative effect if there are expected tangible rewards contingent on task performance within a controlling setting (Ryan & Deci, 2000a; Ryan & Deci, 2000b). On the other hand, Lepper and Henderlong (2000) have shown that external rewards can have a positive effect if they provide information on an individual's competence. The rewards are especially effective when unexpected. This needs to be done in a context that emphasizes learning goals to allow the individual to maintain a sense of autonomy and provide a context for why a task is important. This leads to the question of how to design appropriate incentives for an innovation competition, which brings us to gamification.

2.3.4 Gamification of Innovation

Using gaming principles such as competitions or 'playing' to drive human behaviour in a non-game environment is known as gamification. It is a tool to provide mechanisms to affect human behaviour, develop skills and enable innovation (Burke, 2012). Gamification is a relatively new field, with the first documented appearance in 2008 (Roth, Schneckenberg & Tsai, 2015), but the principles are age old. It makes use of game-mechanisms such as points, badges, leaderboards, levels, time-pressure, teams and feedback to make tasks playful and fun. As a newly popular field, gamification has been widely used for many applications, including business, innovation, scientific discovery, non-profit programs and

civic engagement. However, gamification expert, Chou (2015a), in his book, *Actionable Gamification, Beyond Points, Badges and Leaderboards,* warns against using game-mechanics in a shallow way without having a good understanding of the people you are dealing with and their motivations (p.19). This is likely because of the finding that the overjustification effect can undermine intrinsic motivation through the poor use of external rewards. Gamification aligns with SDT in that the goal is the emergence of intrinsic motivation (Hamari, Koivisto & Sarsa, 2014). Chou (2015a), therefore, describes gamification as "human-focused design (which) optimizes for human motivation in a system as opposed to optimizing for pure functional efficiency within the system." (p.8).

Research into various applications of gamification has shown that gamification does indeed have positive effects. However, these effects are dependent on the context where they are applied (Hamari, Koivisto & Sarsa, 2014). Roth, Schneckenberg and Tsai (2015) give an overview of the research on how the gamification of innovation has been effectively used with various methods on the gamification of business model development; products, services and corporate identities; and ideation. However, they do warn that gamification may be overused. Gamification has also been shown to be effective with regards to building social capital. A study on the effectiveness of gamification on civic engagement has also shown that gamification can be effective in improving the relationship between citizens and the public sector (Coronado, 2014). The study emphasizes that extrinsic motivation can be effective in the early stages of civic engagement, but intrinsic motivations need to be advanced if lasting behavioural change is effected. Therefore, research shows that gamification is a promising tool for supporting innovation and building social capital.

Flow

One of the reasons for the effectiveness of gamification is its ability to induce a flow state in individuals. A flow state is described by game designers and psychologists as an optimal experience where an individual is in a state of being at heightened function, fully focused and engaged in an activity, with a sense of satisfaction and creative accomplishment (Csíkszentmihályi, 2000:206). Csíkszentmihályi (2000) in his book, *Beyond Boredom and Anxiety*, describes flow as a state existing between being bored on the one side, and anxious on the other. When an individual is in this state, their desire is to stay there and neither quit nor win (McGonigal, 2011:24). They can even lose track of time because of being so absorbed in an activity. It has been shown that flow increases the voluntary use of game-mechanisms and increases intrinsic motivation, and thus, performance (Mcgonigal, 2011:35-38). It has also been shown that flow can be systematically activated by external

incentives (Blohm & Leimeister, 2013). Therefore, gamification makes effective use of incentive mechanisms beyond financial mechanisms. Through activating flow, gamification has the potential to change behavioural patterns and support the accompanying learning processes (Hamari & Koivisto, 2014). Behavioural change can be facilitated through giving feedback and inducing positive emotions associated with tasks (Hamari & Koivisto, 2014).

Octalysis Framework

There have been several gamification frameworks created to design the ultimate gaming experience for the user of a process. Chou (2015a) has created a dynamic framework called *Octalysis* (figure 1). The framework describes what he believes are the eight core drives[4] that motivate people. This framework was formulated from a combination of game design, behavioural economics, motivation psychology, user-experience design, neurobiology, and technology platforms (Chou, 2015a: 1). It is a broad framework that takes into account several theories, including SDT, to account for a full range of motivations. The framework can be used to analyse people's motivation as they participate in a process, and then to design a gamified experience for them in order to motivate the participants in the most appropriate way. Furthermore, the framework can be applied to design appropriate game-mechanics for different types of players at various stages of the gamified process. However, in this study, the framework will only be used to categorize the motivations of the innovation competition participants. A useful aspect of the Octalysis framework is that the categories are arranged graphically so that the intrinsic motivations are generally on the right side and the extrinsic on the left.

[4] The terms 'core drives' and 'motivations' are used interchangeably.

Figure 1: Octalysis Gamification Framework (Chou, 2015b)

The eight core drives are briefly discussed below.

1) Epic Meaning & Calling

This core drive has to do with an individual having a perception of doing something greater than themselves, having a sense of purpose, or being chosen to do something (Chou, 2015a: 25 & 411).

2) Development & Accomplishment

This is the drive to make progress, master skills and overcome challenges (Chou, 2015a: 25). Therefore, there is a strong correlation with this drive and the psychological need for competence. Chou (2015a) emphasizes that an important aspect is having an appropriate

challenge in order to make the rewards meaningful (p. 25). This aligns with the findings of Lepper and Henderlong (2000) mentioned above.

3) Empowerment of Creativity & Feedback

This drive is when an individual is fully engaged in a creative activity. Not only do individuals need to express their creativity, but they need to receive feedback on the results of their creativity as well (Chou, 2015a: 25). This motivation is related to having a sense of autonomy (Chou, 2015a: 411). It is a powerful motivation that is at the heart of flow (Chou, 2015a: 426). Chou (2015a) describes 'Evergreen Mechanics', a concept similar to being in a flow state, where an individual will no longer need additional content to be engaged, but the brain will entertain itself through making new combinations with the content it has (p. 25). An example of this would be playing with LEGO bricks.

4) Ownership & Possession

This is where individuals are motivated because they feel like they own or control something (Chou, 2015a: 25). When people have this feeling, they want to continually increase and improve upon what they have. Chou describes this is as the root of the desire to accumulate wealth. It is the drive that makes individuals want to maintain an online profile or avatar. It is also expressed when people feel a sense of ownership over a project or an organization that they are involved with.

5) Social Influence & Relatedness

This drive has to do with all of the social aspects that motivate people, including: mentorship, social acceptance and feedback, companionship, and competition (Chou, 2015a: 26). As the name suggests, this includes the psychological need for relatedness. Chou states that people are drawn to people and experiences that they can relate to. This drive is at the heart of why social media can be addictive.

6) Scarcity & Impatience

This is the drive of wanting something because it is "extremely rare, exclusive or immediately unattainable" (Chou, 2015a: 27). Chou (2015a) refers to something called "Appointment Dynamics" where certain aspects of a game are only available at a specific

time later (p. 27). This makes people think about it, even when they are not playing, until they are able to get it.

7) Unpredictability & Curiosity

This is simply the drive to want to find out what will happen next, which is driven by harmless human curiosity (Chou, 2015a: 27). This also aligns with the findings of Lepper and Henderlong (2000) on how rewards that are given spontaneously can have more of a positive effect on intrinsic motivation than expected rewards.

8) Loss & Avoidance

This is what drives people to avoid something negative happening (Chou, 2015a: 28). Chou states that it can range in scale from avoiding losing previous work to avoiding admitting that everything you have accomplished till that point was useless because you have decided to quit. This is often used in sales where specials are offered for a limited time. It makes use of the phenomenon of ‘fomo’, the fear of missing out.

In summary, innovation competitions have been used as an effective mechanism to incentivize innovation. More than the prize alone motivates participants in innovation competitions. Therefore, the question of what motivates people to enter innovation competitions is an interesting one. It has also been shown that grassroots innovators are not only extrinsically motivated, but that intrinsic motivation plays a large role. SDT shows that intrinsic motivation can improve performance, creativity and increase long-term engagement. In order to maintain intrinsic motivation, or internalize extrinsic motivation, the environment needs to satisfy the psychological needs for competence, autonomy and relatedness. Furthermore, external rewards can undermine intrinsic motivation. Therefore, it is important to consider both the environmental conditions of competition participants and the effect that external rewards have on motivation, in order to design an innovation competition effectively. Gamification provides a framework to analyse the motivations of participants within an innovation competition, and design an effective process to keep participants engaged in a state of flow.

2.4 Developing an Analytical Framework

The various aspects of the analytical framework used to address the research question are given here. It is based on the author's review of the literature.

The framework used in this study is based on the innovation systems framework. Innovation systems are seen as complex systems, therefore the following system constructs are used to describe complexity: differences, networks, emergence and attractors. The innovation systems framework is made up of the following components: actors, drivers, interactions and learning, and institutions. This study is centred on an innovation competition made up of various actors, described in the methodology section. The drivers of the grassroots innovation observed in this study are a product of the motivation of the actors and their interactions within an institutional context, i.e. Cape Town's townships. Therefore, theories and core concepts from other fields are used to analyse these phenomena within the broader theoretical framework.

From the field of psychology, the self-determination theory is used. The core concepts, which were discussed above, include intrinsic and extrinsic motivation, the overjustification effect, perceived locus of causality, internalization and integration, and the psychological needs of competence, autonomy and relatedness. In order to apply motivation theory to a competition, concepts from gamification were used. This included the Octalysis framework, used to analyse different types of motivations. It also included the concept of flow, a highly motivated and productive state for an individual.

The main concepts considered to analyse interactions and learning are as follows. The concept of knowledge transfer is used to explain the process of learning in an innovation system. Knowledge forms include tacit and codified knowledge. The learning form considered is 'doing, using and interacting' (DUI), which is based on the constructionism learning theory. Learning capacity is dependent on the concepts of boundary spanning and absorptive capacity. Finally, social capital is a concept used that relates to civic engagement and institutions.

In this study, institutions are given a broad definition to include all formal and informal institutions that affect innovative behaviour. Formal institutions include aspects such as organizations and laws (IPR). Informal institutions include norms, rules of conduct and

language. The concept of institutional voids explains a how institutions may be poor or non-existent within a certain context. This leads to a need for institutional building.

2.4.1 Conceptual Model

A conceptual model is developed here to show how the concepts in the analytical framework relate to one another and are causally linked in order to enable grassroots innovation using a gamified process such as a competition. A visual representation of the conceptual model is given below in figure 2.

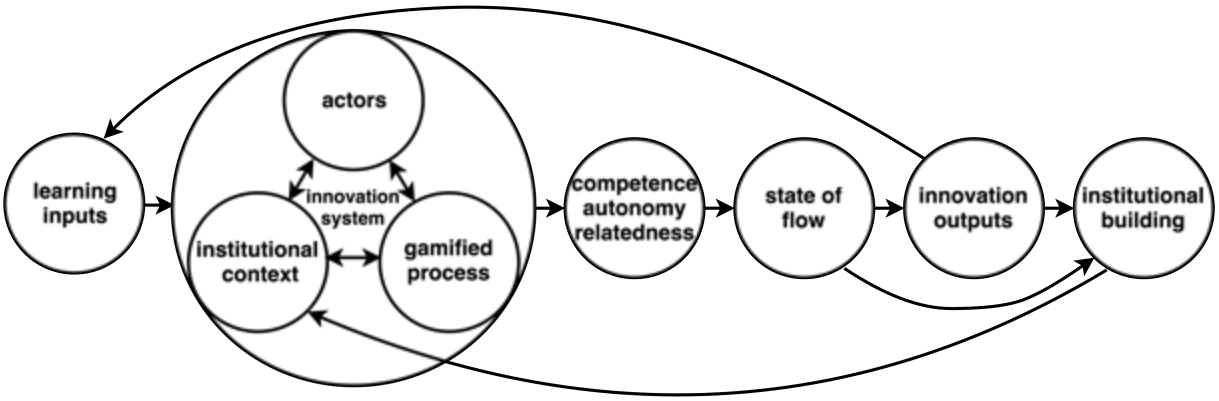

Figure 2: Conceptual Model of Enabling Grassroots Innovation (Source: Author)

In figure 2, the larger circle represents the ITC grassroots innovation system. It consists of actors interacting through a gamified process within an institutional context. The gamified process is the ITC competition. The institutional context is Cape Town's townships. In order for the system to produce innovation there must be learning inputs, if these are not present within the system already. These learning inputs increase the system's learning capacity and hence the potential for innovation. If the actors are interacting and learning in a healthy institutional context through an appropriately gamified process, this should result in the psychological needs of competence, autonomy and relatedness being satisfied (Ryan & Deci, 2000a). This leads to the actors being in an intrinsically motivated state of flow, i.e. an engaged and higher performing state of innovative activity. This should result in innovation outputs that are a form of social innovation. These social innovations will facilitate institutional building, such as the increase of social capital (Hielscher, Seyfang & Smith, 2011). Furthermore, since social innovation includes the innovative interaction of social actors (Moulaert et al., 2005:1973), this activity in a state of flow will result in institutional building as well. Hence, there is a link between 'state of flow' and 'institutional building'. The

innovative outputs should then feed back into the innovation system through the provision of learning inputs, such as organized forms of learning and resources that are a result of the social innovations. Institutional building will in turn positively influence the institutional context. This is similar to the way institutional entrepreneurs are both influenced by their institutional context and can influence institutions. Thus, positive feedback loops can form between the innovative activity and the conditions that facilitate its emergence.

In summary, the conceptual model shows that if a gamified innovation process such as a competition is well-designed within an innovation system it can create conducive conditions for motivated innovators developing social innovations. These social innovations will further increase the innovative potential of the system itself by both increasing the system inputs and changing the system state. The system inputs are the practical learning inputs and the system state change is the change in the institutional context of that system. Therefore, this conceptual model links the concepts within the analytical framework to address the research question of how to enable grassroots innovation by youth with the potential for systemic change. The research questions and objectives of this study are explained in detail in the next chapter.

3 Methodology

In this chapter, the research methodology used to address this research question is presented. This consists of a detailed description of the research questions and objectives. This is followed by the philosophy and approach of this study, the research strategy and sampling method. A detailed description of the ITC competition design and the main actors involved is given. Thereafter, the positionality and reflexivity of the researcher are stated. This is followed by the data collection and analysis methods. The reliability and validity of the study is stated. Finally, ethical issues are discussed.

3.1 Research Questions and Objectives

The research question and sub-questions, followed by objective are given here. The main research question is as follows:

“How might one enable early stage grassroots innovation by youth in Cape Town’s townships using an innovation competition?”

This is broken down into the following sub-questions. Note that the term ‘learners’ is used for all high school learners participating in the ITC competition. Research participants also include mentors.

1. Why do the learners innovate? I.e. what motivates them to initiate their grassroots projects?
2. How can an innovation competition provide appropriate incentives to motivate participating learners?
3. How do the learners learn? I.e. what are the early stage learning processes for grassroots innovation?
4. How can these learning processes be facilitated?
5. What is the influence of institutional arrangement on the motivations and learning processes of the learners?

In order to answer the questions above, the following specific objectives were made.

1. Determine the personal motivations for learners to initiate grassroots innovation projects
    1.1. Determine the reasons for entering an innovation competition
    1.2. Which motivations are dominant?
2. Determine which competition incentives are appropriate to match the motivations in terms of:
    2.1. Eliciting initial attention;
    2.2. Their form: type of incentive, size and format;
    2.3. Their effect on intrinsic motivation.
3. Determine the enabling factors of the early stage learning processes for grassroots innovation by youth in terms of:
    3.1. What skills are needed;
    3.2. What the required inputs for learning are;
    3.3. How knowledge is transferred effectively;
    3.4. What learning environment is conducive for grassroots innovation.
4. Determine the potential influence of the institutional context on the above motivations and learning processes. What are the perception of the learners and the community on:
    4.1. The term, ‘innovation’;
    4.2. Local problems and the perceived locus of responsibility to solve them;
    4.3. Failure;
    4.4. Jealousy of successful innovators;
    4.5. Youth as innovators;
    4.6. Gender roles.

3.2 Philosophy and Approach

This research is a qualitative empirical study given that the subject is a poorly understood form of innovation on the grassroots level (Seyfang & Smith, 2007). Innovation is a complex and interdisciplinary phenomenon. The innovation systems approach attempts to provide a framework to understand these complex processes in a qualitatively and empirically-oriented manner (Carlsson, 2007:858). However, innovation systems is a multi-disciplinary field, therefore it is important to state the epistemology used. The research questions seek to explore perceptions of in-depth drivers of human behaviour and their interactions within a specific context. Therefore, given that the research is exploratory in nature, a subjective interpretative approach is used. An interpretative approach is appropriate for this research

because it is used to analyse the views and culture of the group that is studied (Ritchie & Lewis, 2003:201). Given that the subject is grassroots innovation it was important to use sources of information from people on the ground in order to analyse a variety of perspectives as close to the subject matter as possible.

The research approach began inductively from observations made about young innovators within the ITC competition, which lead to the research question. The research then followed an iterative combination of deductive and inductive processes. This involved a review of literature on innovation that lead to the use of the innovation systems theoretical framework. However, due to gaps shown in the framework through empirical evidence on the role of motivation as a driver of innovation, a theoretical framework on motivation theory was sought out. These frameworks were combined to form an analytical framework with a conceptual model. This analytical framework was used as a basis for the research design process.

3.3 Research Strategy

The research strategy used observations made by the researcher and semi-structured interviews used in individual interviews and focus groups. Semi-structured interviews were designed to determine the interviewees' perceptions about their motivation for innovation, including competition incentives; interaction and learning processes; and the institutional factors that influenced these. Semi-structured interviews allows for enough structure for the interviewer to ask key questions in a similar way, but does leave scope for further probing (Ritchie & Lewis, 2003:111). Having this scope for further probing was important for the exploratory element of the study. Having both individual interviews and focus groups helped to both explore individual motivations as well as facilitate group discussions on the interactive processes and group perceptions on their community contexts.

The formation of the interview protocol began with an analysis of observations made by the researcher, who was immersed in the research space. This included informal conversations between the researcher and participants in the ITC competition on the topics within this study. This was followed by a pilot study, which consisted of three individual interviews and two focus groups. These interviews were less structured in order to be highly exploratory in order to elicit deeper insights. The final interview protocol was based on a combination of observations from this initial process and themes from the analytical framework. This was formed through an iterative process in order to refine the interview protocol. This involved probing with open questions, forming standardized questions, testing these questions and

removing poor questions. The same interview protocol was used for individual interviews and focus groups. The questions used for the mentors were rephrased to ask similar questions from their point of view. Since these were the final interviews, they also included questions to check research findings from the previous interviews. The final interview protocol can be found in the Appendix.

The interviews were divided into three main sections: motivation, interaction and learning, and institutional factors. The interviews included standardized questions, along with open questions. As mentioned, standardized questions allowed for consistency across the interviews. It also allows for the potential to compare this research with other research. The open questions gave an opportunity to continually explore themes even once an interview protocol was established. The interviews and focus groups were conducted and transcribed. The transcriptions and personal notes were analysed in a thematic analysis using the qualitative data analysis software, NVivo. The thematic analysis was used to write the final report.

3.4 Research Population

The target population includes all youth in Cape Town's townships. Purposive and homogenous sampling was used to restrict the research population to high school going youth who have taken part in a grassroots innovation competition. ITC is the only high school grassroots innovation competition within Cape Town, according to the knowledge of the researcher. Therefore, the unit of analysis was restricted to the ITC competition. This restriction was made because this is an in-depth exploration of innovative activity in a specific gamified process, within a specific context, rather than a comparative study. Time and resource constraints were also a consideration when the scope of the research was determined. Therefore, the criteria for sampling follow the criteria for the competition applicants, which were as follows:

Age: 14-20 years of age.
School: applicants must attend a high school within the Cape Town region.
Type of innovation: early stage grassroots innovation with a developmental purpose.

Further details on the ITC competition design and application criteria are given below. There were participants from many backgrounds within the ITC competition. Therefore, the following criterion was used in an attempt to maintain a reasonable amount of consistency with regards to the contextual factors that may influence the participants:

Location: Township areas in Cape Town. These were narrowed down to townships that have a predominantly Black African population and are mainly Xhosa speaking. They are also all a similar distance from central Cape Town (town). According to the potential sample group of ITC participants, these areas included Khayelitsha, Philippi and Imizamo Yethu. The return travel time from these areas to town and back can be up to three hours with public transport. Imizamo Yethu is situated within Hout Bay where there is some economic activity, although less than in town.

Sample Choice

The potential sample group is essentially self-selected given that participants voluntarily applied to ITC with their ideas for grassroots innovation. ITC only accepts up to eight finalist groups per year, therefore the sample size was limited to the number of finalist groups that fit the above criteria. These groups are described in table 1 below.

Group Name	**No. members (interviewees)**	**Year in ITC**	**Theme of Project**	**Township Area in Cape Town**
GoVarsity	2 (2)	2013	Education	Khayelitsha
Rescue for Nature	5 (1)	2013	Environment	Philippi
SLYZ	5 (3)	2014	Education	Khayelitsha
Transport Revolution	3 (3)	2014	Transport	Khayelitsha
BRainStorm	5 (4)	2014	Water	Khayelitsha
Sakhulife	3 (3)	2015	Environment	Imizamo Yethu
Long Walk from Loadshedding	3 (3)	2015	Energy	Imizamo Yethu
Amaqhawe	5 (5)	2015	Finance	Khayelitsha
Health Watch	5 (3)	2015	Health	Khayelitsha
TOTAL	**36 (27)**			

Table 1: Research Population Description

Project Topic Descriptions

Govarsity: a mobile web application that informs high school learners about University study options and career choices.
Rescue for Nature: a community-driven clean-up event on Saturdays and a school garden.
SLYZ: a mobile application that provides educational content and connects learners to both parents and teachers.
Transport Revolution: a USSD payment system that loads prepaid airtime onto a card that users swipe upon travel.
BRainStorm: a water purification mechanism for rural areas.
Sakhulife: training community members to grow their own gardens along with a community market to encourage the sale of produce.
Long Walk from Loadshedding: a solar-powered charging unit attached to a cap.
Amaqhawe: teaching financial literacy through an online blog.
Health Watch: wearable technology that gives users feedback on their health.

There were nine finalist groups made up of 36 individuals that fit these criteria. Of these individuals, 27 were available for interviews. These are designated in brackets in column 2 of table 1. The learners selected for individual interviews were selected across a spread of the finalist teams including participants from each township, but was limited according to the availability of learners. All interviewees were in the age bracket of 16-20 years of age. The fields of innovation within their projects include energy, education, the natural environment, transport, water, health and finance.

The sampling size was limited according to the above criteria, participants' availability and time and resource constraints. However, Ritchie and Lewis (2003) give several reasons for why a small sample size is acceptable in qualitative research (p. 83-84). This includes the fact that increasing a sample size will reach a state of diminishing return with regards to contributing to new evidence. Qualitative research is less concerned with the incidence or prevalence of phenomena in order to draw statistical inference from the data. Finally, qualitative research requires rich detail from the data. Therefore, in order to do the data justice, small samples are preferable, especially where resource constraints are an issue. In this study, it was found that the sample size was sufficient to reach a reasonable saturation point in terms of accumulating new evidence.

Focus groups were conducted separately with finalist groups and mentors. This included a mixed focus group with finalists to create a space for dialogue between teams for a wider

variety in perspectives. The mentor selected for the individual interview was selected because he was a past ITC winner in order to provide a greater dynamic in perspectives over time. The two participants in the mentor focus group were selected according to availability of mentors for interviews. Therefore, there were 29 interviewees in total. An anonymized list of interviewees with descriptions is given in the Appendix. The researcher was immersed in the process and took several notes throughout. This included note taking at the mentor meetings.

3.5 Case Description: Innovate the Cape System

The ITC competition, which is the subject of this case study, will be described here in more detail. This includes the competition structure, notes on the design approach of the ITC organizers and descriptions of the main actors involved.

Competition Structure

ITC is a full year program that includes an ignition phase, prototyping phase and winner's phase. The challenge put forward by ITC is on how to solve a challenge in the community in a new way. In the ignition phase, volunteers go out to schools, advertise the competition, and do creative problem identification and brainstorming exercises. Applicants apply to the competition in groups. Up to eight finalist groups are selected to receive grant funding to prototype their ideas over 10 weeks. Each finalists group receives a mentor and all of the groups attend collaborative workshops that are open to the public.

The prototyping phase is broken up into two rounds. In the first round finalists receive up to R2,500 in grant funding according to their budget. The workshops take the finalists through design thinking methodology with a focus on problem solving, prototyping and testing. The finalists then present their progress in order to make it into round two. If they have not achieved any of the goals they set out to achieve, or have misused funding, they do not go through. In the second round the finalists have another R2,500 grant made available. The workshops in this round have more of an entrepreneurial focus, with subjects like business model development and pitching training. All of the finalists present their prototypes at the final showcase before a panel of judges and an audience. The winners receive R10,000 and further mentorship for six months.

The following competition structure elements are given according to the outline given by Bullinger et al. (2010) for community-based innovation competitions.

Media

ITC is an offline competition, although applications are both hard copy and online.

Organizer

ITC is a program of Innovate South Africa, an NGO based in Cape Town. The ITC team is described below.

Topic specificity

ITC has very low topic specificity. The challenge is, ‘how can you solve a challenge in your community in a new way’. Further explanation is given on how these needs must be developmental in nature. The applicants select their own field and problem, provided they can argue for why it is a pertinent need in their community. There are categories suggested on the application form including health, energy, education, transport, agriculture and the natural environment.

Degree of elaboration for submission

The application form has a few simple and concise questions including:

- What is the challenge you have identified?
- Why is solving this challenge important to you?
- What is your solution?
- How is it innovative?
- What is your plan of action to prototype a solution?
- What budget do you require (limited to R2,500)?

Therefore applicants need only identify a challenge, come up with a novel solution and give a basic plan of action and budget.

Target group

ITC is open for applications from any group of high school learners in the Cape Town area. Participants vary in age from 14 to 20 years old. Although the marketing of the competition is aimed at low-income communities, the competition is open to all high school learners in Cape Town. This ensures a representative group of finalists.

Eligibility

Applicants need to be in a group of two to five learners. They need to have a supervising teacher from their school to verify that they are high school learners.

Time period

ITC is a fairly long-term competition, run annually. Once finalists are selected they have 10 weeks to prototype their solutions with workshops held bi-weekly.

Incentives

The incentives include grant funding and support for the projects. Finalist groups receive up to R5,000 in grant funding in the prototyping phase. They also receive mentorship support and attend workshops. The overall winners receive R10,000 in grant funding and receive mentorship support for six months. Runner up prizes include a ‘Best Progress’ and ‘Most Innovative’ prize of R2,000 each and a ‘Best Presentation’ prize of R1,000.

Community functionality

This feature usually applies to online competitions. There is an online component with an ITC Facebook group. However, most interactions were in person. Therefore, there is high community functionality.

Evaluation

Each application is judged by a group of international volunteers and a group of local judges. Applications are judged as follows:

- Potential social impact
- Potential sustainability
- Innovativeness
- How realizable the plan of action is
- How well the applicants have motivated their project

The final showcase has a judging panel made up of local entrepreneurs. The winning criteria are similar to the application criteria, but include progress and presentation categories.

ITC Design Approach

The purpose of ITC is to inspire and empower young innovators to be change agents in Cape Town. Although the social impact of the innovations is important, the ultimate goal of the competition is to facilitate an engaging learning environment to upskill young innovators through an experiential learning process so that they are confident in their ability to make

changes to issues that they truly understand. Therefore, a lot of support is given to participants, making it much like an incentivized education program as opposed to only an outcomes-focused innovation competition.

It must be noted that ITC is open to pre-existing projects and so not all application ideas were driven by the competition. Therefore learners could be questioned about their reasons for starting their projects, as well as their reasons for entering the competition, making it a good study of ‘natural’ germination conditions for grassroots innovation.

Gamified Elements of ITC

Although a competition is a form of gamification in and of itself, there are particular gamified elements, drawn from the Octalysis framework, used in the design of ITC that are listed here.

- **Prizes**: monetary prizes and mentorship support
- **Levels**: two finalist phases and a winning phase
- **Prize pacing:** the grant made available in the second phase was dependent on performance
- **Teams**: having teams adds to the competitive spirit
- **Friending**: teams were encouraged to collaborate with one another
- **Choice perception:** teams selected their own topics when applying
- **Time pressure**: each phase of the prototyping process was allocated a number of weeks. The mentors also created goals and deadlines together with their teams, which they would hold them to.
- **Feedback**: teams received constant feedback from other teams, mentors and advisors.
- **Badges**: this was not explicit, but it could be argued that presenting each finalist team with an ITC branded cap and the title of ‘innovator’ plays a similar function to badges. Each team that completes the prototyping process also receives a certificate listing the skills that they had acquired from attending workshops.

Actors

The prominent actors and their relationships within the ITC network are visually displayed in figure 3 below followed by a brief description given on each.

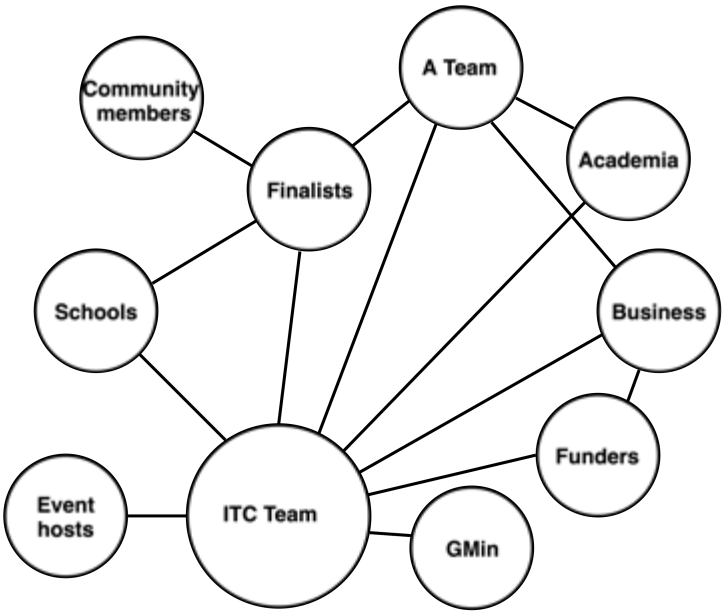

Figure 3: The Innovate the Cape Network (Source: Author)

Finalists: these are the central actors who are the primary innovators. The groups usually came from the same school and community, although this was not a prerequisite.

ITC Team: The ITC team consists of approximately 12 young volunteers who are the competition organizers. Team tasks include marketing the competition at schools, running ideation workshops, facilitating the judging process, running the design thinking and entrepreneurship workshops and events planning. The team also played advisory roles at events. Most of the volunteers are affiliated with the University of Cape Town (UCT).

Global Minimum (GMin): GMin are collaborators with Innovate South Africa on the ITC program as a part of the *InChallenges* program, also run in Sierra Leone and Kenya. They provide funding, administrative support and a network of international judges. Their funding is all grant and donor based. GMin is a diverse and international team of young adults and graduate students. The basic concept of providing grant funding for youth to prototype a solution came from the president of GMin, David Sengeh, who is Sierra Leonean. Sengeh was an MIT graduate student at the time. The philosophy of the program is routed in the MIT constructionism pedagogy of ‘learning-by-making’ described in the literature review. GMin provides further international opportunities for the competition finalists, including positions at

incubators and speaking opportunities at conferences. The finalists from the three countries are able to interact with one another at these events.

Advisory team (A Team): these included mentors and advisors. Each team received a mentor who was required to attend the ITC workshops and contact their group once a week. The ITC team trained all mentors. They were instructed to ensure that they played a guiding role and not create the prototypes themselves. The advisors could sign up to evaluate proposals and receive invites to ITC events. Most of the A Team is made up of university students or young professionals from the Cape Town city bowl and southern suburbs areas.

Academia: local tertiary institutions played a role in providing facilities and expertise to help the finalists. A major contributor was UCT.

Business: local businesses also provided facilities and expertise to finalists. They also provided some funding.

Funders: the operational costs of ITC, including the finalists' grant funding, came from GMin, international donors and local crowdfunding and local businesses.

Event hosts: All ITC finalist events are kindly hosted pro bono by a variety of entities around Cape Town. Venues included the Cape Town City Hall, the UCT Graduate School of Business, the Cape Town International Conference Centre, the Greenpoint Stadium, and co-working spaces including Twenty Fifty in the city bowl, the Bandwidth Barn on the city bowl periphery and Hubspace Khayelitsha.

Schools: All of the learners attended high schools in Cape Town, within Khayelitsha, Philippi, and Hout Bay. A lot of the group work by the learners took place at school after classes. The learners' teachers also played an advisory role and an administrative role in terms of arranging transport and distributing grant funding.

Community members: Community members who played a significant role were the learners' peers and family members.

3.6 Research Activities

The research activities were centred on the ITC competition participants. The researcher conducted the following research activities:

- 18 individual interviews with ITC participants
    - One of these was an individual interview with a mentor who was the 2013 ITC winner (Participant 1).
- 9 focus groups:
    - 8 focus groups with ITC participants: 7 with finalist teams and 1 with a mixed group of individuals from various teams
    - One focus groups with mentors
- Observations and notes were made by the researcher

There were limits according the resources and time available for the researcher as well as the availability of research interviewees.

3.7 Positionality and Reflexivity

The researcher is a white male, 27 years old, living in Southern Suburbs, Cape Town. He is the director of the ITC competition. He has worked on ITC for three years since 2013. As the director of the competition, he is intimately involved with the competition design and the entire competition process. He is part of the team that visits most of the participating schools. He facilitates many of the collaborative design thinking sessions and makes on-site visits to the projects. He is well acquainted with the areas that the participants come from, the schools, the participants themselves, and the projects that they work on. This has given him a rapport and trusting relationship with all of the participants, which is helpful for the qualitative interview process. Being immersed in the research space has enabled him to make many observations and notes.

Given the researcher's position as the director of the competition he repeatedly assured the competition participants that their responses were only for research and won't affect the outcome of the competition. As an older person from a different background, he attempted to make the interviewees as comfortable as possible. Participants were encouraged to share freely, use Xhosa if necessary (which others translated), and allowed time for them to respond. It is acknowledged that there would also be a potential for bias in the interpretation

of the findings in favour of a positive view of ITC given that the researcher is the competition director.

3.8 Data Collection

Timeframe

The study was predominantly cross-sectional. This is not ideal for determining causal relationships, but is still effective with an interpretive approach. There was one special case where a longitudinal study could be conducted. The winner of the 2013 competition (Participant 1) was interviewed as a participant in a pilot study in 2014 and again as a mentor in 2015. The data collection took place from October 2014 until October 2015. Participants from the 2013, 2014 and 2015 competitions were interviewed. The competition structure was similar each year with only minor differences; therefore collecting data from participants over three competitions should not vary significantly according to the year in which the competition was held.

Pilot study

The formal pilot study was conducted in October 2014 with 2013 competition participants. An Innovate South Africa intern assisted in asking questions. These interviews were exploratory and conversational in nature. The interview questions were refined by changing the wording and removing irrelevant or misunderstood questions. Some new questions were added as pertinent topics from the pilot study arose.

Data collection techniques

Data sources included observation notes, individual interviews and focus groups.

A combination of individual interviews and focus groups was used. The individual interviews gave greater space for respondents to respond outside of a group setting where they might feel pressured by other interviewees' responses or are less responsive because of dominant personalities. Individual interviews were especially used to explore the personal motivations of the learners.

Of the 18 individual interviews, five were full interviews and 13 were interviews restricted to questions on motivation. This was due to the observation that these were more personal questions that may have been more susceptible to bias from group responses. The interaction and learning processes, and discussions on institutional factors, were topics more conducive to group discussions. Each of the full interviews lasted approximately 75 minutes with shorter interviews lasting about 30 minutes. The individual interviews offered an opportunity to collect data that was not biased by a group setting. The semi-structured interviews were relaxed and informal which was useful for engaging shy interviewees.

Each of the nine focus group lasted about 90 minutes. The focus groups were useful for facilitating discussion between interviewees who had varying perspectives. This environment allowed for in-depth insights as well as general trends to surface. A limitation of the focus groups was that there was more potential for bias due to peer pressure. They also limited responses from shy students where more confident students dominated the conversations.

Research notes were made after each interview or focus group as well as during the competition process. Having several sources of data allowed for triangulation in order to confirm findings. Some of the final interviews and focus groups were also used to confirm preliminary findings and discuss discrepancies in responses.

The interview process began with the reasons for the research being explained. Confidentiality was assured and each interviewee was presented with an ethics form to read and sign. The ethics form can be found in the Appendix. They were assured that they were free to be completely honest and open about the topics without it having any influence on the competition results. Permission was asked for the audio from interviews to be recorded and were then transcribed at a later stage.

The general weaknesses of the interviews and focus groups were that there may have been response bias where interviewees responded with what they thought the researcher would want to hear. This bias is exacerbated by the fact that only finalists were interviewed who may have a bias towards a positive view of ITC. Unfortunately, there was no access to non-finalist applicants. There may have also been bias due to poor questions, a language barrier and incomplete recollection. The bias was mitigated through ensuring that all information would be kept anonymous and by encouraging respondents to speak freely. The questions included both specific questions and open questions so that interviewees were able to share their thoughts beyond the interview script. The interviewing was made a smooth as possible and overbearance or passivity was avoided. Interviewees were given sufficient time to

respond to one another in focus groups and give full answers without interruption where possible. The pilot interviews also mitigated bias by improving the quality of the questions.

3.9 Data Analysis

A cross-sectional ‘code and retrieve’ method was used for the data analysis. The reason for this approach was to find themes across the data set and allow for connections and comparisons to be made (Ritchie & Lewis, 2003). The approach to the data analysis used both an inductive approach in seeking out emergent themes in the pilot study, and a deductive approach using themes from the analytical framework. For example, the Octalysis framework was used to label types of motivations in the coding process. The interaction and learning section also followed themes from literature quite closely. However, the third section on institutional factors was a lot more exploratory given that there was less theoretical literature on this topic. It is also very contextual information, which was mainly relevant to the study in terms of the participants’ perception of the institutional factors that affected them. However, all findings were still subjective and interpretive.

The data was analysed in an iterative process through various phases. The process was loosely based on the analytical hierarchy described by Ritchie and Lewis (2003:212). The steps are described as follows:

1. **Familiarisation with data:** the researcher read through all the data and made initial notes.
2. **Labelling codes:** the basic elements of the data were labelled using a coding system.
3. **Identifying themes:** the codes were analysed to identify broader themes and concepts that were sorted into a thematic framework.
4. **Sorting by theme:** thematic searches were done in NVivo to group themes.
5. **Describing themes:** depth was given to each theme through adding various perspectives and dimensions to each theme.
6. **Developing patterns:** patterns were sought out within and between themes in order to delve into the interconnectedness of the complex phenomena under analysis and develop broader concepts.
7. **Developing explanations**: these patterns were used to derive explanations to address the ‘why and how’ questions within the themes.

8. **Applying to wider theory**: the explanations were related back to the theories within the analytical framework.

A charting tool was used throughout the above steps to map out the key ideas into different levels of abstraction within a matrix. The levels of abstraction went from codes to themes to broader concepts and then application to theories.

3.10 Reliability and Validity

Reliability and validity help to define the strength of data in qualitative research (Ritchie & Lewis, 2003:270). Reliability has to do with the extent to which the research can be repeated in another similar study (Ritchie & Lewis, 2003:270). The researcher has also openly described the philosophical approach and assumptions in order to be transparent. Purposive and homogenous sampling was done to prevent bias in the sample selection. The fieldwork was carried out consistently in terms of using the same semi-structured interview protocol, whilst allowing space for respondents to share their views. The researcher took care throughout the research to document the research processes. This included the development of the interview questions and the interview chronology. A clear description of the data collection and data analysis process has been given.

Validity has to do with the 'correctness' of a research reading (Ritchie & Lewis, 2003:273). This includes internal and external validity. Internal validity concerns how accurately the researcher is describing phenomena according to perceptions of the research participants (Ritchie & Lewis, 2003:274). Internal validity was ensured by labelling data as close to the participants' meaning as possible. Many quotes were used in the analysis to show how true findings were to the original data. Triangulation through multiple analysis was used as a means for validation by having more than one interviewer, at least for the pilot study, and multiple mentors sharing their observations. Moreover, the themes developed by the researcher during the interview process were crosschecked with other interviewees. However, all data, which did not fit into the themes that were being formed, were still considered in order to validate any generalisations made.

External validity concerns the transferability of findings to a broader population or to other settings (Ritchie & Lewis, 2003:273-274). Triangulation was used as a means for validation through having multiple data sources. This included data from focus groups with multiple finalist teams from various township areas. It also included crosschecking data from

individual interviews and focus groups with the same participants in order to ensure consistency. Member validation was also used, which is to check the researcher's findings with the research participants (Ritchie & Lewis, 2003:276). This was done with both ITC participants and mentors.

3.11 Ethical Issues

The researcher is aware that ethical considerations are important to the Energy Research Centre and the University of Cape Town. The researcher did not compromise on any of the University's values. The interview questions were designed not to cause harm to participants, but rather potentially benefit them as a reflective tool for the process they had been through. Ethics approval before interviews was obtained. This required the research design and interview question outline. All interviewees signed a consent form (see Appendix). All interviewees under the age of 18 had their parents sign the consent forms as well. No incentive was given to interviewees to complete the interviews and they were assured that they were free to not answer or leave at any point during the interviews. All data was kept confidential by the researcher. None of the transcripts or notes were shared.

4 Analysis

This chapter presents the analysis from the thematic analysis of the data in the context of the research questions. There are three main categories, namely:

1. The motivations and incentives,
2. The interaction and learning,
3. And the institutional factors.

Each section will be followed by a discussion on the analysis within that section. A final discussion is given in the following chapter.

4.1 Motivation and Incentives

The first analysis section presents an analysis of the learners' motivation and the role that incentives play. This includes the general motivation to start the project, and to continue in the process once selected. An analysis of the role played by different forms of incentives follows. The motivations are broadly categorized according to the Octalysis framework, with the incentives analysis given in the Development & Accomplishment section.

4.1.1 Epic Meaning & Calling

"*You just feel as if you are a hero*" (Participant 6)

The analysis revealed that the learners' motivation was complex, however creating social impact was given as the primary reason for doing their projects. When asked about the ultimate motivation, all learners gave an answer relating to making a social impact. This was the underlying motivation that linked to many of the others. For example, the main accomplishment motivation was to make a social impact and a strong relatedness motivation was to make a meaningful difference in the lives of those they care about.

There were many reasons behind wanting to make a social impact. In many cases it was frustration at a problem that they had observed for a long time or had personally experienced. This immersion in the problem space was a big motivation besides being helpful in terms of understanding how to approach the problem. It was often noted that one of the main reasons that locals would have an advantage over outsiders is that they would

have much more perseverance because of what the problem meant to them. There was a desire to find something meaningful to do that would help them find fulfilment and wasn't something selfish. These feelings were amplified when the community began to support the projects. Although many of the projects affected the learners personally, there were also many groups that wanted to help others less fortunate than themselves even though they themselves fall within a relevantly low-income bracket in Cape Town. This also came through in projects that involved peer-to-peer sharing. Often the case was that the learners participated in a program where they had learnt a skill or had learnt about a potential solution to a problem and wanted to pass these valuable experiences on to their peers who had not had the same opportunity. The general initial perspective from the teams was that they wanted to solve a community problem and inspire others to do so as well. The desire to start an organization or business was secondary. An example of the finalists inspiring others occurred when one of the finalists inspired her friends to start a library at their school of their own volition.

Box 1: Finalist Project - Transport Revolution

Transport Revolution wanted to revolutionize the payment system for train tickets in Cape Town. They noticed that the majority of people travelling from townships to town use the train because it is cheap and affordable. But, the trains are not safe, are often delayed, have long ticket queues, and can have a shortage of paper for printing tickets. This often makes people late for work and sometimes results in people paying for other means of travel. The team created a ticket system where travellers can pre-pay for travel credit using a mobile USSD application. The credit is loaded onto a card, rather than paper ticket, which is swiped upon travel. This prevents the issues faced for those who have to purchase paper tickets. The application would also have notification system to give important information such as the location of train stations, travelling times and notifications about delayed trains.

The sense of being called or being a 'humanity hero'[5] was a strong motivation. Participant 6 gave the following motivation for starting their project: "You know that feeling when you have done something good? You just feel as if you are a hero." Being selected as a finalist was very meaningful to the learners before they had even started on their projects. It gave a sense of legitimacy to their idea and built confidence through others seeing promise in what they were attempting. An example of this was seen with the *Transport Revolution* team (see Box 1). Although the team usually showed a certain amount of timidity in approaching adults

[5] a gamification term for people who are selected to save others.

for help, they took their own initiative to set up a meeting with the director of innovation at a large telecommunications company to ask for support for their project. The director even flew down to Cape Town to meet with them. When asked about why they had the boldness to contact the company, the team responded that they felt confident because they were wearing their ITC caps, so people could see that they were part of an official program.

The sense of being called to a purpose was seen to be closely tied to a sense of identity. The learners used phrases that alluded to being part of something and having a communal identity as ‘innovators’. They would use phrases such as:

> Now that you are a part of a people who are for innovation you walk down the street and you try by all means to criticize what you see and then you think of ways in which you can... solve whatever problem that you see around. (Participant 4)

For those who continued with their projects beyond the competition they emphasized the need to have a community of innovators to be a part of. They understood the need to make a deep connection with their project and with innovation in general in order to continue being an innovator. One learner went to the extent of giving an analogy of this connection as being a marriage between himself and the project: “There's always room for me to sit back and say ok I'm done. But now I'm engaging in a marriage contract, I vow that I'm going to make this a success.” (Participant 1) Being identified with the project was also a strong motivator in terms of being able to leave behind a legacy where they could look back and say they had made a difference.

4.1.2 Development & Accomplishment

“*I’m learning and improving daily.*” (Participant 1)

This section in the Octalysis framework includes the drive to win the final cash prize as an accomplishment. Therefore, the analysis relating to the role the cash prize played in motivating learners is presented here. This section also includes analysis on the less tangible, but prominent, motivation of personal development.

Cash Prize

The role of the cash prize played an important, but complex role. All learners agreed that it played a strong role in grabbing their attention about the competition. Some initially saw the cash prize as the main reason for participating, but this seldom lasted:

> The first thing that we saw was the grand prize, but then along the way we attached to learning and improving and trying to make an impact. The R10,000 didn't matter anymore, we just wanted to put this through and solve a social problem and learn. (Participant 1)

Once there was a better understanding about the nature of the competition, in terms of how it was an opportunity to solve a community problem, this motivation became more dominant than winning the cash prize. When comparing the importance of winning the prize and impacting the community all learners selected the latter.

Some teams noted that they began to see the cash prize only as a means to the end of solving the problem and potentially setting up a business rather than the end itself. Many learners had a similar response to this remark by Participant 9: "The prize is to make the project a reality." One learner said: "To me the cash prize is just a bonus. The main thing is helping the community. It's a cherry on top." (Participant 19) Some learners were adamant that there must be no selfish desire when trying to make a change in their community. This can be seen in this response: "You don't go trying to change something thinking that you'll get something, you just go because you want to change something and out of that you get so much praise and fulfilment." (Participant 3) The ultimate accomplishment agreed upon by all groups was not winning the prize, but solving the problem at hand. However, all learners admitted that the cash prize was a motivator as well. One learner even broke up their motivation into percentages, "I think the prize was maybe only 30% of it. The project, 70%." (Participant 19) Therefore, the prize did play a role, but that doing the project for its own sake was the dominant motivation.

Learners also noted that the prize was an on-going motivation, besides being an initial attractor. They spoke of how when they were going through tough times in their projects, they were pushed to continue because there was a chance of winning the cash.

It must be noted that in this case the cash prize was grant funding to continue the project and could not be used directly for personal gain. It was literally a means to an end.

Therefore, one can draw limited conclusions on the influence of the cash prize to the individual, as there was no direct monetary gain. However, it was certainly an exciting motivator to all groups to win the cash prize.

One surprising finding that came up in the pilot study was the importance of the size of the prize. This came out of a discussion on how to get more participants to apply to ITC, one of the pain points for the competition organizers. The assumption was that the larger the prize was the more applications there would be. But this was not the case. Some learners replied that it would be very effective, but this wouldn't be a good thing (for them) because the wrong sort of people would apply - those that just wanted to do it for the money and not to solve a community problem. Therefore, it may be effective for the quantity of applications, but not the quality of the applicants, nor the experience of competing. Almost all learners agreed that a big prize would be intimidating, including those who would want a larger prize. They would potentially exclude themselves from applying because such a competition "sounds too big" (Participant 10). Participant 13 said: "I think we would have been too scared, because we would have thought, yoh, there are going to be like very smart guys who are going to enter this competition. Like kids from Bishops (a well known private school in Cape Town)." Another reason that a larger prize wasn't welcomed was that it would take away from their sense of accomplishment and ownership and diminish the drive to continue. Participant 4 said:

> If it had to be a lot of money I promise we would have done way less things. Like, way less things. Because, we would have been like, ok, we have the money so, the more money you have the less you work. (Participant 4)

However, it was noted that once the learners had progressed in the competition and had built up confidence in their abilities a larger prize would be appealing. The conclusion was that the best combination would be for the prizes to come in stages. There needed to be an initial attainable prize and then a larger final prize, with potentially intermediate prizes between the two.

In terms of the type of external rewards it was found that the cash prize wasn't necessarily the most appealing. Other popular choices included travel, mentorship, networking opportunities and further training programs. There was no clear favourite, but from further questioning as to why these were preferable to a cash prize it was clear that attractive prizes would be things that opened up future opportunities for having fun, interacting, building a

network and growing as a person, all of which could result in starting a business or an organization and making a larger social impact.

The process by which the prizes were to be received was also important. The learners were asked about whether they'd prefer a sponsor from the beginning who would give them the cash prize amount, or whether they'd prefer to win the same cash prize. Most groups selected winning the cash prize because it would have forced them to work harder: "If you had the money in the beginning you do less things because you know there is nothing that pushes you." (Participant 4) They would also feel like they had earned it: "If you have less money the more determined you are to work hard to get more money, knowing that you worked for the money." (Participant 8) One leaner even acknowledged that the cash would be wasted on him if he had too much, "Coz the cash, I'll eat (spend) it and then it's going to be gone." (Participant 6) For those who preferred sponsorship their reasoning was that they were guaranteed greater support to make a larger impact on their communities, therefore the motivation wasn't as simple as wanting instant reward for it's own sake. It was also noted that having small initial grants was very helpful for the basic resources that were required. Also, it pushed people to be resourceful with a little and pushed them to try to win more.

Besides the timing of the prize, a strong suggestion was to have multiple runner up prizes. This was especially for those who needed more motivation because they weren't confident that they would come first.

Other External Rewards

Besides winning the cash prize itself there were other external rewards at stake. Winning the competition was a strong motivator for some, but the strength of this motivator varied significantly depending on how competitive the nature of the learner was. One learner expressed one of his motivations to take part in the competition simply as follows, "To win. To shine." (Participant 17) Therefore, winning was closely associated with blossoming as a person. Simply being selected as a finalist was seen by some as reward enough and the final prize was only significant as a means to take the project further. Participant 3's response, when asked about what their group wanted to win, was: "We knew that if we got into the top seven then we would have enough money for our garden[6]. Sharp! That's all we wanted." Receiving a mentor was a strong attraction to the competition as well as the prize.

[6] This was the *Rescue for Nature* project that involved cleaning up litter and planting a garden at their local school.

This was because the mentor could help them with the project, but also open up a new network to the learners. The role of mentorship will be discussed later.

Less Tangible Rewards

Although the external rewards played a significant role a lot of emphasis was given to the role of less tangible internal rewards, such as personal development. This included learning about oneself, learning new hard and soft skills, testing one's abilities and growing as a person.

The learners stated that having appropriate challenges was important in order to grow: "I think I wanted to challenge myself because I never really take part in competitions." (Participant 7) The learners stated that overcoming obstacles was what helps a person grow: "It helped me grow, because we encountered so many obstacles, but we were able to face them." (Participant 13) One group noted that although they didn't always enjoy competitions they knew they were worthwhile because of the potential to grow. The same group had several topics to choose from to submit to the competition and selected the toughest one because of the extent to which they valued being challenged. A descriptive phrase that came from a few learners was: "You can measure the length of your abilities." (Participant 10 & 12) This came out of a context of not having many opportunities to see what they themselves were capable of, as well as a curiosity to see what is possible in general, having not seen many examples of innovation.

The areas in which the learners sought to grow included the hard skills related to the field of their project and often included business and IT skills. Soft skills were also emphasized and included communication skills, learning independence in terms of working without a set of instructions from a teacher, as well as learning how to work in a team and how to collaborate. Many identified speaking in public as the biggest cause of growth in confidence. Learning new ways of thinking was important to the learners. They especially found it fascinating to see how others thought about and approached problems in order to compare their own way of thinking to theirs and to be inspired to think differently.

Personal development was emphasized as a means to maintain engagement throughout the competition. To illustrate this, Participant 1 said that it is possible to still feel motivated even though you do not expect to win: "but having the learning phase you see, ok I'm getting something out of this, I'm learning and improving daily." Therefore, they continued to attend

workshops even though the prize didn't motivate them. Participant 10 explained that getting something on your CV is more important than money because "that lasts forever."

4.1.3 Empowerment of Creativity & Feedback

"*It is the very same thing that makes my heart pump*." (Participant 6)

Many learners were motivated by the opportunity to be creative through innovation. One learner gave the following response when asked about what learning was like during the competition process versus at school:

> But when I am here, ok, I love IT. Yes, I know that I am failing (at school), but I love IT. When I am here I know that this app that I am working on is based on IT and therefore I have interest. I mean, I cannot wait to run for Innovate and then I wish that it would end at 10 o'clock late. Because, I feel like I have to spend most of my time here working on this app, because it is the very same thing that makes my heart pump. (Participant 6)

When asked about the role that the prize had versus doing the project for its own sake, participant 17 responded: "Since I love technology, it's mostly doing the project, the opportunity to express myself through technology, and to help my community." Many participants were simply interested in their subject matter and enjoyed the opportunity to be able to explore learning about a topic with the resources that were provided for them.

Having autonomy was highlighted as a significant part of taking part in the competition. Participant 17 said that what grabbed his attention about the competition was that "it was the freedom to choose anything you want to solve." According to the design of the competition the learners are given the freedom to select their own problem and solution and to approach their projects in a self-directed manner with only guidance given by the mentors. This was a new experience to all of the learners and was on the whole met with enthusiasm. However, given the newness of it all, there were also feelings of insecurity because of a lack of prior experience or clear direction. It was observed that this lead to some feelings of incompetence which was demotivating. As the learners became accustomed to the new style of approaching their work and received good feedback from adults, this insecurity diminished. Once they had begun to make progress with their projects the feeling of growing competence reinforced a sense of empowerment. Once reinforced enough, this feeling of

empowerment included the confidence to attempt to solve problems in general. They said things like, “All problems can be solved.” (Participant 19) Seeing the ideas actualized was pivotal to this process.

Feeling empowerment within the community and receiving positive feedback was very valuable to the learners. They said that having an opportunity to make a difference was very meaningful. The learners took a lot of pride in the fact that they, coming from the township, were able to do something instead of being on the receiving end of some form of aid. Helping others enabled the learners to acknowledge that even though it may seem that they have little materially they do in fact have a lot to offer. The following quote illustrates the importance of having young people from the township showcasing their ideas:

> Ya, it’s (referring to showcasing) also important, because people get to see that this is the problem in Khayelitsha and this is what Khayelitsha itself is trying to do about the problem, because we are also part of Khayelitsha. And then people get to see that we are trying to solve the problem even if it is not only talking about this problem, but people must see that we as youth, we also have a voice. (Participant 10)

4.1.4 Ownership & Possession

“*It feels good to put my name on it.”* (Participant 6)

Linked to the findings on empowerment and autonomy above, the learners had a sense of pride in being able to start something themselves. One learner said that they took great pride in knowing that the name of their application included his initials which showed that he played a big role in this solution: “It feels good to put my name on it” (Participant 6). The potential to own a future business was also appealing. As the learners began to accomplish more tasks in their project process they developed a strong sense of ownership over their work. This was seen in how they often mentioned the need to earn the rewards through working hard as opposed to getting things for free. One learner gave the following reason for preferring to win funding to sponsorship from the beginning: “You know that you worked for it. You got it yourself. It wasn’t just a hand-out.” (Participant 6)

4.1.5 Social Influence & Relatedness

"*Being able to work together*" (Participant 7)

Social influence was a core drive that related very closely to the Epic meaning & Calling drive. The influence of working with others was a dominant motivation. This included both working with the other members in their groups and the other participants in the competition as well as the interaction with community members and adults.

There was the simple enjoyment of "being able to work together" with friends (Participant 7). It was gratifying to see how their efforts as a team resulted in real life results and they were able to encourage each other in that. It was also important for the learners to work in groups to learn teamwork and leadership because they felt like they did not have much opportunity to do so at school where a lot of the work is done individually.

The dynamic of working with the other groups had several motivating factors. It was fun to meet new people and to make new friends, especially learners from different areas who usually wouldn't have any opportunity to interact. Since the groups all had the desire to innovate in common, even though they were from different backgrounds, they found it enjoyable to be around people who were young and like-minded: "As teenagers we understand each other better." (Participant 7) This was found to be lacking amongst their peers at home. The groups went through several interactive workshops, which involved the groups critiquing each other's ideas. This motivated the groups to think more deeply about their ideas and added pressure for them to really know their subject matter in order to avoid embarrassment when they had to present their ideas to each other. One mentor (Participant 1) described these collaborative sessions as "refreshment stations" for the group because of the new ideas and energy they would have from interacting with others.

As previously mentioned, there was also the curiosity to see how other learners thought about their problems and how they progressed. This motivated learners to come to the events so that they could compare their progress. Often groups assumed at the outset of the finalist round that they would struggle to compete with other groups. Therefore, on the one hand the relatively slow progress of some competing groups was encouraging, and on the other hand, the good progress of other groups spurred them on to try harder. Participant 13 said that he was motivated by the inspirational ideas he saw from other groups: "The future of South Africa has hope, because their ideas were brilliant." This dynamic between groups

was described by the learners as both collaborative and competitive in that they were all for each other and wanted others to succeed, but they were also pushed to compete for the prize.

It was a meaningful experience for the learners to work with one another on something that affected their community. Working on the projects gave the learners a greater sense of relatedness to their communities allowing them to feel like contributors, often for the first time. It was very valuable to the learners to be able to have a voice and have their ideas valued. They very rarely have an opportunity to share their ideas and contribute practically on such matters. One learner said that the barrier to innovation in his community is that, “there is no platform, or there is no environment for creativity.” (Participant 1) Therefore receiving recognition and praise from their community was a special experience for them as it gave them an opportunity to influence others as motivational speakers as described by a learner: “When they announced that we were the most motivating youngsters amongst those that we were sitting with and we had to go and speak we were being recognized as motivational speakers you know.” (Participant 12)

The influence of the communities on the motivation of the groups was varied. There were often initial barriers that needed to be overcome from both peers and adults. The learners said that there was a lot of negative peer pressure. Some learners said that a typical phrase they would hear when trying something new is, “No, guy, this won’t happen. Come back to reality” (Participant 1) and “if the government can't do it then no one can.” (Participant 19) In response to this, Participant 8 said, “I don’t blame them because they don’t understand.” Many groups actually took this as a challenge to prove their peers wrong.

Adults in the community often didn’t support the projects immediately. The learners attributed this to a general mistrust of youth, because they are associated with being gangsters and are “full of madness”, as Participant 24 describes. However, once the projects became more established both peers and adults in the communities began showing support for the projects and encouraged the groups. This expectation of the community for the groups to succeed then became a strong motivation for the groups to persevere.

The interaction of the learners with adults, including the mentors, advisors and speakers, at the workshops played a significant motivating role. Having welcoming people who showed genuine concern for the teams and their projects gave the teams a sense of being in a family. One learner described the ITC team as follows: “They were more like parents to us and made sure that we think for ourselves.” (Participant 4) Another quote to illustrate the

importance of having a sense of relatedness with the ITC team is as follows: “You asked us for a solution, and you could just sit down and wait for the solution, but you, unlike other competitions, you create a bond with the participants and we get motivated to push more.” (Participant 17) One mentor commented that he thought that one of the greatest motivators for his team was the fact that he had been through what they had and managed to succeed (Participant 1). Therefore, role models played a big role.

It was an exciting experience for the learners to meet new people, as there were different people at each workshop. It was very valuable for the learners to have adults give their time to listen to their ideas and give helpful suggestions, “We were able to say what we think and people actually listened” (Participant 11). This gave a further badge of legitimacy to their projects. The speakers at events were mentioned as being very inspiring and motivated the groups through showing practical examples of successful innovations or businesses, examples that they didn’t often have. The mentors played a very significant role in motivating the learners. Even if they were not experts in the field of the project, the constant encouragement that they gave was vitally important. Simply the sense of not being alone in the venture and knowing that they could turn to someone if they ran into a stumbling block was very reassuring. Participant 24 described the best thing about his mentor as her being “on the same page”, meaning that she understood them well and identified with their project. Finally, a strong motivator for the groups from their general interaction with the adults was the possibility of growing their networks. This was not only useful for their projects but also gave them the sense of being connected to a bigger world.

The extent to which the learners valued the a sense of relatedness within ITC can be seen in the response that one learner gave for what the best prize for an innovation competition would be, “For me it's maybe that you would not lose contact with us and maybe next year we can help get new entries and share our experience that we had with Innovate (the Cape) this year with kids from next year.” (Participant 19) Another learner said that one of the main reasons for their project was “to make people (in the community) grow and for people to have something to do.” (Participant 15) This showed that they were not only influenced by their social setting, but were motivated to influence the community as well through getting them to work together.

4.1.6 Scarcity & Impatience

"*I am the kind of person that does not let opportunities pass me by*." (Participant 4)

The learners stated that they generally have a lack of opportunities to innovate: "For us we usually don't have those kind of opportunities to identify problems in our community." (Participant 12) The learners remarked that these kinds of competitions where participants receive funding and are able to practically create solutions aren't usually for youth, but rather aid organizations or government: "This kind of idea is usually the type of idea that is done by the government." (Participant 11) Furthermore, opportunities outside of school are scarce in general so any opportunity targeted at township youth has appeal. Therefore, one motivation was to make the most of the few opportunities available. In terms of making the most of scarce opportunities, one learner said about himself, "I am the kind of person that does not let opportunities pass me by." (Participant 4)

Another aspect where scarcity was a motivation, alluded to above, was the scarcity of resources that the learners had to work with. The learners were given small amounts of grant funding to initiate their projects. The learners said this was a good thing as it pushed them to work hard to use what they have and push harder to get further funding. They also took pride in using resources efficiently: "Small money is the right way to go, because we were given a little and we were able to do so much." (Participant 10)

4.1.7 Unpredictability & Curiosity

"*What intrigued me was that the competition was for youngsters.*" (Participant 12)

Given that innovation is centred on new things, unpredictability and curiosity were important motivations. Having a competition for youth that involved activities that would usually be for adults was said to be "intriguing" (Participant 12) and piqued the interest of the learners. Even the concept of innovating was new to most learners, which also garnered interest in the competition.

There were several aspects of the program that the learners were curious about. Firstly, there were the projects themselves and the curiosity about what would unfold as they progressed. For most learners it was the first time doing something like this, so it was a novel experience. As mentioned in the Development & Accomplishment section they were

also curious as to what they were capable of and their strengths and weaknesses. The curiosity in the field of their projects was also a strong driver to learn more about their subject and explore this in an experiential manner through testing things out practically. Exploring the field also allowed the learners to find out whether it was a field they might be interested in as a career option. Working with new people and learning new things in new places was an exciting experience. It stimulated creativity and motivated the learners to think in new ways.

4.1.8 Loss & Avoidance

"*I might as well just run until the finish line.*" (Participant 4)

Although the Loss & Avoidance drive can have a negative connotation, it was an effective driver for various aspects of the competition. A strong motivator linked to the ownership theme was that once the learners had invested a lot of time and effort into their project they felt that they needed to continue to avoid losing the progress that they had made:

> If you run in the race and you are almost reaching the finish line, you think of all the meters that you have run and you think, if I fall now what about all of the distance that I ran, so I might as well just run until the finish line. (Participant 4)

This also involved the fear of disappointing all the people who believed in their project and expected it to succeed. Having deadlines throughout the competition was helpful in terms of keeping momentum going due to the fear of missing deadlines. The 'fear of missing out' was a strong motivator for the learners, both for applying to the competition (an opportunity not to be missed), as well as to keep going to the events, which were all voluntary.

Finally, another motivation that arose was that of avoiding negative activities at home. A few learners said that they attended events because they wanted to use their time constructively and not just waste away their time doing nothing. They also did not want to get involved in unwholesome activities at home like gangsterism. One learner put it in a straightforward way: "I get involved in many things and that way I can stay away from bad things." (Participant 4)

4.1.9 Sensation

"*The best part of this competition is the food*." (Participant 6)

Good food is a physiological motivation that isn't included in the Octalysis framework because it is not a psychological phenomenon. However, Chou (2015a) does refer to the sensation drive, which includes food (p. 32-33). Food was provided for finalists at all of the competition events. Learners often mentioned this as a good motivator to come to events. This comment was always met with a lot of laughter from the participants.

4.1.10 Discussion: motivation and the role of incentives

From the analysis it is evident that the motivations were varied, socially oriented and strongly linked to the learners' contexts. Strong motivations that were frequently mentioned and emphasized related to making a social impact and the role of social influence. This shows the important role that social dynamics played. Another strongly featuring motivation was the enjoyment of learning, being creative and curious. One result of this learning opportunity was the potential for personal development. Many of these motivations are included in the intrinsic motivation section of the Octalysis framework. Tangible rewards also played an important role, but needed to be administered in a rather specific way in order to augment intrinsic motivation rather than diminish it. Intangible rewards, such as personal development, also played an important role.

It must be noted, however, that determining the extent to which motivations were truly intrinsic is difficult to ascertain. For example, the underlying motivation to help the community could be intrinsic motivations such as the love for people and a deep sense of relatedness. On the other hand, it could originally be because of an external suggestion (such as a competition challenge) or for social recognition. Another example is that personal development can satisfy the innate psychological need for competence according to SDT (Ryan & Deci 2000b) and be an enjoyable process of discovery. However, it could also ultimately be for the reward of mastery of a skill where the experience itself is not enjoyable. I.e. the activity is only done for a separable outcome, not the experience itself, making it extrinsically motivated. Therefore, it is difficult to differentiate between intrinsic and extrinsic motivations, even when motivations may seem intrinsic on the surface. However, it is likely that both motivations have a perceived internal locus of causality, even if they could be externally motivated. Therefore, according to SDT, these motivations should either be

internalized or intrinsic, and so effective in the long term. However, if the motivation was extrinsic and not integrated, these motivations may not last. According to SDT, one needs to ensure that the innate psychological needs of competence, autonomy and relatedness are fulfilled to reinforce intrinsic or internalized motivation. Therefore, in terms of considering what incentives would be appropriate in this case, providing healthy social recognition and an improved CV could reinforce a sense of relatedness and competence and be beneficial no matter the form of motivation. Note that *healthy* social recognition is important here. If having a showcasing event resulted in jealousy, this would diminish the sense of relatedness, which would diminish the level of intrinsic motivation. Therefore, understanding the deeper psychological effects that the incentives create is pivotal in order to design effective incentives.

The findings above align closely with SDT on the need to fulfil the need for perceived competence, autonomy and relatedness. In terms of relatedness, this can be seen in the underlying purpose that the learners exhibited in solving a community problem that they were deeply connected to. The ultimate form of this could potentially be through facilitating the development of a communal identity as innovators, which was observed to a certain extent. It can also be seen in the strong influence that others had on motivating them. This often took the form of adults giving the learners a sense of legitimacy so that they could be confident to pursue their ideas. This would result in building competence, which would in turn reinforce confidence (Ryan & Deci, 2000a). Another case is the important dynamic of maintaining perceived autonomy whilst ensuring that perceived confidence and competence were upheld as well. This was especially made evident from the impact that the mentors would have in the level of support they gave. If they gave too much support the learners would become dependent and lose a sense of agency. If they gave too little support then the learners would begin feeling incompetence and lose confidence. This shows the importance of preparing mentors well and putting good feedback loops into place so that mentors are aware of what their groups need.

Likewise, the role of incentives could only be properly understood through having a good understanding of the nature of the learners' motivations and the contextual influence. Incentives played an important role in creating initial excitement to apply to the competition as well as a level of excitement throughout the finalist phase. As discussed above, external rewards such as being selected, receiving a mentor and social recognition played an important role in reinforcing intrinsic motivation through building confidence and providing a sense of legitimacy. This need for external motivation is especially important where

confidence levels are low and, in the case of innovating, the task at hand involves a lot of failure. Rewards are good markers of progress, which can reinforce a sense of competence.

On the other hand, incentives can have a negative effect. This was seen in how some groups were demotivated when they did not win the final prize. For learners who were low in confidence, losing a competition may make them perceive themselves as losers and be detrimental to their sense of competence so that they lose interest in continuing their projects. Participant 12 stated: “If you lose it is not a good feeling – there is that doubt about whether you want to continue or not because of the fact that you lost so you’re not sure if the project will succeed in the future.” The continuity of projects is generally low after the competition, especially for those not awarded prizes. However, from questioning the learners about this, it may be attributed to other factors such as learners going into their final year at school and being too busy. Groups always did at least show interest in continuing at some point. Another potential negative effect that incentives could have was seen in the discussion about the size of the prize. A large prize can reduce confidence to apply or cheapen the experience through making what should be a selfless and intrinsically motivated activity, one that is for personal gain.

In conclusion, the competition incentives were not necessarily detrimental to intrinsic motivation by any means. External rewards were shown to play an important role in reinforcing intrinsic motivation. This confirms the link in the conceptual model (figure 2) between a gamified process and a state of engaged innovative activity. A high level of engagement of groups was observed and often commented on by mentors and teachers, so although this is a cross-sectional study, it is highly probable that the external incentives had no crowding out effect on the participants’ intrinsic motivation during the prototyping phase of the competition.

However, incentives need to be designed carefully. Consideration must be taken for the participants’ values, their context and sensitivities such as levels of confidence in order to design appropriate rewards, or facilitate an environment where intangible rewards can be sought. Therefore, one should emphasize how the innovation competition process will benefit the community and the participant. This presents an opportunity to design a highly motivating process without a high incentive cost.

4.2 Interactions and Learning

The following section presents analysis on the necessary skills required by the learners to innovate, the process of knowledge transfer, how to create a supportive learning environment and the institutional influence of school on learning to innovate.

4.2.1 Skills for innovation

"*I know my people*." (Participant 3)

Many of the skills required to innovate have been mentioned in the section on Development & Accomplishment, but will be given here in more detail. Observations made by the researcher and mentors were important sources of data here.

Some of the largest observable gaps in knowledge were in groups that required hard technical skills for their projects. This often involved some form of ICT knowledge. Many groups were able to pick up these skills rather quickly with the help of online tutorials and help from advisors. Many groups also showed a lack in basic business acumen such as how to budget and create basic business plans.

Soft skills were emphasized by the learners as some of the most valuable skills they needed. This often centred on collaboration. They included learning leadership, how to work in a team, professional communications and critical thinking skills. Many learners found that working in a team was revealing in terms of what personal strengths and weaknesses they had in fulfilling different roles. Another important skill was project management, such as setting goals and having good time management. Participant 1 described this as learning to see projects not as a "big black scary box". He was able to see potential outcomes and figure out what steps he needed to take in order to achieve those. Setting common goals and deadlines was an important feature of the mentoring process for this. It was important for the rapid prototyping process because groups struggled with having products that they had to test out on users that were not the final design. Learners were used to only showing their final products at school.

Local knowledge

An important soft skill was the local knowledge that learners had. This gave them the ability to interact with their communities effectively, which was important since the target market of their human-centred project designs was their local community. One learner gave a good description of the importance of knowing the community context:

> I know my people. They are very political. So if you do something, they're always gonna ask, are you getting something from it?... And if you go out there to my neighbourhood not knowing the social rules of what happens out there you would really get messed up. Because, I don't know, how would you go about it? It's a different culture. It's a different setting, and they have their own minds and their own history. So I kind of knew a lot that could help me that no one could have had out(side) of my neighbourhood. (Participant 3)

Here, it can be seen that being immersed in the problem space, often having experienced the problem first hand, enabled the groups to have a good understanding of the problem and how it affected people. Participant 24 confirmed this, saying: "We are able to solve the problem because we understand the problem through experiencing it." They believed that this would make it far easier to deal with their communities than it would be for an outsider. On the other hand, learners also spoke of an element of respect that the community has for outsiders because they may see them as wealthier or more capable in certain senses, which would mean they would have the means to execute a project.

4.2.2 Knowledge transfer

"The Internet returns things that happen far away from us." (Participant 20)

This section presents analysis on the knowledge transfer process including knowledge forms, the interaction of actors and the learning inputs required.

Knowledge forms

There were many things that the groups learnt that they found difficult to describe or attribute to anything specifically. They would say things like, "Now I'm an innovator" (Participant 1 & 8), "I see things differently" (Participant 8) or, "Now I am confident to solve problems",

(Participant 1 & 24), but could only attribute this to going through the experience as a whole. Although there were some classes on presentation skills, many of the soft skills mentioned above came through learning by example from mentors, advisors and other groups. These included general communication skills such as how to approach people for advice in an appropriate way, general professionalism and new ways of thinking. Participant 2 noted how he would watch the details of how the adults at events conducted themselves, even how they ate, and try to learn from that. One mentor noted that one of the breakthroughs her group had, was as a result of her constantly saying, “let’s Google it” (Participant 29), whenever she didn’t know something. After a while the learners picked up this habit and surprised her with having figured something out through looking it up online themselves rather than asking her for help.

An important part of the learning experience came through trial and error. The rapid prototyping of making things, testing them in communities, failing and redesigning was a powerful means to learn how to apply knowledge in an effective way, even if it was uncomfortable for the learners. This experience of going from thinking to doing in the real world, i.e. knowledge on how to change the world, was not familiar to the learners and they commented that training to do so was needed. Participant 17 described it as a need for “training (his) mind to think and then do.” Thus, taking the groups through the design process with a focus on making, with only a little formal teaching to guide them, enabled the learners to gain confidence in their problem solving ability.

Although the tacit forms of knowledge were emphasized by the learners as the most valuable learnings, codified sources of knowledge were certainly important as well. The main source was the Internet, which was used for learning skills and doing research. As mentioned, some groups were able to teach themselves significant skills online, such as how to code. However, this process was made a lot easier with someone to tutor the learner. Learners had trouble at times understanding the relevance of information on the Internet, especially if it was written in another country. One learner stated that the “Internet returns things that happen far away from us. If you ask people around you about the problem you want to solve, that helps.” (Participant 20) However, with the help of advisors they were able to interpret how to apply the information to their projects and give context as to why they had to learn certain things. Once applied, this knowledge would then be tested and new tacit knowledge would be formed from the learnings. However, the conversion from tacit knowledge back to codified knowledge was often a weak point for the learners in the knowledge building process. Although documenting progress and learning was encouraged, it was seldom done. This would obviously make sharing new knowledge difficult.

4.2.3 Interaction of Actors

Working with others had many positive effects. Most of the work and learning took place in a collaborative fashion. The learners all participated in groups and they each had mentors and advisors. The workshops involved group work as well. The learners noted that most of the learning they experienced came through engaging with others in a collaborative way. Although they found the classes during the workshops useful, they found that working on the project directly with others was most effective for learning. The teams came from a variety of backgrounds. This added to the newness of the experience, which made the collaboration both fun and insightful because of the variety in perspectives. As mentioned in the Social influence & Relatedness section, the dynamic between groups was reported to be both competitive and collaborative. Groups never wanted to hide their ideas and were always willing to help other groups. However, there was still competition for the final prize, which pushed the groups to work harder. Factors that likely contributed to this were that the competition is aimed at creating social impact which was a value held by all participants. The challenge was broad, so groups had a similar purpose, but widely differing topics. Finally, the format of the workshops was open and collaborative.

The interaction with mentors and advisors played a crucial role in the learning process. Firstly, they were able to legitimize the groups' ideas. Participant 1 gave the following remark: "So once you've spoken to your mentor and they've ok'd it, you feel like you can speak with anyone and you have that confidence." As mentioned above, during learning processes the learners were able to learn many things on their own through the Internet and through trial and error, but there were gaps in making the information that was available to them into usable knowledge. However, as in the example of the information on the Internet seeming too far away, advisors were able to identify good information sources, make the information relevant and use their experience to give advice on how it might be applied. Mentors played an important intermediary role for their groups through opening up their networks to give new knowledge sources. Often the groups were afraid to approach new people such as businessmen or academics, but if the mentors introduced them they were confident to interact independently thereafter. This can be seen in figure 4 below in terms of how much more connected the finalists became after the competition.

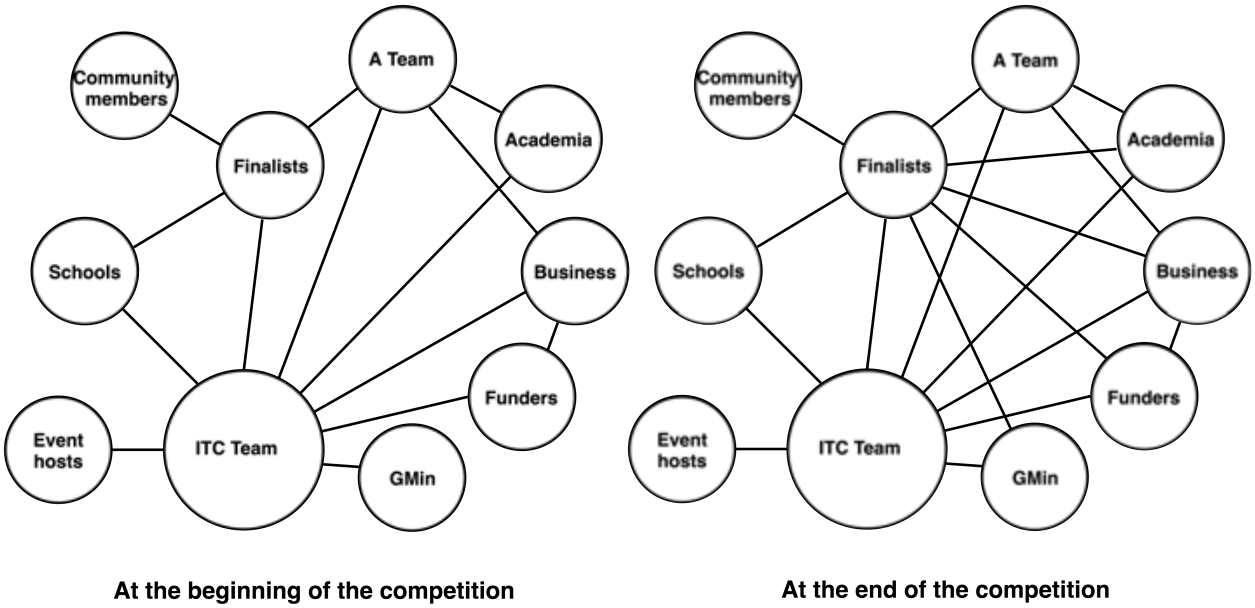

Figure 4: The Innovate the Cape Network at the beginning and end of the competition (Source: Author)

There were some challenges working in groups and with mentors. Within the groups there was a lack of leadership at times. Hence, there was a lack in direction and ownership of responsibility for the lack of progress. There was also difficulty in coordinating within the group and with the mentor to all get to the same place in order to work on the project. This was often given as a reason if there was lack of progress. Another challenge that mentors mentioned was a tendency for the groups to rely on the mentors and take their advice as authoritative, even if the mentors weren't sure about a topic. They would often wait for their go-ahead before initiating action, which caused unnecessary delays.

4.2.4 Learning Inputs

In an innovation system, the essential aim is to propagate knowledge through the system in order for innovations to develop. Therefore information access is an essential, if not the essential, input to the learning process. As discussed above, it could be argued that it is not as simple as providing information access. Rather, usable knowledge needs to be provided along with the tools needed to creatively recombine that knowledge into novel ideas that can be implemented.

The Internet was an invaluable source of information for the learners. Many of the groups relied heavily on the Internet to do research for their projects. The Internet was also used as a communication tool for the teams to coordinate and for the teams to do marketing. There were, however, many barriers to Internet access for the learners. The most common points of access to the Internet are at school or on mobile phones. Almost none of the learners had access to work devices such as computers or tablets at home, so even if they did have Wi-Fi access they would not have a device to use it. None of the learners had Internet access at home besides on their mobile phones. Participant 4 noted that if they did have data on their phones social media sites would take priority and then they would run out of data to do anything else. The Internet at schools can only be used at certain times and is often very slow. There are also limited devices and so it becomes a contested resource. Schools' computer labs are also often targeted by criminals so some groups said they had no access to computers at school. Another access point is Internet cafes. There are a lot of barriers, however. They usually close at 5pm and aren't widely spread through the townships. Therefore, if a learner finishes school in the late afternoon they have very little time to travel a potentially far distance to a cafe before it closes. Even if they do make it in time they are often full and preference is given to adults. They also charge rates that are unaffordable for the learners.

Once again the value of people was emphasized, in this case as a source of information. A lot has been said about the value of relationships for encouragement, inspiration and a sense of relatedness. However, people were also a very valuable source of information and provided the means to develop the information into knowledge. They opened up new networks for finalists to gain more resources and knowledge. Also, a lot of the learning process involved testing prototypes in the communities where community members were able to give valuable feedback to help improve the solutions.

The material needs for the prototyping process included ICT, prototyping materials, tools, workspaces and transport costs. Along with that was the need for Internet data and prepaid airtime in order to communicate amongst themselves and do research. The physical tools needed were usually agricultural implements or basic construction and machining tools. None of the groups had access to workshops where they could access tools to build physical prototypes in the townships. Besides having no workshops with tools, there was also a lack of conducive spaces to work in in the townships. Groups usually met at school, in libraries or at home. However, these venues lacked the resources they needed, especially Internet access, and could be disruptive. Even if there were workshops and workspaces available in town there would be cost and mobility barriers. The learners said they would

have to be very low cost for them to be able to afford them. They would also have to be near transport hubs so that groups needn't spend too much time and money getting to the venues. Even at the relatively low cost of public transport compared with other forms of transport, it would not be affordable for the groups to pay these transport costs regularly. Transport was also a general issue for coordinating teamwork amongst the teams and mentors. Given the spatial layout of Cape Town mentors often lived a substantial distance from their teams and so it was difficult to meet often. In terms of the seed funding usage the biggest needs, especially at the beginning of the prototyping process was for transport, prepaid airtime and data. The lack of affordability of these fundamental needs for mobility and communications is a massive barrier to the innovation process for these youth.

4.2.5 Creating a Supportive Learning Environment

The learners were asked how engaged they were in the process of developing their solutions and how that compared with usual learning processes at school. The consensus was that they were more engaged in this project-based learning environment compared with usual classes. There were many factors that contributed to this, many of which have been mentioned in the motivation section. They were passionate about their topics because they were close to home, in a literal sense. The real-life nature of the work with tangible outcomes made them feel like they were doing something relevant in their lives as opposed to only dealing with abstract concepts. They felt a sense of autonomy and ownership of the project because they were given licence to define their own problems and come up with their own solutions. The fact that it was challenge-based and that there were prizes added to the excitement. Working with new and interesting people was a notable reason for the work being engaging. One other interesting finding was that the fact that the competition had an end-date was appealing because it did not seem like too much of a commitment. This is understandable if the activity at hand is new to potential participants and they do not know what kind of demands it would require of them.

Physical environment

The physical spaces that the youth worked in were found to have a big impact on learning. The workshops were held in various creative spaces around the town as well as in Hubspace Khayelitsha and UCT. The fact that they were in places that were new to them made it exciting. The learners found inspiration in the spaces, describing them as beautiful and creative, often showing their appreciation for the workshop venues. It had the effect of

opening up their worlds to more possibilities than what they see in their everyday lives. One learner gave the following comment:

> We see how big the world is, but when we are at school or normal buildings, we are kind of like in a box and we are only limited to think about schoolwork. Like our minds are kind of limited not to think further, but when we are away from home… (Participant 9).

The newness of the physical spaces was even stated to affect the way the learners thought. Participant 10 commented: “Being in places like that, seeing those kinds of things, will get the creative juices flowing.”

Township versus Town

The learners were asked questions around what it was like learning in town versus in the township. A few learners remarked that there was a sense of freedom and positivity getting away from working at home in the township. One girl gave a descriptive response:

> As soon as I leave Khayelitsha I have that mindset that now I am free to think about everything that I want to think about. When I go to town I usually dress my own way, my own style. I can’t dress like that in Khayelitsha. People will ask me, why are you wearing this? It’s not what black people wear. So I am free to do everything in town because not everyone looks at other people that way. (Participant 11)

Another learner remarked: “You know when you live somewhere and there’s just this negative energy around? Sometimes it rubs off on you faster than you think.” (Participant 3) Therefore, she enjoyed being away from this negativity and in a different environment for a while.

The learners noted that these sessions were often the first occasions where they had gone to town to engage in work rather than as a consumer. This did make them feel somewhat uncomfortable in this new environment. The tall buildings were said to be intimidating. However, being in a group and being around friendly people helped ease this discomfort quickly. Some learners noted that there was a lasting effect from having workshops in town. Some learners shared that they had become recognized as people who could venture into town to the extent that they began receiving requests from their friends to purchase items. The 2013 winners admitted to having a lot more confidence to visit town more frequently.

This was because they had been there before and they knew people who they could visit. They went on to attend many entrepreneurship events in town of their own accord. However, although they now felt welcome, there was an acknowledgement that there was an on-going discomfort visiting town because of not being familiar with the environment.

When workshops were held in the township the learners appreciated that a lot as well. It made them feel like the competition organizers were “meeting them halfway” (Participant 2) and not assuming that the only place to work is in town. They also enjoyed finding out about venues in the township, like co-working spaces for entrepreneurs that they were unaware of.

4.2.6 Discussion: Interactions and Learning

The learning process strongly resembled that of DUI: tacit knowledge was the dominant knowledge form. In terms of acquiring knowledge there were barriers in information access. However, even if information was made available there was an important intermediary role necessary in order to convert this information into usable knowledge. This is pivotal for increasing absorptive capacity. Learning through doing or making was pivotal for materializing the knowledge acquired within the context where projects were carried out. Due to the prevalence of tacit and highly localized knowledge, there is difficulty in transferring and building upon the knowledge produced by the innovators. Documentation is an important area that needs improvement. Documentation is also an important aspect to consider in terms of power dynamics, as discussed in the literature. Therefore considering how to document knowledge in local languages is important.

The interaction of actors was a vital part of the learning process, as well as being important to building social capital. The role that mentors and advisors played was vital for these inexperienced innovators. Much of the knowledge acquired came from questioning advisors and then questioning community members when the prototypes were tested. Before the learners could become confident and independent in running their projects there was a lot of relational support that was needed. However, as mentioned above, mentors need to be careful with the level of support they give to maintain perceived autonomy. This requires a good awareness of power dynamics within mentoring relationships. As with all relationships, there is a need to build trust over time. Building social networks for grassroots innovators would be an important means for this.

Facilitating interaction cannot be over-emphasized as one of the most important aspects of enabling grassroots innovation in this context. There are many important aspects to creating a supportive environment for healthy interaction and learning. A simple starting point is having beautiful physical spaces, which are made available both in town and the township. A general theme in this case was that newness helped to drive curiosity and creativity, whether this be new people, places or processes for encouraging creative thinking. This requires boundary spanning, which encourages greater diversity. Diversity is an important aspect of the creative process, which aligns with the need in the evolutionary learning process of having variety. Diversity also had a social capital building effect in this case. This was also illustrated from the mentors' perspective. One of the most rewarding experiences for the mentors was to learn about what life was like for their groups in the township and forming connections with people outside of their usual social groups.

Facilitating a collaborative environment within a competition setting can be a challenging task. The analysis showed that having a collaborative and competitive environment is possible. Collaboration was vitally important to the learning process in terms of having a greater sense of confidence within a team, increasing diversity and creating an exciting environment filled with novel people and experiences. The competitive environment was also important in terms of motivating groups to work harder, even if they did have a strong intrinsic motivation to make a social impact. Although there was an element of competition in trying to win, much of the competition was internal in the sense of the groups wanting to test their own abilities and grow through the process. There were certain elements of the ITC program that helped to achieve this balanced dynamic. The ITC team was careful to use the term 'challenge' instead of 'competition'. This was done in order to have groups focus more on the solving a challenge and challenging themselves, rather than competing against one another. The design of the competition was centred on a common purpose of solving a social problem. Therefore, the groups were happy to support one another to achieve this common goal. Given that there were social innovations, there was less of a tendency for groups to want to hide their ideas in order to protect them. Although there was an overall winning prize, there were also runner up prizes. This took the emphasis away from trying to find the best group and idolizing them. The workshop exercises were collaborative in nature, which forced groups into interacting and supporting each other. This was reinforced through facilitating as much time for the groups to interact as possible. Having dense interaction helped to build trust amongst the groups.

4.3 Institutional Factors

Here, the formal and informal institutional factors that were perceived by the participants and researcher to affect the innovation process and learning are presented.

4.3.1 Formal Institutions

"*We don't have as many opportunities available to us.*" (Participant 8)

As discussed in the literature review, there is a lack of formal institutions for early stage grassroots innovation compared with mainstream innovation. The formal programs that the learners were aware of were some other competitions such as science expos, as well as leadership and extra maths and science programs. When asked about any form of formal institution that could help them with their projects going forward none of the learners were aware of any. Therefore, even though there are formal institutions that exist to support grassroots innovation, they do not have a broad enough scope to include grassroots innovators within this context, or their marketing is not effective for this audience.

The most influential formal institution affecting young innovators is schools. The learners were asked questions on the effect that their formal schooling had on them innovating. All learners responded that school either helped them very little with their projects or not at all: "They (schools) don't teach you how to solve community problems. They don't teach you to make what you have learnt." (Participant 1) As the quote suggests, there was a lack of application of knowledge learnt in school in the real world. Many learners said that this made school seem irrelevant to them. However, the learners noted that there were some useful subjects in school that enhanced critical thinking and taught them about real world problems. These included Mathematics, CAT (Computer Applications Technology), PAT (Practical Assessment Task), Life-Orientation and Debating. However, they did not feel these subjects prepared them well enough to execute their innovations successfully.

The learners described a rote learning style that does not encourage creative thinking. An interesting finding associated with this is that Participant 1 commented: "When guys start writing they think, no, now it's like I'm at school." Writing is associated with hard work and is avoided if possible. Therefore, even filling out a long application form to apply for a competition was said to be a deterrent. He remarked that this is also a cultural thing for Xhosa people - that they prefer communicating through talking rather than writing.

Therefore, interactive learning with a lot of questioning and discussion is appealing. It may also explain the lack of documentation by groups.

As previously mentioned, the learners were not used to working in teams and had little opportunity to make or build real-life applications in school. They described school content as being formulaic and disconnected from the real world. A learner described learning during the competition as opposed to school as follows: “It allows us to be creative and original. At school they expect us to go a certain direction.” (Participant 22) Therefore, the learners enjoyed doing relevant and contextual projects where they could apply many different ways of thinking to approach their problems.

Time was an important factor given the intensity of schoolwork, especially for final year learners. Learners would often become stressed and drop all other activities, including these projects when it came to exam time. However, when asked about the effect that working on the other projects had on their schoolwork, learners gave positive responses. They generally found that it didn’t take time away from their study time, but rather took away from social time or time that may have been used unproductively. They were also able to see a greater reason for studying the subjects they were taking in school because of the real-life application they were seeing of what they were learning through these projects.

The learners from the township felt that they were disadvantaged in their education attending township schools, especially because they were under-resourced. One learner said: “It's not often that you'll see people from Khayelitsha changing the world.” (Participant 27) When asked about why they thought this, the learner replied: “I don't know, the stigma I guess. That if you come from a public school you'll never be as successful as a person from a private school.” (Participant 27) Another factor that affected their confidence is that learners commented that doing any form of public speaking at school was a scary experience. One learner said: “At school even when we do orals we know we gonna laugh at each other, coz, hey, who knows how to present in English anyway?” (Participant 3) When asked about why the learners laugh at each other the learner replied: “People laugh because they know there’s no hope. It’s a joke to them, but it’s actually real. There’s nothing anyone can do about it, so let’s just laugh about it.” (Participant 3) Furthermore, the she described her perception as a result of this as follows:

> If I think, if these people who are the same as me are laughing at me, what happens when I go out of my comfort zone? People are going to throw stuff at me. It could

> actually be worse. So it actually does pull you down in a way. But, ya, this is normal. (Participant 3)

Therefore, the learners were surprised to get such positive responses from the audiences at the ITC presentation events.

4.3.2 Informal Institutions

Informal institutional factors were found to be major influences on the subject, the extent of which would be difficult to quantify. South Africa's historical context and the legacy of Apartheid were evident as an underpinning influence, but the scope of this research could hardly begin to measure the impact of this on grassroots innovation by youth. As described in the literature review, the socio-economic context in which this research took place is heavily influenced by complex problems such as poverty, unemployment and crime. This context has certainly had an effect on the learners' motivations and learning processes. However, due to the limited scope of the research, only the participants' perceptions of informal institutions, which were emphasized as being strongly influential, are presented.

What is innovation?

"*I see it as healing the pain problem*." (Participant 21)

An important starting aspect of how the institutional context affects being involved in grassroots innovation is the understanding and perception of the word 'innovation'. Many learners said that they were unsure of what innovation meant before entering the competition. There was a big language barrier in that there is no word for innovation in Xhosa. This deterred some people from entering as one learner explained, "For them to not understand the word they can't do anything." (Participant 8) The closest word the Xhosa speaking participants could think of would be translated as 'change'. One group said that they think most people will confuse the word with 'renovation'. For those who had heard of innovation before, the association was that of being something difficult, technological and fancy. It was often misunderstood as invention. On the one hand this made the competition seem intimidating: "It's an intimidating word. It sounds huge." (Participant 8) On the other hand there was an elitist appeal to be part of something that involves something prestigious: "Once you know it it's cool." (Participant 24)

Once the learners were further along in the competition process they gave many profound definitions of innovation. Many learners said that it is to “think outside of the box”. Other definitions were as follows: “Innovation is what forces you to be a better person and to think in much more creative ways.” (Participant 4) “Coming up with new ideas for making the world better.” (Participant 27) “Innovation is taking risks” (Participant 16). “For me, I take the 'inno' from Eno (the common pain medication), so I see it as healing the pain problem.” (Participant 21)

Therefore, the perception of the ‘innovation’ was generally a positive one and was seen as an appealing field to take part in. However, there is the danger of scaring potential competition participants off who do not have a word for innovation in their mother tongue or associate it with something intimidating.

Poverty mindset

“*Why should I think about getting out of here?*” (Participant 12)

Box 2: Finalist Project - Long Walk from Loadshedding

This team wanted to create a personalized energy solution for high school students. They live in a community where many of the students have to walk a long way to get home from school, and when they get there they often have loadshedding. This means that they cannot study at night at times. Their first solution was a pair of shoes that charges a set of rechargeable batteries as you walk using piezoelectric discs. The batteries are connected to a USB outlet that can be used to charge devices such as lights when they get home. They faced technical challenges in sourcing the piezoelectric discs in their first attempt, so they created an alternate solution. This was a similar USB device, except this time it was connected to a solar panel on the peak of a cap.

The participants described a link between the poor socio-economic conditions faced by people in townships as having a negative effect on their mindsets in terms of the potential for individuals to innovate within those conditions. One learner described this as follows,

> People there, they think about the situation that they are in, it’s so little - like, their minds. They do not think about the future. They just think, ok, I am living in a shack. I don’t get sunshine on my face; I am protected when it rains, so why should I think about getting out of here? (Participant 12)

This may be termed generally as a poverty mindset or as one mentor described it, a “deficit approach” (Participant 29). The learners said that many people feel that because they are surrounded by so much poverty that living in poverty becomes normal and expected. One learner spoke of why people do not expect change and bring others down who try to make a change: “Their sense of reality is that you are not going anywhere based on their experience and what they see around us – people who are not successful, people who are illiterate, our parents.” (Participant 1) One of the finalists from the team *Long Walk from Loadshedding* (see Box 2) had the following comment on the community mindset on dealing with problems like loadshedding: “It's not even that they don't have resources, it's that they are not even thinking about solving these problems.” (Participant 17) The reasons he gave for this are poor education, as well as the issue of the government making promises around voting time and then not delivering. A learner gave the following comment about government involvement in their community:

> Now nothing is happening in the place we live in, but when it comes to voting time then they come and say they will do this and that and then the people will vote for them. But then they don't carry through their promises, so people have anger for the politicians. Our government has been giving us things for free, so we are spoilt. We don't want to work for things and just want to get them for free. And when we don't get them we start throwing stuff. (Participant 19)

The cycles of poverty and lack of examples of people breaking out of poverty lead to low motivation to make changes in the community. This was described to be prevalent in the mindsets amongst their peers as well. The learners said that they felt like their peers expected them to fail and would sometimes actively pressurize them out of doing certain constructive activities because they believed there was no purpose in it. The learners said this is why many young people turn to gangsterism, and that being a gangster has become something that many people see as normal or cool. Participant 3 said that this is why it’s so important to have a team when doing something new. Each member has some influence, so as a group it is easier to change the community’s mindset with the combined influence, whereas trying to do so alone would be very difficult.

Perception of Failure

"*There's a lot of judgement when it comes to failure*." (Participant 23)

Failure is an integral part of innovation because of how solutions need to be prototyped within complex contexts with little guarantee of success. The poverty mindset described above had a strong influence on how the communities perceive failure. It is something that people are used to. One group noted that there is a lot of judgement and disgrace associated with failure (Participant 23 & 24). This would make some families not share their problems with others in case people started gossiping about them. At school, failure is generally seen as something negative and not part of learning. This results in youth being afraid to try new things or leave their comfort zone from a fear of failure. One of the mentors noted that her group would often want everything to be perfect before trying something new, which prevented them from making quick progress (Participant 29). Therefore, during the competition process a common message was that failure is part of innovating and that it helps you to learn. Most of the learners said that from being part of ITC their mindsets on failure changed to align with this perspective. One learner said: "Failure is what we live on. If you don't fail how will you know if you're doing well or not?" (Participant 24) Some remarked that failure even became a motivating factor because it pushes you to try something new.

Jealousy - Tall Poppy Syndrome

"*Who do you think you are*?" (Participant 1)

Box 3: Finalist Project - Govarsity

The Govarsity team wanted to address the lack of helpful information about universities provided to high school students in townships. The marketing departments of universities visit insufficient schools. If they do, the information has a lot of complicated content that students find difficult to understand. This makes it difficult to understand how to apply and what to apply for. When the universities visit the schools many students do not ask for application forms because they do not want to stand out. Furthermore, once they make it into university they are unfamiliar with the social life in their new context, making it a difficult place to flourish. This leads to many students dropping out. Govarsity address these issues with a mobile web application that provides concise and engaging text and videos that are categorized according to familiar career titles. These titles are linked to the appropriate course titles with quick links

to application forms from local tertiary institutions. The platform also has a forum to discuss non-academic university life in order to provide students with a support structure.

Govarsity were the first winners of Innovate the Cape in 2013. They went on to incubate and launch their product at RLabs in Cape Town. The two team members have had an opportunity to travel to many local and some international conferences. These included the *Rockefeller Next Century Innovators Awards* event in New York and the EdTEch Europe conference in London. They have subsequently been involved in starting three initiatives in Khayelitsha. *Have Fun* is a children's program that provides after school educational content in a playful way. *Dine* is an initiative aimed at facilitating a cultural exchange over a meal. People from town are invited to Khayelitsha to share a meal and engage in interactive sessions to discuss topical issues and find common ground. *Design Entourage* creates a space for local designers to sell their products on a closed off street with accompanying music and local food sold.

A strong form of peer pressure evident in the communities was what is termed 'tall poppy syndrome'. This theme came up in the pilot study. Tall poppy syndrome is defined as "a tendency to disparage any person who has achieved great prominence or wealth." ("Tall poppy syndrome, n.", 2015) Therefore, there can be a fear of trying to do something different because of the potential to be mocked or ostracized. Participant 1 described it as follows: "As soon as you start to innovate or start something, you are going to be seen as a smart guy and people are going to start criticizing you, saying, who do you think you are?"

Govarsity, the winners of the 2013 competition (see Box 3), created a solution that directly addressed the issue of tall poppy syndrome. As mentioned in Box 3, this group needed to address the problem of learners not asking for university application forms for fear of standing out. The group explained that the learners' peers do not like it when learners show their aspirations to attend university when most of their community would not have the opportunity to do so. When asked about the reasons behind this tall poppy syndrome the learners said it was due to jealousy and hopelessness.

The literature on tall poppy syndrome suggests that it occurs in societies with a high power distance and are egalitarian as opposed to individualistic (Smale, 2008). Power distance refers to the concentration of power held across a society, and how accepted those who have the power are. The most innovative societies, according to the number of patents issued, usually have a low power distance and are individualistic societies (Shane, 1992). In a study on informal entrepreneurship in South Africa it is suggested that the notion of setting

up an enterprise could be contradicted by the egalitarian Ubuntu culture, and so tall poppy syndrome threatens wealth creation (Mayrhofer & Hendriks, 2003). The following section gives further insight into the power dynamic within the communities in this study.

Multigenerational relationships

"They think that we are full of madness." (Participant 24)

A cultural theme that came through in the interviews was the relational dynamic between people of different ages. This is especially important for a study on innovation by youth.

There were certain factors that related to the learners' age that affected their ability to innovate. One factor was the preference given to adults over contested resources. An example of this was given above with regards to adults taking children's seats at Internet cafes. There was a submissiveness that learners had towards adults in many aspects of the study. This could be seen in the way that the relationship between teachers and learners was discussed as well as the dynamic between learners and mentors. Some learners described the teaching style as authoritarian. Learners are given instructions by teachers that they are expected to follow without asking questions and with little scope for self-directed learning and lateral thinking. This dynamic carried through to the dynamic between the learners and mentors. The mentors noted that they had to be careful about any form of instruction that they gave to the learners because it would be taken as the final word and wouldn't be questioned: "If you are a mentor, they'll assume that everything you say is right." (Participant 1) A sense of superiority associated with age was also evident in the expected activities of adults versus youth. The learners noted how the competition was different in that they became involved in tasks that adults would usually carry out. Any material change carried out in the community was expected to be done by adults.

The communities' perception of youth was somewhat complex. On the one hand, there was said to be a high level of hope placed in the youth who are seen as the future and are worthwhile investing in. This was evident in the way that certain projects were shown grace in that community members and local businesses supported them to an extent that would be uncommon if adults were to run similar projects. On the other hand, especially in the early stages of projects, the communities showed distrust towards the groups. The learners said that this was because youth are seen as troublemakers and gave the following description of the community's perspective on them,

> In our communities you will always find people who look down on us and take us for granted. We are not always expected to succeed and be up there and to make things happen for other people. They don't expect the best, always the worst of you. (Participant 18)

Many groups reported that both young and old community members initially discouraged them. However, once they began showing good progress and began to build trust within the community many community members changed and began to support them. One learner noted that this perception is not exclusive to adults, but that many young people see youth in a negative light. He even reflected on how he used to have this perception:

> Another example at an event was when someone asked the audience what they think about young people and if they think they're bad and a lot of hands went up. But most of the people there were young people who raised their hands. And even I accepted that when it comes to young people, it's just gangsters and drugs and alcohol. But now I see it's about the individual. (Participant 1)

Gender Roles

"*In the business side of things you have to be a man.*" (Participant 1)

Gender roles had an influence on the learners' ability to innovate, as well as their prospects to continue to do so as a career option. There was no gender bias evident in terms of finalists chosen for the competition. The finalists were chosen purely according to merit. In each competition there were, in fact, more girls than boys in the finalist pool. However, when it came to carrying out the projects, there were some restrictions for girls. The learners noted that there is a certain expectation for girls. According to the expectation within the community they should stay at home and perform certain chores. Also, they shouldn't travel around too much or be out late. This restricted the girls' time and their flexibility to be mobile and visit certain places or events. It was also noted that there are career expectations for girls. This was contested by some girls who said they had complete freedom to choose the career that would make them happy. However, older mentors from the same areas said that although parents may say this, it was not really the case. One mentor gave the following response with regards to the role of women in his community:

> Ya, because in the business side of things you have to be a man. That is how it is. If you are a woman you can own things that sell beauty hair products, a salon, a tuckshop, that's the line. There's a line and you have to be that side. Even for professional careers like a nurse, a psychologist, doctor, lawyer or teacher. But even there, there is a line. You don't cross to engineering, science-related careers. (Participant 1)

He went on to say that women would be considered rebellious and potentially be ostracized if they were to be another kind of entrepreneur or choose an alternate career path.

Ownership of Problems

"*I think the youth, man. The old people are tired and they don't expect anything good from us*." (Participant 3)

The learners were asked about who is responsible for solving community problems in order to establish whether there would naturally be impetus from within the community to solve local challenges. In general they felt that the community would say it is the government because they pay tax. However, the learners' opinions were different. Their first answers were almost always that it is the youth: "I think the youth, man. The old people are tired and they don't expect anything good from us...they (the youth) have the will and they have the energy." (Participant 3) Another learner said about older people: "They are not experimenters. They always want to stick to one thing or one problem. They are not open-minded." (Participant 18) One group said that the community members just blame each other and the government (Participant 14 & 16). When asked about the role of the community as a whole and the government, learners would then say that it is everyone's responsibility. One learner said: "The problems that are there, it's because of us. It's not the government. And I feel like, then we put the responsibility for them solving it when it is actually us who created it." (Participant 3) This learner also noted that when someone from the community does something it is like a "real person" doing something, meaning that it was not some abstract entity coming in to fix things, but someone they can relate to. Another learner said: "We cause the problems. Then people go and burn tyres which is stupid because then there are more problems." (Participant 10) A group noted that there was also a need for the community to solve problems because the government would take too long to fix some problems. They also felt like at least community members should address some problems: "In South Africa, people often complain about service delivery. So I think that it

would be a lot easier for them to help us if they see that we are also determined to fix the problems as well." (Participant 27)

Advantages and Opportunities

"*It's the best thing ever*." (Participant 10)

Although there are many descriptions of negative influences of informal institutions on grassroots innovation by youth, there were also positive comments.

As has been discussed, there were strong advantages that came with having local knowledge of the problem and the communities they affect. Having evident needs creates many opportunities for innovation. This was evident from a competition organizers point of view. Even though the groups that competed came from a context of widely varying socio-economic conditions (not all ITC participants took part in this study), the 'under-resourced' groups were often able to make obvious changes more readily. As the saying goes, 'necessity is the mother of invention'. One group said that it is an advantage to come from a disadvantaged area because of the evident need: "It's the best thing ever." (Participant 10) This is because many wealthier or 'advantaged' people are willing to help. Townships are also seen by learners as relatively advantaged compared with rural areas.

Another advantage described by learners is the communal spirit that exists in the township. There is a strong sense of connectedness amongst neighbours and families that may not be as strong in wealthier, more individualistic communities[7]. This results in a strong communal understanding of common needs felt by all and the ability to garner community support swiftly. Contrary to the negative perception of youth discussed above, this helpful communal spirit was described by some groups to be within the youth. Many young people were willing to give up their time and effort to assist projects even if they weren't part of the core team. One team leader remarked: "Those guys were happy to do anything." (Participant 3) Although the finalist teams were restricted to five members, oftentimes the teams would grow into much larger teams with auxiliary members volunteering their time to support the cause.

[7] the participants were shocked when the interviewer said that he did not know all of his neighbours.

4.3.3 Discussion: Institutional Factors

It is evident from the analysis that the institutional arrangement in this context has a big influence on grassroots innovation. There is a lot of scope for increased formal institutional support. The main formal institutional focus for youth would certainly be the schooling system. It was evident that the learners felt ill prepared for running their projects, lacking skills that the schooling system does not provide. Many of these skills were acquired through the rare opportunity to create real-world solutions, an important aspect of learning according to the constructionism learning theory (Papert, 1991). The teaching style and authoritative culture referred to in some township schools limits curiosity and creativity. Therefore, in order to have a schooling system that supports this form of learning significant changes in both content, and especially in teaching style, are necessary to prepare young innovators for real-world applications of what they learn at school.

The informal institutional influences were shown to shape and give context to a lot of the motivation and learning analysis. A common thread throughout the research on the influence of the institutional context was the theme of self-efficacy and the large effect that it has on many aspects of the youth taking part in the competition. It is evident how the theme of self-efficacy comes through in the analysis above in terms of how a poverty mindset, the expectation and fear of failure, tall-poppy syndrome and a patriarchal paradigm may result in low levels of self-efficacy.

Self-efficacy can be defined as “a person's estimate of his or her capacity to orchestrate performance on a specific task” (Gist & Mitchell 1992). Innovation is an inherently risky activity; therefore a high level of self-efficacy is pivotal for innovators to continue through uncertainty and failure. Research by an organization called *Nesta* who have a study entitled *The Identification and Measurement of Innovative Characteristics of Young People: Development of the Youth Innovation Skills Measurement Tool* identify self-efficacy as one of the main characteristics that young innovators need (Chell & Athayde 2009).

It was clear that there was generally a low level of self-efficacy amongst the learners, especially at the beginning of the competition. This could be seen in how the learners were wary of applying to the competition because of lack of belief in their abilities to compete. One learner described her feelings of apprehension to enter competitions as follows: “Sometimes you feel like you don't have the right ideas to participate with people from other areas. I feel like I don't deserve to be in that space.” (Participant 7) Even the 2013 winners admitted to

almost not applying because of their lack of belief in their idea. The low levels of self-efficacy explains why it was so important for the learners to have a sense of legitimacy with their projects which mainly came through adults giving their approval. This is why encouragement from teachers, the ITC organizers and the mentors was highly influential according to the learners in terms of keeping motivation up throughout the competition. It also explains why many learners felt intimidated by large prizes, thinking that doing something to deserve such a prize would be out of their reach. This theme also came through in the learning processes in terms of the learners having a lack of confidence in their ideas in general and a fear of approaching others to ask for advice.

Some potential causes of low self-efficacy were described by the learners in some of the discussions that arose in the interviews. One learner said, in reference to the township where he came from: “There is an environment where there is a lack of confidence and no inspiration.” (Participant 1) This was attributed to social ills in townships and the apartheid legacy. The learners said that due to inferior schooling their proficiency in English was low. This makes them afraid of being embarrassed when communicating, and especially presenting. The negative effects that learners have on each other was illustrated in the example above about how learners laugh at each other when they make mistakes presenting. Language was said to be a barrier when applying to the competition. As mentioned earlier, innovation is a term that can seem intimidating. Moreover, the title, *Innovate the Cape,* made the competition seem daunting because it is for a large area.

The main cause of increased confidence reported by the learners was presenting and receiving positive feedback: “When I speak about serious things and people clap it gives me a confidence boost.” (Participant 10) General encouragement, especially from respected adults helped a lot, especially in terms of having a sense of legitimacy for their ideas. The learners noted how an informal environment at events helped them to not feel intimidated. The mentor that had won the 2013 competition said that he believed what helped his group most was that he was able to give examples of himself being in similar positions and then went on to succeed (Participant 1). Another mentor said that having a lot of time spent together was the key to getting her group to trust her and be confident to share ideas (Participant 28). In terms of their tips on how to get more applicants the learners said that in order to overcome low confidence it is necessary to visit the schools in person and speak to people face to face. Therefore, as a whole, positive interaction with people was pivotal to building self-efficacy. Other factors that the learners mentioned included being selected as a finalist, as well as making progress in their projects which helped them to see for themselves that they are competent. These findings align well with studies on how to improve self-

efficacy. One model on building self-efficacy gives four principle sources of information which expectations of self-efficacy are derived from. These are, “performance accomplishments, vicarious experience, verbal persuasion, and physiological states.” (Bandura, 1977) Apart from the physiological states, the above discussion shows how these sources of information are provided through creating a sense of competence, role models and encouragement respectively.

5 Discussion: An Innovation Systems Approach to Grassroots Innovation by Youth

Chapter 4 gives an analysis of the components within the innovation systems framework with regards to the research question of how to enable grassroots innovation by youth. In this chapter a discussion on the analysis will be given from a systems perspective. The complexity constructs are used to do so.

In this study a systems approach was taken to understanding a very specific micro level context of innovation. Although this is not a common application for innovation systems the approach has proved useful for attempting to understand a complex phenomenon from a holistic perspective. This was of vital importance given the significant influence of the institutional context described above. It was found that seeing the innovation process as an interconnected system that is a product of the context gave important insights that could otherwise have been lost if a narrower and more focused framework were used. Many of the phenomena observed in each analysis section could not be explained without an understanding of other system components. Therefore a multidisciplinary and qualitative approach was important.

Networks

Here, this narrowly defined innovation system will be briefly discussed from a network perspective.

The network structure of ITC in the early stages of the prototyping stage was fairly centralized around the competition organizers. This can be seen in figure 4 from how connected the ITC Team node is versus the Finalists node. All of the competition participants and mentors were dependent on the organizing team. As time went on the networks expanded, especially through the mentors opening their personal networks to the participants. Mentors played an important role in augmenting the finalists' networks where there was previously little access to nodes within broader networks outside of townships. Having open events assisted node access as well. As the participants developed confidence and agency the networks grew without reliance on the ITC organizers or mentors. This could be seen when finalists reported on connections they had made and maintained independently. This caused the overall network structure to become more decentralized and connected, and therefore, more resilient.

Having high node connectivity was important for having greater access to information, i.e. increasing boundary spanning. However, this could only be propagated in a meaningful way as usable knowledge through high quality connections between nodes. In other words, there was a need for social capital within the networks in order to increase the absorptive capacity of the actors. Mentors played a large role as intermediaries in this. However, this came with a caveat for managing the careful dynamic between providing support for their groups whilst maintaining a sense of autonomy. If this dynamic was well managed, it would result in less dependency on a few nodes. This is important for system resilience in order to avoid a critical system state. Therefore, the principle of having bottom-up support as opposed to overbearing top-down control is important for creating a resilient system.

Differences

There were many differences that needed to be overcome within the ITC system. Firstly, there were the different socio-economic states between the township and town. It was evident from the analysis that besides the different socio-economic conditions there are many differences in education opportunities, mindsets, culture and language. This creates gaps that make it difficult for people in townships to relate to people and the environment in town. This is perpetuated by a lack of resources to enable mobility and communication, even if there is a desire to interact with town and the resources available. Therefore, township areas can become closed systems.

With regards to innovation, having these difference leads to poor knowledge transfer, which leads to a knowledge divide, which can lead to a benefit divide, as discussed in the literature review. This can become a positive feedback loop that creates greater economic exclusivity. On the other hand, as a consequence of the differences between these periphery areas and the mainstream, there is greater variation in sources of knowledge and perspectives. This can result in radical new approaches to solving social problems. There is also a lot of potential for rich interaction between actors from different contexts.

Emergence

There were several cases of emergent self-organized behaviour both within and outside of ITC. Inside ITC, finalist teams were formed independently and the learning was self-directed. New node connections were formed independently. Over time, ITC organizers as well as participants spontaneously formed new organizations and initiatives outside of the competition. One organizer set up her own NGO in a township that runs several programs,

including an innovation competition. There were also several reports of the participants and their friends initiating their own projects, such as the library example. Another example came from Participant 1, as seen in Box 3, where he and his friends spontaneously initiated other initiatives. This shows that under the right conditions emergence is indeed possible.

Attractors

Facilitating an environment that enables the emergence of grassroots innovation could be described as institutional building. This is synonymous with developing new attractor states, as discussed in the literature review. The potential for developing inter-attractors that can result in systems change is of particular interest from a systems perspective. Currently, it could be said that some of the dominant attractors in townships are poverty, poverty mindsets, learned helplessness, disillusionment, alienation and gangsterism. In order to see a systems change there would need to be enough perturbations from the current attractors until new attractors form. Participant 1 gave an example of how new attractors can emerge on a small scale within his personal network. He had described in early interviews after winning the 2013 competition how there were negative mindsets from the township that were negatively affecting his ability to innovate. In a later interview there was a discussion about whether these mindsets had affected the group he was mentoring. His response was as follows:

> But I think now I'd say like in my community we've broken that barrier (the negative mindsets) through our project (referring to his winning project in 2013). It's no longer a barrier. If people want to do something and they have ideas, if you walk down the street they come up to you and say, “I have an idea”. And now there's the *Dine* team. So everyone wants to start something. (Participant 1)

Although this is a change within a small network, it does show how good role models can act as institutional entrepreneurs and influence the attractor states around them. Therefore, the social innovation that results from an innovation competition can result in institutional building, according to the conceptual model (figure 2). This affected the local institutional context in that there was a perceived increase in interest to innovate, largely caused by the successes of previous winners.

Policy interventions could play an important role in facilitating these perturbations in attractor states within grassroots innovation networks. This could influence broader innovation systems as well. A good starting point would be to transition away from the mainstream

technology-dominant paradigm of innovation in South Africa through revisiting policy documents on definitions of innovation. This should include strategies that outwork these policies in practical means. This requires inclusive multi-level analyses of innovation systems that take into account grassroots actors. Appropriate incentives outside of the usual market incentives should be introduced. These need to be carefully administered according to the context in order to take the institutional factors into account. There must be an awareness of the potentially negative impact that incentives can have in order to allow for intrinsically motivated activities. Healthy interaction between disconnected sectors of society should be facilitated. This can be facilitated by opening up communication channels, providing multi-disciplinary workspaces and by providing intermediaries. In order for formal institutional building to take place various grassroots innovation and cross-sectoral initiatives, such as competitions and organized networks, should be initiated. These should be accompanied with good marketing of the opportunities, including awareness campaigns. This can be done powerfully through role models and storytelling. Resources need to be mobilized for young innovators' needs for mobility, communications and Internet connectivity. With all of these interventions it is important to understand the role of top-down structures in bottom-up processes as flexible facilitators of emergence rather than being rigid and controlling.

In summary, enabling grassroots innovation within this context could be approached from a systems perspective as follows: one needs to build networks to overcome and embrace differences in order to facilitate emergent innovative behaviour, which can result in new attractor states. This study shows that this can be done in a gamified process such as an innovation competition according to the conceptual model in figure 2. However, this requires a good understanding of the system actors, their motivations, how they interact, and the influence of the institutional context.

6 Conclusions

This chapter concludes the research by re-stating the research questions and summarizing the main findings. This is followed by the research contribution of this study. Finally, the limitations of this research are discussed and recommendations for further study are given.

6.1 Research Questions

Firstly, a recap of the research questions is given. The main research question is:

“How might one enable early stage grassroots innovation by youth in Cape Town’s townships using an innovation competition?”

This is broken down into the following sub-questions:

1. Why do the learners innovate? I.e. what motivates them to initiate their grassroots projects?
2. How can an innovation competition provide appropriate incentives to motivate participating learners?
3. How do the learners learn? I.e. what are the early stage learning processes for grassroots innovation?
4. How can these learning processes be facilitated?
5. What is the influence of institutional arrangement on the motivations and learning processes of the learners?

6.2 Summary of Findings

An innovation systems approach was used to address these research questions. An analytical framework, which included motivation theories, was used in the analysis. The findings are summarized here.

6.2.1 Motivation and Incentives

The ITC participants had a wide variety of motivations for initiating their grassroots projects and taking part in the competition. It was found that the motivations were socially oriented. That is, participants were primarily motivated to make a social impact. Social influence also played a large role. There was, therefore a strong intrinsic component in the participants' motivation. This was also manifest in the participants' natural curiosity and desire to learn. Intangible rewards also played a large role. A dominant form of this was the personal development motive.

The role of incentives was a complex matter. It is difficult to concretely ascertain whether the motivation associated with different forms of rewards was ultimately intrinsic or extrinsic from a surface level enquiry. One needs to understand how the rewards are perceived in terms of how they affect the individual's sense of competence, autonomy and relatedness. These psychological needs were found to be prominent themes throughout the study. There can be conflicting dynamics between these needs and this should be managed carefully. An example of this is the dynamic of giving and withholding of assistance to the participants so that they are given a sense of competence while maintaining a sense of autonomy. Good feedback is essential in order to maintain this balance.

Incentives played a positive role as means of attracting applicants to the competition. However, this extrinsic motivation could be internalized over time, as participants understood the value of the process. Rewards were also a good marker of progress, which enhanced a sense of competence. On the other hand, the negative role of incentives was that those who did not receive them could develop a sense of being incompetent. Inappropriate prizes can cheapen the experience for intrinsically motivated participants if it attracts people who are only motivated by the prize. Large prizes can also be intimidating. Therefore, one cannot make generalisations about the effect that incentives have. Various factors, such as the form and size of incentives, as well as the process in which they are given need to be considered in light of how they may affect intrinsic motivation. Furthermore, competition designers should emphasize the personal and community benefits which will result from the competition process.

6.2.2 Interactions and Learning

There were several gaps in the knowledge, skills and resources needed by the participants to be well equipped to run their projects. It was found that the schooling system does not prepare the learners well for these types of projects. Learners reported that schools have a rigid authoritarian style that does not encourage creative self-directed learning. There was a big need for applying knowledge to the real world. The specific knowledge and skills that were lacking included basic business acumen, project management, ICT related skills and professional communications. Resources were missing to provide for basic needs of mobility, connectivity and communications.

The main knowledge form observed was DUI. This involved a lot of tacit knowledge. There was a disconnect in the learning cycle going from tacit to codified knowledge. Although learners could access codified knowledge, they struggled to assimilate it and develop it into tacit knowledge. There was a need to make the knowledge usable in order to increase their absorptive capacity. In turn, the rich tacit knowledge that was created was not well documented, which limits the knowledge building process.

In order to facilitate this learning process, a lot of interaction between actors was necessary. The learners required a lot of relational support from mentors in the process. There was also an important intermediary role necessary for converting knowledge into usable knowledge by making it more relevant. Intermediaries were also important for network building and connecting the learners to new knowledge sources. Therefore, building a trusting relationship between learners and mentors was pivotal. However, this must be done without creating unhealthy dependency.

Creating various platforms for interaction was of vital importance. This can be done through interpersonal connections, making physical spaces available, and using online social networks. Having a high level of novelty in terms of new spaces, people, knowledge and experiences added a lot to the learners' motivation. This was also true for their learning processes in terms of having a lot of variation in knowledge sources and inducing new ways of thinking. Increasing the diversity of people in these interactions also had a social capital building effect. All actors involved valued this.

It was found that it was possible to create a collaborative and competitive environment. This was done through having a common purpose, but variety in projects. The projects were

social innovations; therefore there was less likelihood of trying to hide ideas to protect intellectual property. Furthermore, there were a number of workshops that were collaborative, so the participants had time to build trusting relationships.

6.2.3 Institutional Factors

There was an evident institutional void in this context. There are either insufficient formal institutions, especially for this stage of innovation, or they are not inclusive enough. The most relevant institution would be the schools, however, as discussed above, are not effective in preparing learners for real world applications.

Informal institutions played a significant role in affecting the motivations and learning processes of the learners. Some negative influences were language, including confusion and negative perceptions around the term ‘innovation’. It was evident that there were negative influences from a ‘poverty mindset’. This was closely linked to socioeconomic conditions and the lack of role models who have broken out of the cycle of poverty. There were negative perceptions of failure, which is an integral part of the innovation process. This lead to a fear of attempting novelty. Jealousy was found to be problematic in terms of people disparaging others who are successful or are doing innovative things. There were elements of culture such as patriarchy and age dynamics that negatively influenced participating girls and youth in general. There was also a perceived lack of ownership of problems within the communities. These negative institutional factors were suggested as the cause of the low levels of self-efficacy observed in the learners. Low self-efficacy was found to be a significant factor in many aspects of the learners’ motivation and learning processes.

On the other hand, positive influences included a good understand of problems through immersion in the institutional context. Needs are made more obvious in this setting, therefore there are ‘gaps in the market’ for innovation. Some learners perceived coming from a township as an advantage because more ‘advantaged’ people are willing to help. Finally, there was also a willingness to help from people within the communities and a strong community spirit.

6.3 Research Contributions

This research has made a contribution to the literature by finding empirical evidence for a topic that is not well studied. It provides a qualitative understanding of the drivers of grassroots innovation by youth in the germination stage. This has addressed a gap within innovation systems literature in terms of doing a micro level study within a developing context. It also provides a greater understanding of how an innovation competition can potentiate innovation using the mechanisms of engaging participants in a learning process through game-mechanics. Linked with this are findings on how to create both a collaborative and competitive environment for innovation processes.

Many of these findings may have the potential to be transferrable to mainstream innovation processes. As Schumpeter suggests, intrinsic motivation also plays a big role in mainstream innovation processes, so the findings on motivation are relevant. Therefore, these in-depth findings on personal motivation may have a wider application, especially by using gamification principles to design an enabling process for innovation.

On a more abstract level, the study has used concepts rooted in complexity science to describe how processes within grassroots innovation activities may lead to systems level change. This has been linked to the literature that suggests that social innovation and social entrepreneurs can lead to increased social capital and institutional building. This has been observed empirically on a very small scale. However, if changes to the institutional context are significant enough, an innovation system theoretically has the potential to undergo a regime change.

6.4. Limitations

One of the main limitations to the study was the sample size. Although the sample yielded rich data, it would likely have been beneficial to increase the sample size, especially by including different types of actors. The ITC competition was a very narrowly defined competition, within a specific context. Therefore the potential to make generalisations from the findings to other forms of competitions and other contexts may not have a good basis. The resources and timing were also limited. There could be a lot more rich data from doing more of a longitudinal study to analyse long-term motivations of participants after the competition.

6.5 Recommendations for Further Study

This empirical study was exploratory and multi-disciplinary in nature. It has shown the potential value in conducting more empirical studies on this topic. There is a need for more case studies within this context as well as other contexts. There is also a lot of potential to study different forms of innovation competitions, as well as other forms of gamification of innovation in general. Comparative studies of similar competitions across different contexts could yield interesting results on the scope of the influence that the local context can have on grassroots innovation. As has been suggested, longitudinal studies are also recommended. It is recommended that these studies take a systems approach in terms of collecting relational data in order to take the interconnectedness of grassroots innovation processes into account. This includes considering relationships between actors and the contextual influence. Given this interconnectedness, there is a lot of potential for further in-depth studies within the various fields as they pertain to this topic. There is a need for more micro level studies that include analysis on a personal level, such as motivation and learning processes. These factors have been seen to have potential to explain phenomena on a macro level. Furthermore, there is the need to have studies that create feedback loops by bringing together bottom-up and top-down approaches in innovation research. This can provide insight into how grassroots innovation processes can influence innovation policy to make it more relevant on the ground.

7 References

Abramson, L.Y., Seligman, M.E. & Teasdale, J.D. 1978. Learned helplessness in humans: critique and reformulation. *Journal of Abnormal Psychology.* 87(1): 49.

Ahmed, P.K. 1998. Culture and climate for innovation. *European Journal of Innovation Management.* 1(1): 30-43.

ANDE. 2015. *South Africa's Entrepreneurial Ecosystem Map.* Available: http://www.aspeninstitute.org/sites/default/files/content/upload/ANDE%20ENTREPRENEUR%20ECOSYSTEM%20MAP%202015.pdf [10 September 2015].

Arocena, R. & Sutz, J. 2002. *Innovation Systems and Developing Countries.* DRUID, Copenhagen Business School, Department of Industrial Economics and Strategy/Aalborg University, Department of Business Studies.

Balzat, M. & Hanusch, H. 2007. Fundamentals of the concept of national innovation systems. In *Elgar Companion to Neo-Schumpeterian Economics.* H. Hanusch & A. Pyka, Eds. Northampton, Massachusetts: Edward Elgar Publishing Limited. 926.

Bandura, A. 1977. Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review.* 84(2): 191.

Battilana, J., Leca, B. & Boxenbaum, E. 2009. How actors change institutions: towards a theory of institutional entrepreneurship. *The Academy of Management Annals.* 3(1): 65-107.

Bhaduri, S. & Kumar, H. 2011. Extrinsic and intrinsic motivations to innovate: tracing the motivation of ‘grassroot’ innovators in India. *Mind & Society.* 10(1): 27-55.

Blohm, I. & Leimeister, J.M. 2013. Design of IT-based enhancing services for motivational support and behavioral change. *Business & Information Systems Engineering.* : 275-278.

Bower, J.L. & Christensen, C.M. 1995. Disruptive technologies: Catching the wave. *Harvard Business Review.* 73(1): 43-53.

Brunt, L., Lerner, J. & Nicholas, T. 2012. Inducement prizes and innovation. *The Journal of Industrial Economics.* 60(4): 657-696.

Bullinger, A.C., Neyer, A., Rass, M. & Moeslein, K.M. 2010. Community-based innovation contests: Where competition meets cooperation. *Creativity and Innovation Management.* 19(3): 290-303.

Burke, B. 2012. Gamification 2020: What Is the Future of Gamification? *Gartner, Inc., Nov.* 5.

Byrne, D.S. 1998. *Complexity Theory and the Social Sciences: an Introduction.* Psychology Press.

Capello, R. & Faggian, A. 2005. Collective learning and relational capital in local innovation processes. *Regional Studies.* 39(1): 75-87.

Carlsson, B. 2007. Innovation systems: a survey of the literature from a Schumpeterian perspective. In *Elgar Companion to Neo-Schumpeterian Economics.* Northampton, Massachusetts: Edward Elgar Publishing Limited. 857.

Carlsson, B., Jacobsson, S., Holmén, M. & Rickne, A. 2002. Innovation systems: analytical and methodological issues. *Research Policy.* 31(2): 233-245.

Carvalho, A. 2009. *In Search of Excellence-Innovation Contests to Foster Innovation and Entrepreneurship in Portugal.* Évora, Portugal: CEFAGE-UE Working Paper.

CCDI. 2013. *Western Cape Design Strategy Summary.* Available: http://c.ymcdn.com/sites/www.ccdi.org.za/resource/collection/D064CFA3-95B4-4876-A11F-15B05CFBCF14/WC_Design_Strategy_Summary_-_Digital_Publishing.pdf; [11 October 2015].

Chell, E. & Athayde, R. 2009. *The Identification and Measurement of Innovative Characteristics of Young People: Development of the Youth Innovation Skills Measurement Tool.* UK: Nesta.

Cheng, M.Y. & Mittelhammer, R. 2008. Globalization and economic development: Impact of social capital and institutional building. *American Journal of Economics and Sociology.* 67(5): 859-888.

City of Cape Town: Strategic Development Information and GIS Department. 2012. *City of Cape Town – 2011 Census – Cape Town.* Cape Town, South Africa: CoCT.

City of Cape Town: Strategic Development Information and GIS Department. 2013. *City of Cape Town – 2011 Census Suburb Khayelitsha.* Cape Town, South Africa: CoCT.

Chou, Y. 2015a. *Actionable Gamification: Beyond Points, Badges, and Leaderboards.* Yu-Kai Chou.

Chou, Y. 2015b. *Octalysis: Complete Gamification Framework.* Available: http://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/#.VvwC0GR96t- [2 September 2015].

Collier, P. 2002. Social capital and poverty: a microeconomic perspective. In *The Role of Social Capital in Development: An Empirical Assessment.* C. Grootaert & T. van Bastelaer, Eds. Cambridge (MA), Cambridge University Press. 19-41.

Coronado Escobar, J.E. & Vasquez Urriago, A.R.2014. Gamification: an effective mechanism to promote civic engagement and generate trust? *Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance.* ACM. 514.

Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., Friel, S., Groce, N. et al. 2009. Managing the health effects of climate change: lancet and University College London Institute for Global Health Commission. *The Lancet.* 373(9676): 1693-1733.

Cozzens, S. & Sutz, J. 2012. Innovation in informal settings: a research agenda. *IDRC, Ottawa, Canada.*

Csikszentmihalyi, M. 2000. *Beyond Boredom and Anxiety.* Jossey-Bass.

Cuevas-Rodríguez, G., Cabello-Medina, C. & Carmona-Lavado, A. 2014. Internal and external social capital for radical product innovation: do they always work well together? *British Journal of Management.* 25(2): 266-284.

DST. 1996. *White Paper on Science and Technology.* Pretoria: Government Printers.

Dutta, S. 2012. The global innovation index 2012. *Stronger Innovation Linkages for Global*.

Esders, M. 2013. COLLOQUIUM: Grassroots Innovations for Inclusive Development: Need for a Paradigmatic Shift. *Vikalpa.* 38(3): 120.

Fischer, M.M. & Fröhlich, J. 2013. *Knowledge, Complexity and Innovation Systems.* Springer Science & Business Media.

Foray, D. 2007. Tacit and codified knowledge. In *Elgar Companion to Neo-Schumpeterian Economics.* H. Hanusch & A. Pyka, Eds. Northampton, Massachusetts: Edward Elgar Publishing Limited. 235.

Foster, C. & Heeks, R. 2013. Conceptualising Inclusive Innovation: Modifying systems of innovation frameworks to understand diffusion of new technology to low-income consumers. *European Journal of Development Research.* 25(3): 333-355.

Fowler, A. 2000. NGDOs as a moment in history: beyond aid to social entrepreneurship or civic innovation? *Third World Quarterly.* 21(4): 637-654.

Fukuyama, F. 2002. Social capital and development: The coming agenda. *SAIS Review.* 22(1): 23-37.

Gist, M.E. & Mitchell, T.R. 1992. Self-efficacy: A theoretical analysis of its determinants and malleability. *Academy of Management Review.* 17(2): 183-211.

Godin, B. 2006. The Linear model of innovation the historical construction of an analytical framework. *Science, Technology & Human Values.* 31(6): 639-667.

Goldstein, J. 2008. Complexity science applied to innovation: Theory meets praxis. *Special Issue on Complexity of the Innovation Journal.* Citeseer.

Goldstein, J., Hazy, J.K. & Silberstang, J. 2010. A complexity science model of social innovation in social enterprise. *Journal of Social Entrepreneurship.* 1(1): 101-125.

Grootaert, C. & Van Bastelaer, T. 2002. *The Role of Social Capital in Development: An Empirical Assessment.* Cambridge University Press.

Gupta, A.K. 2003. Conserving biodiversity and rewarding associated knowledge and innovation systems: Honey Bee Perspective. *Intellectual Property: Trade, Competition, and Sustainable Development.* 3:373.

Gupta, A.K. 2013a. Tapping the entrepreneurial potential of grassroots innovation. *Global Perspectives on how Social Innovation can Promote the Well-being of Humanity.* 18-21.

Gupta, A.K. 2013. COLLOQUIUM: Grassroots Innovations for Inclusive Development: Need for a Paradigmatic Shift. *Vikalpa.* 38(3): 103.

Hagedoorn, J. 1996. Innovation and entrepreneurship: Schumpeter revisited. *Industrial and Corporate Change.* 5(3): 883-896.

Hamari, J. & Koivisto, J. 2014. Measuring flow in gamification: Dispositional flow scale-2. *Computers in Human Behavior.* 40: 133-143.

Hamari, J., Koivisto, J. & Sarsa, H. 2014. Does gamification work? A literature review of empirical studies on gamification. *System Sciences (HICSS), 2014 47th Hawaii International Conference on.* IEEE. 3025.

Hekkert, M.P., Suurs, R.A., Negro, S.O., Kuhlmann, S. & Smits, R. 2007. Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change.* 74(4): 413-432.

Herrington, M. & Kew, P. 2016. Global entrepreneurship monitor: South African report 2015/2016. *Graduate School of Business.Cape Town: University of Cape Town.*

Hielscher, S., Seyfang, G. & Smith, A. 2011. *Community Innovation for Sustainable Energy.*

Hodgson, G.M. 2006. What are institutions? *Journal of Economic Issues.* 40(1): 1-25.

Iizuka, M. 2013. *Innovation systems framework: still useful in the new global context?* Maastricht, The Netherlands: United Nations University-MERIT Working Papers.

Katz, J.S. 2006. Indicators for complex innovation systems. *Research Policy.* 35(7): 893-909.

Kraay, A. 2006. When is growth pro-poor? Evidence from a panel of countries. *Journal of Development Economics.* 80(1): 198-227.

Kumar, V. 2013. COLLOQUIUM: Grassroots Innovations for Inclusive Development: Need for a Paradigmatic Shift. *Vikalpa.* 38(3): 108.

Lepper, M.R., Greene, D. & Nisbett, R.E. 1973. Undermining children's intrinsic interest with extrinsic reward: A test of the" overjustification" hypothesis. *Journal of Personality and Social Psychology.* 28(1): 129.

Lepper, M.R. & Henderlong, J. 2000. Turning" play" into" work" and" work" into" play": 25 years of research on intrinsic versus extrinsic motivation. *Educational Psychology.* (257-307).

Lundvall, B. 2007a. National innovation systems—analytical concept and development tool. *Industry and Innovation.* 14(1):95-119.

Lundvall, B. 2007b. National innovation systems: from List to Freeman. In *Elgar Companion to Neo-Schumpeterian Economics.* H. Hanusch & A. Pyka, Eds. Northampton, Massachusetts: Edward Elgar Publishing Limited. 872.

Lundvall, B. & Johnson, B. 1994. The learning economy. *Journal of Industry Studies.* 1(2): 23-42.

Lundvall, B., Johnson, B., Andersen, E.S. & Dalum, B. 2002. National systems of production, innovation and competence building. *Research Policy.* 31(2): 213-231.

MacCormack, A., Murray, F. & Wagner, E. 2013. Spurring innovation through competitions. *MIT Sloan Management Review.* 55(1): 25.

Mair, J., Martí, I. & Ventresca, M.J. 2012. Building inclusive markets in rural Bangladesh: How intermediaries work institutional voids. *Academy of Management Journal.* 55(4): 819-850.

Manson, S.M. 2001. Simplifying complexity: a review of complexity theory. *Geoforum.* 32(3): 405-414.

OECD (Organization for Economic Cooperation and Development)/Eurostat. 2005. Guidelines for Collecting and Interpreting Innovation Data — The Oslo Manual, 3rd edn. Paris: OECD.

Marquardt, C. 2013a. *Social Enterprises' Distinctiveness and Social Innovation – The Driving Force Behind Social Enterprise? .* Available: http://www.humanitariancentre.org/2013/04/social-enterprises-distinctiveness-and-social-innovation-the-driving-force-behind-social-enterprise/ [1 December 2015].

Marquardt, C. 2013b. *Social Enterprise in Development, or for Development?* Available: http://www.humanitariancentre.org/2013/03/social-enterprise-in-development-or-for-development/ [1 December 2015].

Mayrhofer, A.M. & Hendriks, S.L. 2003. Service provision for street-based traders in Pietermaritzburg, KwaZulu-Natal: comparing local findings to lessons drawn from Africa and Asia. *Development Southern Africa.* 20(5): 595-604.

McGonigal, J. 2011. *Reality is Broken: Why Games Make Us Better and How They Can Change the World.* Penguin.

Mitchell, T.R. 1982. Motivation: New directions for theory, research, and practice. *Academy of Management Review.* 7(1): 80-88.

Morçöl, G. & Wachhaus, A. 2009. Network and complexity theories: A comparison and prospects for a synthesis. *Administrative Theory & Praxis.* 31(1): 44-58.

Morgan, J. & Wang, R. 2010. Tournaments for ideas. *California Management Review.* 52(2): 77.

Moulaert, F., Martinelli, F., Swyngedouw, E. & Gonzalez, S. 2005. Towards alternative model(s) of local innovation. *Urban Studies.* 42(11): 1969-1990.

Mphahlele, K.M. 2012. Innovation agenda for South Africa in the 21st century: towards an alternative inclusive and integrative model. Doctorate. University of South Africa.

Murray, F., Stern, S., Campbell, G. & MacCormack, A. 2012. Grand Innovation Prizes: A theoretical, normative, and empirical evaluation. *Research Policy.* 41(10): 1779-1792.

Page Scott, E. 2007. *How the Power of Diversity Creates Better Groups, Firms, Schools and Societies.* Princeton.

Papert, S. & Harel, I. 1991. Situating constructionism. *Constructionism.* 36: 1-11.

Paunov, C. 2013. *Innovation and Inclusive Development.* OECD Publishing.

Heintz, J. & Posel, D. 2008. Revisiting informal employment and segmentation in the South African labour market. *South African Journal of Economics*, *76*(1), pp.26-44.

Putnam, R.D. 1996. The strange disappearance of civic America. *Policy: A Journal of Public Policy and Ideas.* 12(1): 3.

Redclift, M. 2002. *Sustainable Development: Exploring the Contradictions.* Routledge.

Ritchie, J. & Lewis, J. 2003. *Qualitative Research Practice: A Guide for Social Science Students and Researchers.* Sage.

Roth, S, Schneckenberg, D. & Tsai, C. 2015. The Ludic Drive as Innovation Driver: Introduction to the Gamification of Innovation. *Creativity and Innovation Management.* 24(2): 300-306.

RSA. 2011. *National Planning Commission: National Development Plan.* Pretoria: Government Printers.

Ryan, R.M. & Deci, E.L. 2000a. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist.* 55(1): 68.

Ryan, R.M. & Deci, E.L. 2000b. Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology.* 25(1):54-67.

Schumpeter, J.A. 1934. *The Theory of Economic Development: An Inquiry Into Profits, Capital, Credit, Interest, and the Business Cycle.* Transaction publishers.

Sebba, J., Griffiths, V., Luckrock, B., Hunt, F., Robinson, C. & Flowers, S. 2009. *Youth-led Innovation: Enhancing the Skills and Capacity of the Next Generation of Innovators.* UK: Nesta.

Seyfang, G. 2006. Sustainable consumption, the new economics and community currencies: developing new institutions for environmental governance. *Regional Studies.* 40(7): 781-791.

Seyfang, G. 2009. Grassroots Innovations for Sustainable Consumption. In *The New Economics of Sustainable Consumption.* Springer. 63-82.

Seyfang, G. & Smith, A. 2007. Grassroots innovations for sustainable development: Towards a new research and policy agenda. *Environmental Politics.* 16(4): 584-603.

Shane, S.A. 1992. Why do some societies invent more than others? *Journal of Business Venturing.* 7(1): 29-46.

Smale, T. 2008. The Influence of National Culture on New Zealand's Innovation Outcomes, MBA thesis, Henley Management College. *Reading, UK.*

South Africa. 2008. *National Youth Development Agency Act, No 54 of 2008*. Available from: http://www.thepresidency.gov.za/docs/nyda_act.pdf.

Spielman, D.J., Ekboir, J. & Davis, K. 2009. The art and science of innovation systems inquiry: applications to Sub-Saharan African agriculture. *Technology in Society.* 31(4): 399-405.

Stats SA. 2014. *Poverty Trends in South Africa: An Examination of Absolute Poverty Between 2006 and 2011*. Pretoria: Stats SA.

Szogs, A., Cummings, A. & Chaminade, C. 2009. *Building Systems of Innovation in Less Developed Countries: The Role of Intermediate Organizations.* Georgia Institute of Technology.

Tabellini, G. 2010. Culture and institutions: economic development in the regions of Europe. *Journal of the European Economic Association.* 8(4): 677-716.

"Tacit, a.". 2015. *Collins Dictionary Online.* Available: http://www.collinsdictionary.com/dictionary/english/tacit; [2 December 2015].

"Tall poppy syndrome, n.". 2015. *Collins dictionary online.* Available: http://www.collinsdictionary.com/dictionary/english/tall-poppy-syndrome; [1 December 2015].

van der Hilst, B. 2012. Inclusive Innovation Systems: How Innovation Intermediaries can Strengthen the Innovation System. Masters. University of Utrecht.

van Heyningen, P. & Brent, A. 2010. Potentials and advantages in shifting towards sustainability oriented innovation systems in South Africa. *ERSCP-EMSU Conference: Knowledge Collaboration & Learning for Sustainable Innovation.* 25-29 October 2010. Cape Town.

Von Hippel, E. 2005. Democratizing innovation: The evolving phenomenon of user innovation. *Journal Für Betriebswirtschaft.* 55(1): 63-78.

Appendix A: Semi-structured Interview Protocol

Innovate the Cape Participant Questions

1. **Personal Motivation**
    - 1.1. Why did you start the project?
    - 1.2. What were your personal reasons and goals for starting?
    - 1.3. What was the biggest reason for you starting the project?
2. **General Incentives**
    - 2.1. Which incentive would most valuable to do a project like this?
    - 2.2. Would you prefer cash for you or for the project?
    - 2.3. Would a larger cash prize be more appealing?
    - 2.4. What about other types of prizes?
    - 2.5. Which prize would be most appealing when entering?
    - 2.6. Would you prefer sponsorship or winning prize money?
    - 2.7. Why did you attend the Innovate the Cape events?
3. **Competition**
    - 3.1. Why did you enter innovate the Cape?
    - 3.2. What drew you to enter?
    - 3.3. How much of a motivation was the competition prize?
    - 3.4. What do you think about competing in competitions?
    - 3.5. How did you feel about the other competition participants?
        - 3.5.1. Did they feel like competitors or collaborators?
    - 3.6. Have you ever done a project like this or taken part in a competition like this?
        - 3.6.1. If not, why was this different?
    - 3.7. What was it like having an opportunity to solve the challenge that your project solves?
    - 3.8. How did it feel coming from your area and doing this project?
    - 3.9. Do you see many similar projects being done where you live?
        - 3.9.1. If not, why not?
    - 3.10. Was it important receiving recognition for your project and showcasing it?
    - 3.11. Do you feel like youth have a voice in your community?
    - 3.12. What did/do you enjoy most about the program?
    - 3.13. How did it feel to be a part of Innovate the Cape?
        - 3.13.1. How did you feel when you were accepted as a finalist?
    - 3.14. What was it like meeting new people and being in new places?

4. Learning

4.1. What helped you with this project?

4.2. What held you back?

4.3. Did you have financial constraints to run this project before the competition?

4.4. What did you learn doing this project?

4.5. How did you learn these things?

4.6. Are you taught these skills at school?

4.7. What skills do you still need to learn to help you with this project?

4.8. Do you have computer access with Internet?

4.9. How much did you make use of the Internet?

4.10. Who helped you with the project?

4.11. How were they helpful?

4.12. What helped you to connect with these people?

4.13. What role did your mentor play in the project?

4.14. How was coming from your area an advantage or disadvantage to do this project?

4.15. What local knowledge do you have that others don't?

4.15.1. How did this help you?

4.16. Are the places you work good working environments?

4.17. Do they have the facilities you need?

4.18. Are you aware of available places to work?

4.18.1. Why don't you work there?

4.19. Do you feel like you are welcome to work in the city centre?

4.20. What activities do you usually do in the city centre?

4.21. Did having events in the city centre help you in any way?

5. Institutional factors

5.1. How do you think your community context has affected you in this project?

5.2. What is your community's view on the problems it faces?

5.2.1. What are your views?

5.3. Has your mindset about community problems changed?

5.3.1. What changed that?

5.3.2. Who do you feel is ultimately responsible to solve the challenge that you are solving?

5.4. Have your confidence levels changed?

5.4.1. If so, what caused that?

5.5. How do you define innovation?

5.5.1. How does your community perceive the word innovation?

5.6. Do you think that failure is acceptable?
    5.6.1. How about your community?
5.7. Have you seen instances of people being jealous of successful people?
5.8. Have you faced challenges in your community because you are young?
5.9. Have you faced challenges in your community because you are a girl?
5.10. Have there been any challenges as girls?
5.11. Do you get many opportunities to enter programs like this?
5.12. Are you aware of any other initiatives or programs that could support your project?

6. Is there anything else you would like to share?

Innovate the Cape Mentor Questions

Note: many questions were adapted from the Innovate the Cape participant questions.

1. Motivation

1.1. What has it been like being a mentor?
1.2. Why did you decide to be a mentor?
1.3. What did you enjoy and not enjoy about being a mentor?
1.4. What do you think motivated your group?

2. Learning process

2.1. What role do you think you play as a mentor?
2.2. What role did you play in their learning process?
2.3. What is the value of your relationship with them?
2.4. What have they learnt?
2.5. How did they learn those things?
2.6. What kind of progress have you seen in them and their projects?
2.7. Have you seen a change in confidence?
2.8. What basic skills necessary for innovating are missing?
2.9. What was the role of using the Internet to learn?
2.10. Was your group surprisingly good at anything?
2.11. How do you think their local knowledge helped?
2.12. What were the barriers and enablers with regards to:
    2.12.1. Accessing information for their projects?
    2.12.2. Internet usage?
    2.12.3. Implementing the knowledge from the Internet?
    2.12.4. The students' personal development?
    2.12.5. The work environment?

3. Institutional factors

3.1. What were the barriers and enablers with regards to:

3.1.1. Coming from the areas they came from?

3.1.2. The influence from the community?

4. Do you have anything else you'd like to add?

Appendix B: Participant Descriptions

Participant	Participant Type	Team	Interviews	Focus groups
Participant 1	finalist, mentor	Govarsity	3	1
Participant 2	finalist	Govarsity	1	1
Participant 3	finalist	Rescue for Nature	1	
Participant 4	finalist	SLYZ		1
Participant 5	finalist	SLYZ		1
Participant 6	finalist	SLYZ		1
Participant 7	finalist	Transport Revolution	1	1
Participant 8	finalist	Transport Revolution	1	2
Participant 9	finalist	Transport Revolution	1	2
Participant 10	finalist	BRainstorm	1	1
Participant 11	finalist	BRainstorm	1	1
Participant 12	finalist	BRainstorm	1	1
Participant 13	finalist	BRainstorm	1	1
Participant 14	finalist	Sakhulife	1	1
Participant 15	finalist	Sakhulife	1	1
Participant 16	finalist	Sakhulife	1	1
Participant 17	finalist	Long Walk from Loadshedding	1	1
Participant 18	finalist	Long Walk from Loadshedding	1	1
Participant 19	finalist	Long Walk from Loadshedding	1	1
Participant 20	finalist	Amaqhawe		1
Participant 21	finalist	Amaqhawe		1
Participant 22	finalist	Amaqhawe		1
Participant 23	finalist	Amaqhawe		1
Participant 24	finalist	Amaqhawe		1
Participant 25	finalist	Health Watch		1
Participant 26	finalist	Health Watch		1
Participant 27	finalist	Health Watch		1
Participant 28	mentor			1
Participant 29	mentor			1
TOTAL			**18**	**9**

Appendix C: Consent Form

Researcher: Stefan Louw
Student number: LWXSTE009
Supervisor: Britta Rennkamp
Institution: the University of Cape Town

Information Sheet and Consent Form for Interview with innovate the Cape Participants

Hello, my name is Stefan Louw and I am conducting research towards a master's degree. I am researching how to enable innovation processes in low-income communities in Cape Town and would like to invite you to participate in the project.

I am interested in finding out about innovation by youth in low-income communities in Cape Town. I would like to get a better understanding of what causes and motivates youth to start innovative projects that are aimed at community upliftment, as well as what helps or prevents these projects from becoming successful. From this understanding I hope to inform education programs, innovation and entrepreneurial competition designers and government policy on these innovation processes to improve their practices in order to help youth implement these innovative projects.

Please understand that you do not have to participate, i.e. your participation is voluntary. The choice of participation is yours alone. If you choose to not participate, there will be no negative consequence. Note that this research will not influence the outcome of the innovate SA program in any way. If you choose to participate, but wish to withdraw at any time, you will be free to do so without negative consequence. However, I would be grateful if you would assist me by allowing me to interview you.

The interview should take no longer than one hour of your time. An audio recording of the interview will be done which will be written into a transcript. You will be sent a copy of the transcript once it is completed. Please give your permission for this by signing below.

All of your answers, including personal information, will be kept anonymous. If your personal details are used or your comments are quoted you will be contacted in order to obtain express permission to do so.

Participant's Name: **Parent's Name:**
Signature: **Parent's Signature:**

Appendix D: Ethics Clearance

See pages attached.

EBE Faculty: Assessment of Ethics in Research Projects (Rev2)

Any person planning to undertake research in the Faculty of Engineering and the Built Environment at the University of Cape Town is required to complete this form before collecting or analysing data. When completed it should be submitted to the supervisor (where applicable) and from there to the Head of Department. If any of the questions below have been answered YES, and the applicant is NOT a fourth year student, the Head should forward this form for approval by the Faculty EIR committee: submit to Ms Zulpha Geyer (**Zulpha.Geyer@uct.ac.za**; Chem Eng Building, Ph 021 650 4791).
NB: A copy of this signed form must be included with the thesis/dissertation/report when it is submitted for examination

This form must only be completed once the most recent revision EBE EiR Handbook has been read.

Name of Principal Researcher/Student: Stefan Louw Department: Energy Research Centre

Preferred email address of the applicant: stefanclouw@gmail.com

If a Student: Degree: Energy Studies (MPhil) Supervisor: Britta Rennkamp

If a Research Contract indicate source of funding/sponsorship: DST: RSES

Research Project Title: Enabling grassroots youth innovation in low-income communities in Cape Town.

Overview of ethics issues in your research project:

Question 1: Is there a possibility that your research could cause harm to a third party (i.e. a person not involved in your project)?	YES	~~NO~~
Question 2: Is your research making use of human subjects as sources of data? If your answer is YES, please complete Addendum 2.	~~YES~~	NO
Question 3: Does your research involve the participation of or provision of services to communities? If your answer is YES, please complete Addendum 3.	~~YES~~	NO
Question 4: If your research is sponsored, is there any potential for conflicts of interest? If your answer is YES, please complete Addendum 4.	YES	~~NO~~

If you have answered YES to any of the above questions, please append a copy of your research proposal, as well as any interview schedules or questionnaires (Addendum 1) and please complete further addenda as appropriate. Ensure that you refer to the EiR Handbook to assist you in completing the documentation requirements for this form.

I hereby undertake to carry out my research in such a way that

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

Signed by:

	Full name and signature	Date
Principal Researcher/Student:	Stefan Louw	25/09/2014

This application is approved by:

Supervisor (if applicable):	Dr. Britta Rennkamp	25/09/2014
HOD (or delegated nominee): *Final authority for all assessments with NO to all questions and for all undergraduate research.*		
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.		

ADDENDUM 1:
Please append a copy of the research proposal here, as well as any interview schedules or questionnaires:

Title

Enabling grassroots youth innovation in low-income communities in Cape Town.
Key words: grassroots innovation, innovation systems, sustainable development, youth, low-income communities, motivations, barriers, enablers.

Research question/s

What are the motivations, barriers and enablers of grassroots youth innovation in low-income communities in Cape Town?

Using innovation systems as a framework how do the motivations, barriers and enablers of these innovation processes give a better understanding of how to enable innovation in this context? Do the findings in this study require that the framework be modified for use in this context?

Introduction

In order to achieve sustainable development in developing countries the traditional approaches have largely been driven by large international foreign aid organizations. These approaches usually take a top down and technology centered approach in transferring technologies from the developed to developing countries. This approach has seen limited success especially with regards to the appropriateness of the technologies and the local acceptance and dissemination of the technologies in a sustainable fashion.

A recent trend in the developmental approach is emerging where local people are innovating in order to solve their developmental needs with a human centered approach from the bottom up. These movements have a focus on using 'appropriate technologies', a term used by the economist E.F. Schumacher, in order to develop new technologies or adjust current technologies to meet the needs of the communities they serve. Closely linked to this is the emergence of grassroots innovators that are developing solutions primarily for a social purpose rather than for profit. This is contrary to the majority of literature on innovation which considers the drivers of innovation to be related to market forces and the actors to be from formal firms and R&D departments.

The literature on innovation largely centers on the framework of innovation systems in order to understand the complex processes that are involved in innovation. This tool provides policy makers with a tool to pinpoint the key elements and processes that are pivotal to enable innovation and thus drive economic growth. However, the innovation systems framework is based considered as an economic instrument rather than one that can be used for a broader definition of innovation that defines innovation with an emphasis on problem solving for social needs rather than a novel technological product that meets market needs or creates a new market. This new approach to innovation as well as to development can be termed innovation for development where the primary purpose of innovation is to provide solutions for developmental needs.

A context where innovation for development is increasingly necessary is that of low-income urban and peri-urban areas or slums. It is already estimated that 72% of the urban population in Africa live in slums (Cohen, 2006). Given that these people will largely come from low-income rural areas they will predominantly reside in these low-income urban fringes. These areas already face several complex challenges that involve issues never tackled before and will increasingly require innovative solutions to solve the challenges that will inevitably come with the expected population explosion. In order to cope with these challenges there is a great need to not only generate solutions through formal institutions but also to build innovative capacity in the informal settings where traditional solutions by the public and private sector do not suffice. These innovative solutions also need to have a focus on being inclusive, i.e. serve those at the bottom of the pyramid, in order to tackle challenges of increasing global inequality.

A better understanding of innovation for inclusive development in the low-income urban context is necessary in order to encourage and enable this type of innovation. However, innovation of this nature is largely under-researched (Foster and Heeks, 2013). This study seeks to do on the ground research of grassroots youth innovation for inclusive development in low-income areas in Cape Town. Given the legacy of Apartheid and the fact that South Africa has the highest gini-coefficient in the world (Armstrong et al., 2008), the Cape Town context is an excellent one to understand these processes.

The study is focused on a youth innovation competition called innovate SA based in Cape Town. The competition gives youth the opportunity to come up with innovative solutions to local challenges and receive funding and support to develop prototypes of their ideas. The study uses the innovation systems framework in order to get insights into the innovation processes in these projects. These insights will come through researching the motivations, barriers and enablers to innovation in this context. The findings will be used to understand how to enable innovation in this context and show how appropriate the innovation systems framework is to understanding this type of innovation.

Background

What is the study about?
This study is about understanding the motivations, barriers and enablers of grassroots youth innovation in low-income areas in Cape Town low-income areas in order to enable innovation in this context.
The study focuses on a case study of grassroots innovation in a competition called innovate SA.

The structure of the innovate SA competition is as follows. Applicants must be from a South African high school. They work in teams of 2 to 5 to submit an innovative solution to a local challenge. The finalist teams receive R5,000 to develop a prototype of their ideas. Each team is supported by a mentor, a network of advisors and attend workshops on design thinking and entrepreneurship. After a 3 month period the finalist teams present their prototypes to a panel of judges where a winning group is selected to receive a further R10,000.

All participants range in age between 16 and 20 years of age. Although the competition is open, there is a focus on working in low-income communities in Cape Town. The participants in this study are selected from these areas. Their projects must have a developmental focus where they solve a pertinent issue in their community. The projects need not have a technological focus, although many do include the use of innovative technologies. All projects are at an early stage of development with the majority having only accomplished proof of concept.

Who is conducting the study?
The study is being conducted by Stefan Louw, a Masters student at the Energy Research Centre and the program manager of innovate SA.

Assistance in making observations will be provided by the program's mentors.

Prior experience: Stefan has conducted informal interviews with previous participants.

Positionality: As the program manager of innovate SA, Stefan is familiar with the participants and the communities that the participants work in.

What type of study is this?
It is a qualitative and exploratory study to get an in-depth understanding of inclusive innovation at the grassroots level.

Why is the study being conducted?
In order to understand the innovation processes in this context so that more similar types of innovation can be incentivized and supported.

Who is the study for?

Society: inclusive innovation directly impacts society in a positive manner. Enabling it through a greater understanding of the processes involved will increase the impact.

Town planners: to understand the impact of the spatial separation of low-income areas from urban hubs on innovation. How could these spatial divides be bridged?

Social Innovation and Entrepreneurship programs: provide a holistic framework to understand the needs of young innovators in order to provide them with adequate incentives and support.

Education department: to understand the impact of teaching style on youth innovation. What are the gaps in knowledge that need to be filled in order to be equipped to innovate?

Innovation literature: is the current innovation systems framework adequate to describe innovation in this context? How should it be adjusted?

Definitions

Innovation: this is a widely used term that is difficult to define. In the broadest sense it is doing something new or in a new way or in a new context. The definition predominantly used in innovation literature is that of creating a new product that meets market needs. This definition was traditionally narrowly focused on technological products. Subsequently this definition has been broadened beyond products to include social innovation, meaning new strategies, concepts, ideas and organizations that meet social needs.
In this study innovation will be taken in a broad sense and centred on problem solving.

Inclusive innovation: innovation does not necessarily benefit all of society and could be argued to be something that creates further divides (George et al., 2012). Given the growing inequalities in society there is a need for innovation that is inclusive, i.e. it is by or for the poor. Another related field is that of innovation for inclusive development which includes the purpose of the innovation. This purpose of inclusive development is implied when referring to inclusive innovation in this study.

Grassroots innovators: innovators outside of formal institutions like R&D departments that are on the ground innovating either for their own or for their communities' needs.

Sustainable development: leading on from the term innovation for inclusive development is the need to define development. Like innovation it is a loosely used term. Here it is understood to be the enhancement of the quality of life of all individuals through economic development which has a benign effect on the environment. There is an implication of inclusivity, i.e. sustainable development that also serves the bottom-of-the- pyramid (BoP).

Youth: learners ranging in age from 16-20 years.

Low-income areas: areas in Cape Town that were disadvantaged under the Apartheid regime. These typically lie outside of affluent urban centres.

Literature Review

Innovation literature is centred on the innovation systems framework. This framework is used to understand the complex processes involved in innovation in order to improve the processes that result in innovation and lead to economic growth (Iizuka, 2013). The main components of innovation systems include the drivers of innovation, the actors and their interactions, knowledge transfer, institutions and policy that affects innovation. The traditional innovation systems have drivers which are market related. The actors are typically formal in nature and would be R&D departments from formal firms or other institutions such as academic institutions . The flow of knowledge typically comes through formal codified literature (Iizuka, 2013). The policy has a focus on funding the formal R&D departments and providing IPR in order to facilitate market incentives (Hekkert et al., 2007).

However, there is an emerging form of innovation which differs from traditional the traditional form of innovation seen in literature. The main differences are that the primary focus of the innovation is to solve societal problems rather than make profit and that the actors include individuals and less formal organizations. There are a myriad of terms that describe this type of innovation, including innovation for inclusive development, grassroots innovation, social innovation and user innovation. The common themes in these forms of innovation are that the aim is not rent-seeking; they focus on problem-solving; they are not firm-centred; they are for BoP users; they have a non-technical focus; there is less formal interaction between the actors often requiring intermediaries, the processes are inclusive; they are informal in terms of using tacit and codified knowledge and are not necessarily supported by formal institutions; the innovators are immersed in the problem space (Foster and Heeks, 2013).

Given that these themes differ in many respects from market-driven innovation it is necessary to get a better understanding of these innovation processes through on the ground research. This study undertakes to do so through using focusing on the elements given in the innovation systems framework and analysing the innovation processes through researching the motivations, barriers and enablers to innovation in this context.

Research Methods

Nature of research

The research method will be qualitative and exploratory by nature. The research will take an inductive approach.

Scope

Due to time and resource constraints and given the nature of the case study the scope of the study will be restricted in terms of

Location: low-income areas in Cape Town including Khayelitsha, Philippi and Athlone.

Age: youth from 16-20 years old

Type of innovation: grassroots innovation for inclusive development

Stage of innovation: early stage. Therefore a focus on motivations and early stage learning processes.

Participants

Participants in the study will be selected if they fit the following criteria:

- They are participants of the innovate SA competition
- Their innovations are for inclusive development
- They live in low-income areas in Cape Town

There are 9 participants that fit these criteria.

Research activities

The research activities will center on the innovators. They include:

- Interviews conducted by me
- Focus groups
- Observations conducted by the group mentors and me

Framework for questioning

The framework for the research is based on the themes of innovation systems given in the literature.

Traditional Innovation Systems Themes

- The drivers of innovation (firm centered)
    - Approach: top-down
    - Motivations: market-driven (IPR)
- The actors and their interactions (firms, institutions, R&D departments)
- Learning processes and knowledge flow (relationships are important)
- A supportive environment for innovation (policy, regulations)

Research Aims and Objectives

The aim of the research is to get an understanding of the factors that cause, support and hinder grassroots youth innovation in low-income areas. These findings will be framed around questions of motivations, barriers and enablers of innovation.

Using the innovation systems framework it is evident that it is important to understand the new motivations for innovation since grassroots innovation is not market-driven. This study will examine how appropriate a competition as a driver of innovation in this context and what the motivations besides a prize are.

Observations from the 2013 competition in combination with the literature on inclusive innovation lead to the following barriers and enablers of innovation being chosen to be explored. The factors are in relation to the innovation systems themes of learning processes, knowledge flows and the environment in which the innovation takes place:

- people (actors involved)
    - mentors
    - networks
    - collaborators
- spaces (working in low-income areas vs in urban hubs)
    - access and inclusion
    - creativity and safety
- locality and knowledge
    - combination of tacit and codified knowledge
    - immersion in problem space
- education
    - learning through making
    - required skills development
- resources
    - facilities
        - physical workshops
        - computer access
    - funding
        - what are the important needs at the early stages?
- mindset
    - dependency
        - who is responsible for problem-solving?
    - self-efficacy
    - perceptions on innovation

Data Collection

The interviews and focus groups will be open and in depth asking questions according to the motivations, barriers and enablers above. They will also include contextual questions regarding the learners' backgrounds and details about their innovations.

Observations on the innovators' motivations, barriers and enablers will be made by the mentors. These will be written in notebooks. These notes will be framed around questions that focus on motivations and learning processes:

- What factors motivate the learners to work on their projects?
- When did breakthroughs in progress occur and what lead to the breakthroughs?
- What did the group learn? What were the contributing factors?
- Where are the barriers/enablers to accessing information for their projects?
- What are the barriers/enablers to implementing the knowledge?
- What basic skills necessary for innovating are missing?
- Was their funding spent responsibly?

Data Analysis

The data will be collected and transcribed. The information will be codified using a software package called Atlas Ti.

The findings will be tabulated giving the findings for each group with regard to motivations, barriers and enablers. These findings will be discussed.

Research Plan

The prototyping phase of the competition runs over three months from August to October 2014. Observations will take place throughout this period. Interviews and focus groups will be held intermittently at events or on site where the innovators implement their ideas during October.

The ethics forms will be submitted by 25 September 2014.

The data will be collected and transcribed during the prototyping phase of the competition.

The findings and conclusions will be written up from November 2014 to January 2015.

A draft will be submitted by 15 January 2015.

The final deadline for submission is 15 February 2015.

References

Armstrong, P., Lekezwa, B. & Siebrits, K. 2008, "Poverty in South Africa: A profile based on recent household surveys", *Matieland: Stellenbosch Economic Working Paper,* vol. 4, no. 08.

Cohen, B. 2006, "Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability", *Technology in society,* vol. 28, no. 1, pp. 63-80.

Foster, C. & Heeks, R. 2013, "Conceptualising Inclusive Innovation: Modifying systems of innovation frameworks to understand diffusion of new technology to low-income consumers", *European Journal of Development Research,* vol. 25, no. 3, pp. 333-355.

Hekkert, M.P., Suurs, R.A., Negro, S.O., Kuhlmann, S. & Smits, R. 2007, "Functions of innovation systems: A new approach for analysing technological change", *Technological Forecasting and Social Change,* vol. 74, no. 4, pp. 413-432.

Iizuka, M. 2013, "Innovation systems framework: still useful in the new global context?", *Innovation,* , pp. 005.

Interview Outline:

1. Introduction
    a. What is your name?
    b. Which area are you from?
    c. Describe the project you are working on
2. Motivation
    a. Why did you start the project?
    b. What do you want to achieve through the project
        i. For your community?
        ii. For yourself?
    c. Why did you enter innovate SA?
        i. Open question
        ii. What was the role of:
            1. The prize?
            2. Meeting new people?
            3. Competing?
            4. Having an opportunity to solve the challenge that your project solves?
            5. Receiving recognition for your project?
            6. Being a part of innovate SA?
    d. Which incentive would most valuable to do a project like this?
        i. Open question
        ii. Cash
            1. For the project
            2. For you
            3. Would a larger cash prize be more appealing?
        iii. A trip
        iv. Networking opportunities
        v. Mentorship
        vi. A well recognized award for your CV
        vii. A certificate to verify the skills that you have obtained
        viii. Anything else?

3. Barriers and Enablers
    a. People
        i. Who helped you with the project?
        ii. How were they helpful?
        iii. What helped you to connect with these people?
    b. Spaces
        i. Where did you usually meet to work on your project?
        ii. Were there disadvantages in meeting there?
            1. If so, what were they?
            2. Where else would you prefer to work?
                a. Why don't you work there?
        iii. How long does it take you to get to the city centre?
        iv. How often do you usually go?
        v. Do you feel like you can are welcome to work in the city centre?
        vi. Did having events in the city centre help you in any way?
        vii. How do the following factors affect your creativity?
            1. Noise
            2. Busyness
            3. Safety
            4. Quality of facilities
    c. Education
        i. What did you learn doing this project?
        ii. Are you taught these skills at school?

iii. Have you ever done a project like this before?
iv. How did your local knowledge help you?
v. What do you need to learn to help you with this project?

d. Resources
    i. Facilities
        1. Do you have computer access with internet?
        2. Did you have physical workshops available to you?
    ii. Funding
        1. What were the major initial costs for your project?

e. Mindset
    i. Who do you feel is ultimately responsible to solve the challenge that you are solving?
    ii. Have your confidence levels increased?
        1. If so, what caused that?
    iii. How do you define innovation?
        1. Do you think that failure is acceptable?

f. Further opportunities
    i. Are you aware of any other initiatives or programs that could support your project at its current stage of development?
        1. If so, have you been assisted by them in any way?

g. Open question
    i. Is there anything else you would like to share?

Information Sheet and Consent Form for Interview with innovate SA Participants

Hello, my name is Stefan Louw and I am conducting research towards a masters degree at the Energy Research Centre, University of Cape Town. I am researching how to enable innovation processes in low-income communities in Cape Town and would like to invite you to participate in the project.

I am interested in finding out the motivations, drivers and barriers young innovators experience in low-income communities in Cape Town. I am asking the winners of the Innovate SA program about their experience to identify the factors that contributed to their success stories. I would like to get a better understanding of what causes and motivates youth to start innovative projects that are aimed at community upliftment, as well as what helps or prevents these projects from becoming successful. From this understanding I hope to inform education programs, innovation and entrepreneurial competition designers and government policy on these innovation processes to improve their practices in order to help youth implement these innovative projects.

Please understand that you do not have to participate, i.e. your participation is voluntary. The choice of participation is yours alone. If you choose to not participate, there will be no negative consequence. Note that this research will not influence the outcome of the innovate SA program in any way. If you choose to participate, but wish to withdraw at any time, you will be free to do so without negative consequence. However, I would be grateful if you would assist me by allowing me to interview you.

The interview should take no longer than one hour of your time. An audio recording of the interview will be done which will be written into a transcript. You will be sent a copy of the transcript once it is completed. The transcript and recording will not be shared with any third party. Please give your permission for this by signing below.

All of your answers, including personal information, will be kept anonymous. If your personal details are used or your comments are quoted you will be contacted in order to obtain permission to do so.

Participant's Name: **Parent's Name:**
Signature: **Parent's Signature:**

h. **ADDENDUM 2:** To be completed if you answered YES to Question 2:

It is assumed that you have read the UCT Code for Research involving Human Subjects (available at http://web.uct.ac.za/depts/educate/download/uctcodeforresearchinvolvinghumansubjects.pdf) in order to be able to answer the questions in this addendum.

2.1 Does the research discriminate against participation by individuals, or differentiate between participants, on the grounds of gender, race or ethnic group, age range, religion, income, handicap, illness or any similar classification?	YES X	NO
2.2 Does the research require the participation of socially or physically vulnerable people (children, aged, disabled, etc) or legally restricted groups?	YES X	NO
2.3 Will you not be able to secure the informed consent of all participants in the research? (In the case of children, will you not be able to obtain the consent of their guardians or parents?)	YES X	NO
2.4 Will any confidential data be collected or will identifiable records of individuals be kept?	YES	NO X
2.5 In reporting on this research is there any possibility that you will not be able to keep the identities of the individuals involved anonymous?	YES	NO X
2.6 Are there any foreseeable risks of physical, psychological or social harm to participants that might occur in the course of the research?	YES	NO X
2.7 Does the research include making payments or giving gifts to any participants?	YES	NO X

If you have answered YES to any of these questions, please describe below how you plan to address these issues:

The participants are youth aged 16-20. All participants have a good understanding of English. Informed consent will be obtained from the participants and their parents.

I will be conducting the research and am also the program manager of the innovate SA competition. I am, therefore, familiar with the communities involved having done previous work in them. I have worked with the research participants periodically since May 2014 when they entered the competition. My role is to oversee the competition process as well as to work closely with the teams and mentors to help them with their projects.

The participants come from low-income areas in Cape Town. All participants are from the innovate SA competition and are already aware that they have been chosen to participate in the competition in order to solve challenges in low-income areas in Cape Town.

ADDENDUM 3: To be completed if you answered YES to Question 3:

3.1 Is the community expected to make decisions for, during or based on the research?	YES	NO X
3.2 At the end of the research will any economic or social process be terminated or left unsupported, or equipment or facilities used in the research be recovered from the participants or community?	YES	NO X
3.3 Will any service be provided at a level below the generally accepted standards?	YES	NO X

If you have answered YES to any of these questions, please describe below how you plan to address these issues:

ADDENDUM 4: To be completed if you answered YES to Question 4

4.1 Is there any existing or potential conflict of interest between a research sponsor, academic supervisor, other researchers or participants?	YES	NO
4.2 Will information that reveals the identity of participants be supplied to a research sponsor, other than with the permission of the individuals?	YES	NO
4.3 Does the proposed research potentially conflict with the research of any other individual or group within the University?	YES	NO

If you have answered YES to any of these questions, please describe below how you plan to address these issues: