

**THE SOCIAL INNOVATION SYSTEMS APPROACH FOR SUSTAINABLE DEVELOPMENT IN
AN AFRICAN URBAN INFORMAL SETTLEMENT**

Dissertation

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by

HLOKOMA MANGQALAZA



Supervisor:

Prof Josephine Kaviti Musango

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Abstract

Seeking innovative approaches to addressing social problems demands creative activities that differ from those associated with improved financial processes and the introduction of technologies to industrial ventures mainly intended for economic spinoffs – although there are some innovations intended for social transformation through collective action that are still related to technological and entrepreneurial initiatives. Other ways of seeking improved socioeconomic prospects and development activities in disadvantaged communities have resulted in a greater population shift to urban areas. This tends to result in socioeconomic challenges such as overpopulation, poor access to social services (housing, electricity and water) and unemployment. The social complexities that result from large-scale migration to urban areas demand radical, innovative solutions and methods that can cut across the adverse effects of development on the environment, while also addressing socioeconomic challenges in complex communities such as informal settlements. In 2016, the United Nations (UN) identified sustainable development goals (SDGs) as one of the radical approaches to address socioeconomic challenges in complex communities such as informal settlements. This study presents the argument that, to achieve sustainable development goals in African urban informal settlements, the actors involved in the process should function as social innovation systems. The literature reviewed for this work advocated a framework that focused on the spatial, economic/entrepreneurial, interactive and firm- or industry-level aspects from which innovative activities stem in theory and practice in urban informal settlements. Findings from the literature reviewed demonstrated that objectives of social innovation systems resonated with the sustainable development goals in African urban informal settlements. For this study, interviews, focus groups, observations, documentation and archival records were employed to gather evidence on the iShack project social innovation system case study. The iShack Project was identified as a social innovation initiative whose main function was to provide electrical power in the form of renewable energy (solar panels) at Enkanini informal settlement in Stellenbosch in the Western Cape province of South Africa. Empirical evidence revealed that the social innovation system established through the iShack Project occurred in different phases, namely the initiation, intermediary and stability phases. A top-down intervention was implemented during the initiation and intermediary phases. These phases relied predominantly on research development, availability of science and technology, and interaction and trust established between the organisations and institutions at local, regional and national level. The participants' ease of access to resources and services of the iShack Project ensured the sustainability of this social innovation system for the community. Institutional bottom-up interventions were also operative during the initiation, intermediary and stability phases. Perceptions gathered from the beneficiaries and providers of the innovation further revealed that addressing a social problem could simultaneously result in long-term and temporary solutions, and that income generation for the iShack project was mostly necessary to take care of financial obligations (such as salaries). Lastly, findings revealed that the social innovation system established through the

iShack Project was instrumental in addressing social challenges, which resulted in the realisation of more sustainable goals that were beyond the scope of providing energy. This work contributes to existing literature by identifying a social innovation system that can be applied to address sustainable development goals in a typical African urban informal settlement.

Keywords: social innovation, social innovation systems, informal settlements, African urban informal settlements, sustainable development goals, sustainable development

Opsomming

Op soek na innoverende benaderings om sosiale probleme aan te spreek, vereis innoverende aktiwiteite wat verskil van dié wat geïdentifiseer is met verbeterde finansiële prosesse en die bekendstelling van tegnologieë vir nywerheidsondernemings wat hoofsaaklik bedoel is vir ekonomiese spinoffs. Sommige innovasies wat bedoel is vir sosiale transformasie deur kollektiewe aksie is egter steeds verwant aan tegnologiese en entrepreneuriese inisiatiewe. Ander maniere om verbeterde sosio- en ekonomiese vooruitsigte en ontwikkelingsaktiwiteite in benadeelde gemeenskappe te soek, het gelei tot 'n groter bevolkingsverskuiwing na stedelike gebiede. Dit lei tot sosio-ekonomiese uitdagings soos oorbevolking, swak toegang tot maatskaplike dienste (behuising, elektrisiteit en water) en indiensneming. Die sosiale kompleksiteite wat voortspruit uit migrasie in stedelike gebiede, vereis radikale, innoverende oplossings en metodes wat die negatiewe gevolge van ontwikkeling op die omgewing kan sny, maar ook sosio-ekonomiese uitdagings in komplekse gemeenskappe soos informele nedersettings aanpak. In 2016 het die Verenigde Nasies (VN) volhoubare ontwikkelingsdoelwitte (SDG's) geïdentifiseer as een van die radikale benaderings om sosio-ekonomiese uitdagings in komplekse gemeenskappe soos informele nedersettings aan te spreek. Hierdie studie beweer dat, ten einde volhoubare ontwikkelingsdoelwitte in Afrika-stedelike informele nedersettings te bereik, die betrokke rolspelers as sosiale innovasiestelsels moet funksioneer. Die literatuur wat vir hierdie werk hersien is, het 'n raamwerk aanbeveel wat op die ruimtelike, ekonomiese / entrepreneuriese, interaktiewe en firma- of industriële vlak fokus, waaruit innoverende aktiwiteite in teorie en praktyk in stedelike informele nedersettings strek. Bevindinge uit die literatuur wat getoets is, het getoon dat die doelstellings van sosiale innovasiestelsels met volhoubare ontwikkelingsdoelwitte in Afrika-stedelike informele nedersettings gerangskik is. Empiriese bewyse is ingesamel deur middel van onderhoude, fokusgroepe, waarnemings, dokumentasie en argiefrekords wat die iShack Project se sosiale innovasiestelsel gevallestudie ingelig het. Die iShack-projek is geïdentifiseer as 'n maatskaplike innovasie-inisiatief waarvan die hoof funksie energie in die vorm van hernubare energie (sonpanele) by Enkanini informele nedersetting in Stellenbosch, Wes-Kaap Provinsie, verskaf. Bevindinge van die empiriese bewyse het aan die lig gekom dat die sosiale innovasiestelsel wat deur die iShack-projek gestig is, in verskillende fases die inisiatief fase, tussenganger en die stabiliteitsfase plaasgevind het. onderste ingryping vir organisatoriese en institusionele ondersteuning. Die top-down intervensie was instrumenteel tydens die inisiëring en intermediêre fases. Die inisiatiewe en tussengangerfases was hoofsaaklik gebaseer op navorsingsontwikkeling, beskikbaarheid van wetenskap en tegnologie, interaksie en vertroue tussen plaaslike organisasies en instansies op plaaslike, streeks- en nasionale vlak. Die maklike toegang van enkanini-gemeenskapslede tot hulpbronne en dienste van die iShack-projek het die volhoubaarheid van die sosiale innovasie (iShack-projek) vir die gemeenskap verseker. Institusionele bottom-up intervensie was ook instrumenteel tydens die inisiasiefase, die intermediêre en stabiliteitsfases. Persepsies wat by die begunstigdes ingesamel is en die verskaffers van die innovasie

het verder aan die lig gebring dat die aanspreek van 'n sosiale probleem gelyktydig kan lei tot 'n langtermyn- en tydelike oplossing. Literatuur oor die sosiale innovasiestelsel het die belangrikheid daarvan gewys om selfs vir die sosiale innovasie-inisiatief te breek. Die bevindinge van hierdie studie het egter getoon dat die generering van inkomste vir die iShack-projek meestal nodig was om finansiële verpligtinge (soos salarisse) te verseker. Laastens, bevindinge het getoon dat die sosiale innovasiestelsel wat deur die iShack-projek gestig is, instrumenteel was in die aanspreek van sosiale uitdagings, wat gelei het tot die verwesenliking van meer volhoubare doelwitte wat buite die omvang van die verskaffing van energie was. Hierdie werk het bygedra tot bestaande literatuur deur 'n sosiale innovasiestelsel te identifiseer wat toegepas kan word om volhoubare ontwikkelingsdoelwitte in 'n tipiese Afrika-stedelike informele nedersetting aan te spreek.

Sleutelwoorde: Sosiale innovasie, sosiale innovasiestelsels, informele nedersettings, Afrika stedelike informele nedersettings, Volhoubare Ontwikkelingsdoelstellings, volhoubare ontwikkeling

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List of abbreviations

AIDS	acquired immunodeficiency syndrome
BMGF	Bill and Melinda Gates Foundation
CBD	central business district
DBSA	Development Bank of Southern Africa
DEA	Department of Environmental Affairs
ERC	Enkanini Research Centre
HIV	human immunodeficiency virus
ICA	International Co-operative Alliance
ILO	International Labour Organisation
KDF	Kayamandi Development Forum
LPG	liquid petroleum gas
MDGs	millennium development goals
NGC	new generation cooperative
NGO	non-governmental organisation
NIS	national innovation systems
OECD	Organisation for Economic Co-operation and Development
RIS	regional innovation systems
SDGs	sustainable development goals
SDI	Slum Dwellers International
SIS	social innovation systems
SSS	specialised solar system
TIS	technological innovation system
UISP	Upgrading Informal Settlement Policy
UN	United Nations

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Chapter 1: Introduction

1.1 Background of the study

Addressing complex problems such as urbanisation and the lack of social services in informal settlements requires innovative and contextualised solutions and approaches (Kraemer-Mbula & Wamae, 2010:65). Innovative ideas were initially perceived as instruments that ensure long-term technological and entrepreneurial activities (Alic & Sarewitz, 2016; Metcalfe & Ramlogan, 2008; Nauwelaers, Maguire & Marsan, 2013). The conversation and perspectives on innovative activities became prominent in the 1930s through the work of Joseph Schumpeter, who referred to ‘innovation’ as the introduction of new or improved methods of entrepreneurship, and through the allocation of resources in response to economic changes (Drejer, 2004; O’Sullivan, 2005). Improved entrepreneurial and resource allocation is closely linked to improved financial processes and the introduction of technologies to industry or measures that have economic spinoffs (Drejer, 2004; O’Sullivan, 2005). For a long time, the debate on innovative ideas has narrowly focused on industry-related activities and constraints, neglecting socially inclined innovation activities.

According to Harrisson, Klein and Browne (2010), social transformation through collective action is an important act and outcome of social innovation. Cahill (2010) defines social innovation as an initiative, product, process or programme that profoundly changes the basic routines, resource and authority flows and beliefs of any social system such as families, organisations, neighbourhoods, communities and whole societies. Social innovation relates to interventions that aim to improve or overcome complex social problems and challenges (Huddart, 2012; Martin & Upham, 2016).

The concept has since been widely defined owing to increased interests in social problems that require *social innovation* (Harrisson *et al.*, 2010; Mulgan, Tucker, Ali & Sanders, 2007). Several scholars have submitted that innovations are executed through systems (Edquist, 2011; Soete, Verspagen, & Ter Weel., 2010). For instance, Edquist (2011) argues that a system that drives innovation contains all the determinants of the innovation process. These include economic, social, political, organisational, institutional determinants and other factors influencing the development, diffusion and use of innovation in organisations and institutions. A vast amount of literature on innovation systems has thus far been produced according to sector and delineation, with only limited scholars focusing on innovation systems intended to address complex social problems (Fulgencio & Fever, 2016; Huddart, 2012).

Finding innovative approaches to addressing social problems demands creative activities that differ from those identified with improved financial processes and the introduction of technologies to industry or means that have economic spinoffs. Some of the approaches seeking improved social and economic prospects, coupled with development activities in disadvantaged communities, have resulted in large sections of the population moving into urban areas. Such influxes into urban areas have spurred the development of informal settlements, thereby putting a strain on urban resources. Such activities are common in countries such as South Africa and Kenya giving rise to informal settlements such as Khayelitsha in Cape Town and Kibera in Nairobi (Justo &

McCauley, 2017; Urama & Acheampong, 2013). In such instances, the supply of social resources such as water, land and recreational services tends to be affected owing to the unplanned nature of informal settlements. The effects of global warming, climate change and an increase in population in poor regions such as rural areas and informal settlements are some of the complex challenges that have adversely affected quantities and availability of natural resources and thus the delivery of social services such as water, and affordable and adequate food supplies. Such situations demand radical innovative solutions and methods that cut across the adverse effects of development on the environment.

While Gong, Liang, Carlton, Jiang, & Wu (2012) simply define urbanisation as the migration of rural populations to urban areas, Cobbinah, Erdiaw-Kwasie & Amoateng (2015) describe urbanisation as a more complex demographic, ecological, sociological and economic phenomenon that results in a concentration of the population in urban areas. Zasada, Fertner, Piorr, & Nielsen (2011) define a different form of urbanisation, namely peri-urbanisation, as the physical expansion of settlement areas, but they also attribute such expansion to socioeconomic transformation, which results in major spatial developments beyond urban fringes. Urbanisation has the potential to stimulate or hinder the growth and development of areas such as towns, cities, metropolises, megacities and megalopolises in both developing and developed countries (Cobbinah *et al.*, 2015).

Urban areas tend to provide better economic and social opportunities than rural and peripheral areas (Cohen, 2006). Urbanisation has been a characteristic of African countries, as well as of many other developing countries in Asia, the Pacific, Latin America, and the Middle East prior to the 1950s (Cohen, 2006; Zhang, 2016). For over 50 years, vast numbers of the population from the rural areas have migrated to the urban areas for better livelihoods (Cohen, 2006). Recent evidence further suggests that the rapid rate of urbanisation has resulted in both negative and positive results in urban areas (Cobbinah *et al.*, 2015; Zhang, 2016).

The increased pressure on urban resources, due to the rapid rate of urbanisation, further results in suburbanisation – the formation of suburbs – that affects employment opportunities. Migration to and increasing population in urban areas, as well as the inability of the urban infrastructure to contain or sustain the growing urban population, result in the continuous spread of informal dwellings (Cobbinah *et al.*, 2015; Zhang, 2016). These dwellings, which are the physical representation of urban sprawl, are usually in the urban outskirts and are usually a distance from the main economic hub, being the inner city or central business district (CBD) (Cobbinah *et al.*, 2015).

This urban sprawl is not only affected by the influx of people from rural areas; the increase in the urban population is also affected by larger urban accumulation resulting in suburbanisation. Zhang (2016) refers to suburbanisation as the dispersion of urban population and employment opportunities from the city centres to the periphery. Suburbanisation results in the increased demand for affordable social and economic infrastructure in the form of transport, housing and other social services. The urban influx or rural-to-urban migration tends to result in a hostile political climate that is partly aggravated by adverse social, economic and environmental conditions in urban areas (Cobbinah *et al.* 2015; Zhang, 2016). This sudden increase in

population caused by migration further affects spatial zoning, and thus having negative knock-on effects in the economic provision of basic services.

According to Cobbinah *et al.* (2015), the population of rural-to-urban migrants in developing countries such as South Africa, Iran, Zambia, Senegal, Gabon, Botswana and Colombia has doubled from 1950 to 2000 from 18% to 40%. It is expected to exceed 50% by 2020, and 64% in 2050 (Cobbinah *et al.*, 2015). Urbanisation in Africa has resulted in informal urban settlements that range between planned and unplanned, legal and illegal, formal and informal (Smit, Musango, Kovacic & Brent, 2017). These urban informal settlements have both sustainable and unsustainable development effects. Cobbinah *et al.* (2015) and Swilling (2016) describe the positive factors of urbanisation as the key to Africa's urban development, which further demonstrates a strong overlap with sustainable development. Urbanisation drives sustainable development through economic growth and centres of integration for human and entrepreneurial resources that spur new ideas, innovation and technologies that are necessary for promoting sustainable and productive utilisation of resources (Cohen, 2006).

The “unplanned, illegal or informal nature” of urbanisation has been coupled with rather complex or negative factors that have created unsustainable conditions of urbanisation (Amuda, Adebisi, Jimoda & Alade 2014). The erosion of resources due to the influx of population in urban areas interferes with the sustainability of bio-physical, human resources and social services, resulting in socioeconomic challenges. The unsustainable patterns of urbanisation, among other factors, have resulted in the formation of informal settlements or dwellings; social ills caused by high rates of unemployment; high levels of poverty; insecurity; and erratic provision of water and sanitation (Cohen, 2006; Zhang, 2016). The negative factors of urbanisation have furthermore eroded socioeconomic and environmental benefits through unmanageable human activity (Cobbinah *et al.*, 2015).

Urban migration is an alternative to a life of poverty, unemployment and poor social services for migrants. However, it has not proved to be a sustainable option for the urban environment and society (Cobbinah *et al.*, 2015; Cohen, 2006; Zhang, 2016). There are urban socioeconomic objectives that remain unsustainable in urban informal settlements. In an effort to meet the needs of the world's poorest, and to address the socioeconomic challenges, such as the ones that stem from urbanisation, the United Nations (UN) formulated the millennium development goals in order to fight poverty from 2000 to 2015, particularly in developing countries (Griggs Stafford-Smith, Gaffney, Rockström, & Öhman, 2013; Ware, 2011). The millennium development goals (MDGs) focused on eight international developmental goals that were implemented from 2000 until 2015, and are as follows: (i) to eradicate extreme poverty and hunger; (ii) to achieve universal primary education; (iii) to promote gender equality and empower women; (iv) to reduce child mortality; (v) to improve maternal health; (vi) to combat HIV/AIDS, malaria, and other diseases; (vii) to ensure environmental sustainability; and (viii) to develop a global partnership for development.

The MDGs largely focused on socioeconomic challenges, and less on the effects of growing human activity on the bio-physical world. This led to the realisation that poor development trajectories not only affect the

social and economic factors of development, but are also detrimental to the political and environmental landscape. Furthermore, the influx of the population into urban areas has adverse effects on the natural resources of urban areas. When the time frame of the millennium development goals ended in 2015, the 17 sustainable development goals (SDGs) (see Figure 1.1) were implemented. The aim of the SDGs is to tackle global social challenges that are rampant in the 21st century. The SDGs were adopted after the target date of the MDGs had been reached in 2015 and became effective in January 2016. The SDGs were predominantly designed to build on the achievements of the MDGs; thereby creating a transformative agenda by balancing the economic, social and environmental objectives. Further, SDGs were developed to deal with the effects of spiralling and complex problems that stem from climate change and insufficient natural resources that cannot fulfil the needs of the growing population. The SDGs are also an integral part of the new international development framework for all countries and will therefore have major implications for their national development planning efforts in the post-2015 period (Allen, Metternicht, & Wiedmann, 2016). This study aimed to couple innovative approaches and environmentally friendly methods to address social problems caused by urbanisation in the developing world. According to Cobbinah *et al.* (2015), a significant increase in population moving into urban centres is expected to cause acceleration in growth in the overall African population in the next decade. This study paid specific focus on urbanisation in the South African context.

Goal 1	•No poverty
Goal 2	•Zero hunger
Goal 3	•Good health and well-being
Goal 4	•Quality education
Goal 5	•Gender equality
Goal 6	•Clean water and sanitation
Goal 7	•Affordable and clean energy
Goal 8	•Decent work and economic growth
Goal 9	•Industry innovation and infrastructure
Goal 10	•Reduced inequality
Goal 11	•Sustainable cities and communities
Goal 12	•Responsible consumption and production
Goal 13	•Climate action
Goal 14	•Life below water
Goal 15	•Life on land
Goal 16	•Peace, justice and strong institutions
Goal 17	•Partnerships for the goals

Figure 1.1: Sustainable development goals

Source: United Nations, 2015.

The SDGs focus on how all countries can collectively achieve a state of global well-being for their present populace and future generations (Schwerhoff & Sy, 2017). There is a shortcoming in the practical operation of these goals as they apply equally to the whole world, with no apparent cognizance of what wealthier nations can do for poorer ones. In fact, wealthier and poorer countries cannot be expected to operate at the same level, because of the unequal endowment of resources. There are aspects of social and economic development that could be tackled in partnership between poorer and wealthier countries, while the wealthier countries could take the lead in others.

The aspect of social inclusion and participation are central to the SDGs (Allen *et al.*, 2016; Schwerhoff & Sy, 2017; Wanyama, 2016). The methods and approaches through which the SDGs are to be achieved will however

be specific to different regions and countries. This is a result of different regions being faced with unique and localised challenges. The way economic growth and environmental sustainability are balanced varies in different countries. In all the uniqueness of regions, inclusion and the participative behaviour of the actors is therefore central to the sustainability of this initiative (Degert, Parikh & Kabir, 2016; Stattman & Mol, 2014; Rasul, 2016). This study presents the argument that social innovation systems are fundamental to achieving sustainable development goals in urban informal settlements in the African context.

1.2 Some of the existing approaches to achieving development goals

Societies that operate as a system through a well-connected network to achieve a specific purpose ensure maximum participation, collaboration and information sharing (Läpple, Renwick, Cullinan & Thorne, 2016; Powell & Grodal, 2005). With the MDGs period that ended in 2015, there was a natural need for an improved approach to addressing development challenges that would also address the adverse effects of the development patterns and activities on the environment (Allen, Metternicht & Wiedmann, 2016; United Nations, 2016). The SDGs largely focused on building on the achievements, and correcting the shortcomings, of the MDGs through establishing a transformative agenda that prioritises the integration and balance of the economic, social and environmental objectives (Allen *et al.*, 2016; Angelidou & Psaltoglou, 2017; Hák, Janoušková & Moldan, 2016).

The 17 SDGs listed in Figure 1.1 prioritise social challenges and economic poverty without inflicting harm on the environment – a modernised, pragmatic approach ensuring the successful implementation of the SDGs to be employed. There are various forms of institutions¹ that have been used to achieve development objectives resonating with the MDGs. These organisations or institutions are non-governmental organisations (NGOs)², associations³, unions and mutual societies⁴. Certain studies have however revealed cooperatives and non-governmental organisations were some of the popular engines through which the MDGs were implemented (Bacon, Ernesto Mendez, Gómez, Stuart, & Flores, 2008; Esim, 2014; Kilby, 2006). Table 1.1 on the next page lists the 12 proposed SDGs that could be achieved through cooperatives as suggested by the High-Level Panel of Eminent Persons in the post-2015 development agenda (Wanyama, 2016). Cooperatives are voluntary social institutions established predominantly to combat poverty, inequality, hunger and unemployment, especially in poor communities (International Labour Organisation, 2015). Furthermore, the survey findings of Simmons and Birchall (2008) and Majee and Hoyt (2011) on the International Labour Organisation (2015) reveal that cooperatives have been some of the instrumental actors in the execution of some of the MDGs, such as poverty

¹ Institutions, as used in this context, encompass organisations (both national and international), the stakeholders who interact with them, the processes by which they reach decisions and which have an impact on progress towards sustainable development, and the activities they undertake to implement their goals. This includes multilateral agreements on economic, social and environmental issues, and domestic legislative instruments (OECD, 2001).

² A non-governmental organisation (NGO) is a citizen-based association that operates independently of government, usually to deliver resources or serve some social or political purpose (<http://whatis.techtarget.com/definition/NGO-non-governmental-organization>). [Remove underlining of URLs throughout]

³ An association is a gathering of people for a common cause or purpose (<http://www.businessdictionary.com/definition/association.html#ixzz4KyaGIBbA>).

⁴ A mutual society is an organisation owned by its members and managed for their benefit, such as a building society or friendly society (<http://www.businessdictionary.com/definition/mutual-society.html#ixzz4KyZivYjF>).

eradication, gender inequality, environmental sustainability, job creation and establishing global partnerships for development (Majee & Hoyt, 2011; Wanyama, 2014). Cooperatives have however not been entirely successful in combating hunger, inequality, poverty and unemployment, which are all factors related to the millennium development goals (Birchall, 2004; Esim, 2014; Twalo, 2012). This is evident from the reported significant failure of cooperatives in areas, particularly in developing countries, where pressing socioeconomic constraints persist (Bacon *et al.*, 2008; Birchall, 2004; Twalo, 2012).

Table 1.1: The illustrative United Nations sustainable development goals, as proposed by the High-Level Panel of Eminent Persons on the post-2015 Development Agenda

1.	End poverty
2.	Empower girls and women and achieve gender equality
3.	Provide quality education and lifelong learning
4.	Ensure healthy lives
5.	Ensure food security and good nutrition
6.	Achieve universal access to water and sanitation
7.	Secure sustainable energy
8.	Create jobs, sustainable livelihoods and equitable growth
9.	Manage natural resource assets sustainably
10.	Ensure good governance and effective institutions
11.	Ensure stable and peaceful societies
12.	Create a global enabling environment and catalyse long-term finance

Source: Wanyama, 2016

In most developing countries, such as Indonesia, India, Bangladesh, Philippines, Tanzania, Malawi, South Africa and Mozambique, cooperatives are some of the engines through which MDGs such as poverty alleviation, elimination of inequality and improving overall health of communities were executed (Bacon *et al.*, 2008; Birchall, 2004; Oluwatayo, 2009; Task Force on Health Systems Research, 2004; Ware, 2011; Yadoo & Cruickshank, 2010). However, Birchall (2004), Twalo (2012), Esim (2014) and Fryatt, Mills, A. & Nordstrom (2010) illustrated that the resilience of cooperatives has been poor, with these bodies having been unreliable engines for achieving millennium development goals.

Firstly, the expected outcomes of cooperatives were largely hindered by their organisational and institutional structures which tended to straddle capitalistic and non-profit socially driven initiatives that created obstacles for the sustainability of the entities (Chibanda,Ortmann & Lyne., 2009; Stofferahn, 2009; Nilsson, 2001; Ortmann & King, 2007; Twalo, 2012). Chibanda *et al.* (2009) refer to the cooperatives institutional and organisational arrangements as the dominant contributing factor to the significantly low levels of equity and debt capital, dependence on public funding, poor investment levels and loss of members. Governance problems attached to these entities were related to the low levels of confidentiality, low levels of education, absence of

production and management skills, and poor marketing arrangements that ultimately fed into low returns to members and beneficiaries. Secondly, the uncertain organisational arrangements of cooperatives fed into the unclear objectives of the cooperatives in terms of membership and beneficiaries that were usually subject to membership fees and contributions to members only and not to the community at large (Majee & Hoyt, 2011; Twalo, 2012). Thirdly, the International Labour Organisation report on the engagement of the cooperative movement in sustainable development further indicated the poor government support for cooperatives, the cooperatives' limited engagement with global objectives and the persistent misconceptions of the cooperative business model among employers' organisations such as trade unions and research institutions (Esim, 2014). Owing to the above-mentioned shortcomings, cooperatives have been deemed irrelevant for socioeconomic development and the SDGs pertaining to such development. In the light of the inconsistencies, inadequacy and poor achievement of the lasting aspirations of the MDGs, a new model had to be employed to augment them – hence the setting of the SDGs. The International Labour Organisation, together with the International Cooperative Alliance, has identified 12 SDGs which can be achieved through cooperatives (Wanyama, 2016), as illustrated in Table 1.1.

NGOs, as vehicles used to achieve development objectives resonating with the millennium development goals, were entities known and expected to be trustworthy drivers of development initiatives (Kilby, 2006). This was due to their long-term commitment to providing relief for development-related challenges across countries through financial aid, social services and training. NGOs continue to offer relief in various forms, including social services for disaster-stricken areas, environmental assistance, structural aid for civil society and governance. However, NGOs have also faced several challenges that have hindered their expected contribution through their purposes, processes, systems and therefore their outcomes (Collingwood, 2006; Kilby, 2006; Stoddard, 2003).

Firstly, NGOs offer long-term relief to their beneficiaries, thus offering sustainable solutions (Aksel & Baran, 2006; Kilby, 2006). However, this is contrary to the argument of Stoddard (2003) and Banks Hulme & Edwards (2015) on the sustainability of NGO interventions, which alludes to their undefined terms of involvement. Stoddard (2003) substantiates this by making use of United States NGOs that recalled their funding to other countries for sustainable development and humanitarian purposes in order to prioritise their own country's challenges, such as the September 11 and Haiti disasters. In this way, NGOs may not necessarily provide the needed long-term solutions required for sustainable development challenges. Sustainable development entails ensuring long-term solutions.

Secondly, at times NGOs tend to be selective. Therefore, NGOs would not unconditionally serve the beneficiaries' interests. Instead, their objectives take precedence over those of the beneficiaries, based on the NGOs' convenience (Banks *et al.*, 2015; Brass, 2012; Stoddard, 2003). For example, the conditional intervention of NGOs is also evident in Brass's (2012) survey that was conducted on 4 210 NGOs in 70 districts of Kenya. The study revealed that NGOs are likely to establish themselves in communities where it is convenient for them to reach their beneficiaries.

NGOs tend to intervene when government fails to deliver social services to citizens. For this reason, NGOs have been viewed as government whistle-blowers. This therefore places NGOs in conflict with the host government. NGOs also tend to present Western policies and solutions that conflict with local problems for southern countries. These policies, solutions, systems and approaches result in implementation challenges in foreign cultures. In such instances, NGOs are most likely to attempt to persuade key actors in government and in the private sector to change policies or systems for their convenience (Banks *et al.*, 2015; Collingwood, 2006). In some instances, NGOs may collaborate with government of the host country only to influence policies that are expedient for their own objectives (Collingwood, 2006). Owing to the persuasive, top-down and coercive nature of NGOs, they would be unlikely to spur cooperative and well-governed sustainable development – which has more to do with the 17th SDG (refer to Figure 1.1).

According to Sachs (2012), Schwerhoff and Sy (2017) and Hák *et al.* (2016), the sustainable development goals, unlike the millennium development goals, strongly rely on good governance entailing all levels of government and relevant actors in the development process. Therefore, all spheres of governance – local, national and regional – were deemed sustainable if they were able to balance global effects of development with local, national and regional goals. Through the 17th sustainable development goal, the UN further stresses that sustainable development-related efforts and objectives entail ensuring that external support from private and public sources at national, regional and international level is secured (United Nations, 2015).

1.3 Social innovation systems for sustainable development goals thus far: The departure point

Figure 1.2 below situates social innovation systems within the overall innovation system based on Fulgencio and Fever's (2016) framework of a social innovation system. The first triangle on the left shows the spatial dimensions, while the right triangle depicts economic activities of the innovation system according to order of rank. In the second triangle, on the right-hand side, social is above the other forms of innovation systems to illustrate that the social aspect of the innovation system was the dominant component of the innovative activity of a social innovation system. This is because it hierarchically highlights the collective needs of the society above individual benefits. The focal point of social innovation systems, as concluded by Fulgencio and Fever (2016), is therefore the role of society as defined through the different social actors. The arrows in between the two triangles illustrate that the innovation systems depicted in the two triangles are complementary, and the social innovation system that is in its early stages would evolve over time. Thus, theoretically, social innovation systems are based on non-profit (or breakeven) activities and outcomes, unlike the other types of innovation systems depicted in Figure 1.2, which focus more on economic activities and commercial outcomes.

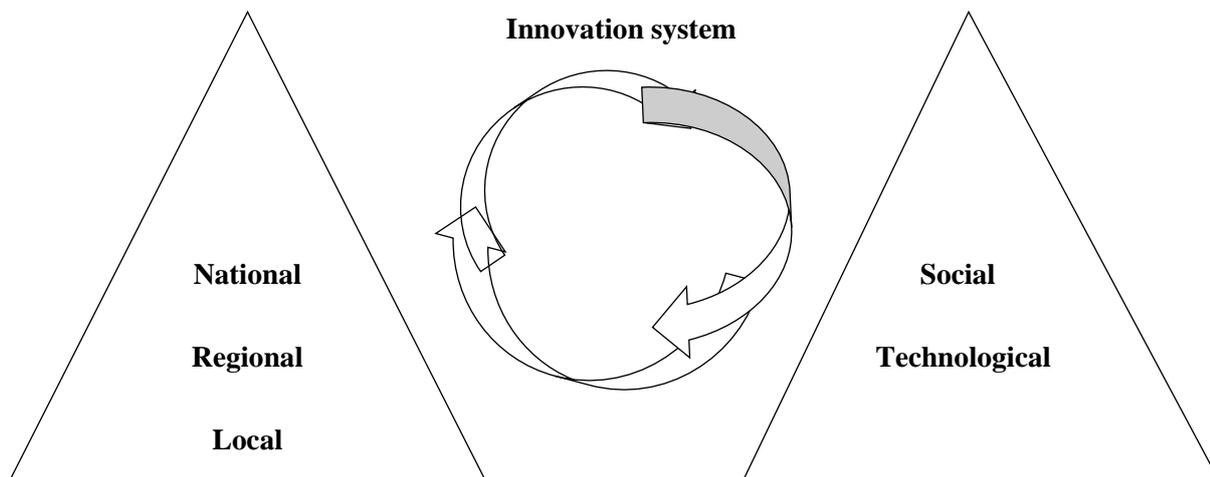


Figure 1.2: Complementary spatial and focus-oriented innovation system

Source: Fulgencio and Fever, 2016.

This study sought to present an alternative approach for the implementation of the SDGs in addressing societal-level challenges, using Fulgencio and Fever's (2016) framework of social innovation systems. Just like the approaches used to implement and execute SDGs, as discussed above by Kanter, Schwoob, Baethgen, Bervejillo & Carriquiry (2016), Rasul (2016), Schwerhoff and Sy (2017), Allen *et al.* (2016) and Janowski (2016), the social innovation systems approach is still at a premature stage. Specifically, the social innovation systems approach is still at a theoretical, contextual, and methodological level with limited empirical work related to the execution of socioeconomic challenges in developing regions. This work therefore expands on the social innovation systems framework and attempts to assess its applicability to an African urban informal settlement.

Owing to the premature nature of the social innovation systems framework, its current applicability only acknowledges the economic and spatial innovation system at societal level (Kraemer-Mbula & Wamae, 2010; Kraemer-Mbula & Wunsch-Vincent, 2016). Cozzens and Sutz (2012) used the framework for informal settlements but only went as far as identifying innovation activities in informal markets. To develop, grow and understand the applicability of the social innovation systems framework, it is important to acknowledge how social challenges manifest in complex societies or communities and appreciate the complexities of addressing them. The current study argues for a wider approach based on social innovation systems to address social challenges in complex communities such as informal settlements through the implementation of the SDGs.

1.4 Problem statement

Extant studies focusing on the implementation and achievement of SDGs have thus far been both sector- and country-specific (Kanter *et al.*, 2016; Mugagga & Nabaasa, 2016; Schwerhoff & Sy, 2017). Others by Kanter *et al.* (2016), Mugagga and Nabaasa (2016), Schwerhoff and Sy (2017) and Janowski (2016) largely focus on the implementation of the SDGs at macro level or from top down, in that the implementation is executed from

organisational and institutional level. However, Rasul (2016) and Schwerhoff and Sy (2017) developed a framework approach based on the use of resources to implement a SDG but gave rise to spinoffs resulting in the achievement of more than one SDG. Through this approach, Rasul (2016) identified the increasing challenges in meeting the demand for food in South Asia, which overlapped the demand for water and energy. Thus, Rasul's framework approach suggests cross-sectional coordination and management for the interconnected challenges. His study found that the growing need for food could not be met without addressing the issues of insufficient provision of water and energy. Therefore, the aspect of the macro-level focus refers to how the existing work referred to in this paragraph adopts a holistic approach to addressing social challenges by achieving SDGs. This is done by the lack of focus on a specific actor and type of setting in which the SDGs are achieved.

The framework approaches of Kanter *et al.* (2016), Janowski (2016), Rasul (2016) and Schwerhoff and Sy (2017) were however not adequate for the implementation of the SDGs because they were biased towards either a certain sector, such as agriculture, or science and technology infrastructure that were country-specific and operated at macro level using top-down approaches. Furthermore, the macro level and country-specific approaches by Schwerhoff and Sy (2017), Janowski (2016) and Kanter *et al.* (2016) took an umbrella approach without considering different characteristics of a country's regions.

Allen *et al.* (2016) identified different quantitative models with the potential to support national development planning processes for the SDGs. However, the model established could not apply to all 17 SDGs as it was based on a top-down approach with biases towards long-term national level goals. The models with bottom-up approaches on the other hand were sector-focused and supported detailed impact analysis of solid interventions, technologies and investments.

With limitations in all the proposed approaches discussed above, it is evident that there is a gap in terms of establishing a suitable approach to implement the SDGs. Most of the approaches for achieving and implementing SDGs identified are largely contextual, and only go as far as the methodological stages. There is consequently a need for a dynamic approach that is applicable to different types of settings in which SDGs are to be executed, rather than merely at national or industrial level. This is because SDGs aim to address developmental challenges at micro level, rather than only at macro level.

As with Schwerhoff and Sy (2017), this study also focused on the renewable energy-related activities, i.e. SDG 7, by applying the social innovation systems approach. However, this study further applied Schwerhoff and Sy's (2017) focus on renewable energy, but expanded this focus to the context of an African setting and informal settlement. This study accounts for the dynamics and complexities of the varied communities within different countries whose social challenges need addressing through achieving SDGs. The social innovation system was introduced to address complex social challenges. According to Fulgencio and Fever (2016), social innovation systems are the interconnectors of things or actors in developing, diffusing, and utilising innovation targeting social issues or needs. The concept of social innovation systems stems from innovative systems whose activities were intended for social benefit. The concept developed to refer to innovations intended to

address social challenges is called social innovation (Harrisson *et al.*, 2010; Moulaert, MacCallum, Mehmood & Hamdouch, 2013; Picciotto, 2015). Social innovation systems are systems⁵ through which social innovative activities are executed by way of inclusive, participatory and bottom-up approaches (Huddart, 2012). A social innovation could be a new product or service provided to address a social problem. For example, the introduction of a cervical cancer vaccination programme for young girls in high school may be perceived as a social innovation. For such a product or service to achieve its intended objective, a relevant social innovation system would be required. The social innovation system would require the interaction of medical institutions and organisations, educational organisations and institutions, and household representatives to perform specific duties to ensure the cervical cancer vaccination can be optimally administered.

Therefore, this study suggests the utilisation of social innovation systems as crucial in tackling societal issues in various industries and settings for various social circumstances, especially in African urban informal settlements such as those highlighted in the 17 SDGs indicated in Figure 1.1. Social innovation systems should preferably consist of more problem-specific, transformative institutions and networks for nurturing, growing and spreading social innovations which will address unique and complex social, economic and environmental problems. To foster social innovation to achieve SDGs, actors are required to engage with the intermediary bodies linking the supply of ideas to effective uses, thereby functioning as social innovation systems.

1.5 Significance of the study

Upon presenting the shortcomings of cooperatives in executing development goals and the suggested potential solutions to address social challenges through SDGs in Section 1.2, it is evident that there is a need for engines that can successfully deliver SDGs. The shortcomings in existing approaches such as cooperatives illustrate the complex nature of socioeconomic problems to be addressed through SDGs. Resilient, innovative and transformative approaches are required that do not purport to be one-size-fits-all solutions. The social innovation systems approach is different from the other approaches proposed to implement SDGs because it accommodates activities in all sectors, without macro-level limitations. Secondly, it is a macro-level-based approach. The problem with macro-level-based approaches is that they do not focus on a specific type of setting or the specificities of the particular social innovation system. Understanding the context in which the social innovation occurs is important in that it can aid in identifying the shortcomings and the specific characteristics of the context in question. A drawback of the current social innovation system is that it does not specify its objectives or the social problems to be addressed.

For any society or community to exist, it needs basic and other essential services. These basic services are water and sanitation, electricity, energy, and refuse and waste removal. In South Africa, the government has committed itself to providing a minimum amount of free water and electricity to poor people. Free sanitation and waste removal services are also to be provided where possible. The South African government policy on basic service provision of electricity and energy, water and sanitation, and refuse and waste removal are a

⁵ A system is an interconnected set of elements that is coherently organised in a way that achieves something (Meadows & Wright, 2008).

means of ensuring that key features of the developmental state are accessible to, provided to, and benefit everyone. It is noteworthy that, in providing these basic services, other aspects of development, such as the environment, are not compromised. Therefore, recycling and renewable energy as facets of innovation are widely interrogated in this study.

Accessing energy, regardless of the form, is one of the main socioeconomic services that has presented obstacles in urban informal settlements in developing countries (Cobbinah *et al.*, 2015; Cohen, 2006). Furthermore, policymakers in many countries have recognised the benefits of renewable energy and its positive impact on energy access, particularly off-grid and mini-grid solutions in rural and other remote areas. Such solutions have served as enablers of healthcare, food security, water access, education, gender equality and job creation (United Nations, 2015). The International Labour Organisation (2015) has also stressed the importance of sustainable energy to sustainable economic growth and sustainable social development. However, this organisation failed to give an indication of the effects of urbanisation on informal settlements.

For the context of this study, the focus was on SDG 7 which concerns affordable and clean energy, to demonstrate how complex social problems could be addressed through social innovation systems. Energy is one of the most important services for any community as it creates positive spillovers in different sectors (Schwerhoff & Sy, 2017). Affordable and clean energy derived from renewable sources are regarded as important, sustainable, efficient and valuable options for energy supply (Schwerhoff & Sy, 2017). Creating affordable and clean energy is regarded as a key objective for addressing global challenges, including universal energy access, energy security, climate and ultimate poverty eradication and sustainable development (United Nations, 2015). This study is important as it focused on establishing a social innovation system that would be instrumental in the achievement of SDG 7 in a poor informal settlement of an African urban area faced with continuous urbanisation.

1.6 Research objectives

The overall objective of this study is to investigate how a social innovation systems approach can facilitate the achievement of renewable energy-related activities (SDG 7) in an African urban informal settlement. The study uses a case from the iShack Project based in the Enkanini informal settlement in Stellenbosch. To achieve this, the specific sub-objectives are as follows:

- i. To examine critically whether a social innovation system can deliver SDGs;
- ii. To establish the social innovation systems that facilitate sustainable communities in African urban informal settlements, with a specific focus on energy access;
- iii. To determine a viable social innovation systems approach that can facilitate access to renewable energy (SDG 7) through the iShack Project in Enkanini informal settlement.

1.7. Proposed research, paradigm, design and methodology

The challenges of cooperatives as social innovation systems were introduced in Section 1.3. The review in Chapter 2 demonstrated the overlap between SDGs through social innovation systems. The cross-fertilisation between social innovation and sustainable development approaches was made evident in the framework in Section 1.3 that was introduced as a necessary approach to test the theoretical overlaps discovered in Chapter 2. Therefore, the framework introduced in Section 1.3 of this study was instrumental in creating a closer, or more realistic, understanding of the dynamics of a social innovation system and its ability to achieve SDGs, and its role as a contributor to the social economy of a typical African urban informal settlement. The following section presents the paradigms, methods and approaches that were applied in the data collection process and aided in the realisation of social innovation systems in an African urban informal settlement.

1.7.1 Research paradigms

Scientific research paradigms are the overall theoretical perspectives about the world that are known to a community of scientists undertaking a study (Healy & Perry, 2000). In concise terms, a research paradigm is a worldview or a set of assumptions about the world. The research paradigm assumptions or worldviews usually affect the selection of methods and methodology applied (Creswell & Miller, 2000). The researcher's worldview basically refers to the abstract knowledge that encompasses the way in which the researcher perceives and understands the world. Therefore, the way the research dimensions (ontology, epistemology and methodology) contribute to theory is guided by the research paradigms (Healy & Perry, 2000). The research paradigm essentially guides the researcher on what knowledge exists and how to construct the knowledge. Paradigms, therefore, take different forms and include the following: positivism, post-positivism (critical theory and constructivism) and realism. The following section unpacks the ontological and epistemological perspective and paradigm suitable and relevant for this study.

1.7.1.1 Ontology

According to Thomas (2004), ontology is the central knowledge that exists in a certain field. This form of knowledge tends to be the abstract type of knowledge that is accepted without proof owing to the inevitable limitations of inadequate competencies or infrastructure. Therefore, ontology tends to be unjustified knowledge that is hypothetical in nature. Healy and Perry (2000) submit that ontology is what the researcher investigates. The ontological perspective (which focuses on how knowledge is produced in research) is the starting point of any research, as it is a claim or assumption that is made about the nature of social reality, a claim about what exists, what it looks like, what units make it up, and how these units interact with each other (Grix, 2002). The researcher's ontological assumption influences the topic selection, the formulation of the research questions and the strategies for conducting the research (Hesse-Biber & Leavy, 2011). The theoretical framework of the study (presented Chapter 2) represents the ontological position of the study. According to Best and Khan (2006), theory is an attempt to establish the general assumption of a phenomenon. Therefore, theory is a primary catalyst for the development of knowledge.

Chapters 2 and 3 served as a starting point that guided the direction that this work would take through a framework. This was achieved by reviewing the literature to understand and know what factors constitute a social innovation system in an African urban informal settlement and to what extent it had been tested. By reviewing the literature, this work was able to establish the general assumptions and knowledge that exist in the body of knowledge related to social innovation systems and their relation to SDGs in informal settlements. The ontological perspective in this work was related to understanding the factors that constitute a social innovation system according to the literature. The ontological perspective enabled the researcher to obtain an understanding and discover the gap in the literature on social innovation systems and SDGs in an African urban informal settlement. This enabled the development of an understanding of what is known in existing theory through a framework and influenced what could be applied in testing what is known.

The study looked at constructivist theory to understand its applicability to the study. Constructivists apply a plurality of theories to understand and analyse cases. Unlike positivists, constructivists do not assume a single reality, and theoretical concepts are mutually constitutive. In this study, constructivism was more suitable to help answer the research question, which was to understand the nature of social innovation systems through perceptions, experiences and understanding of society's realities. According to Healy and Perry (2000), constructivist theory involves research approaches that entail interaction between the interviewer and the respondent. Respondents interacted with the researcher so that the researcher could gather the society's perceptions and realities as part of data collection to inform theory. In this work, the constructivist approach is evident in the data collection process. This is a process that enabled the creation or construction of knowledge by interacting with actors involved in the iShack Project to understand their experiences. This was achieved through one-on-one interviews, focus groups, observations and conversations that took place during the time of data collection, which will be discussed at length in the sections that follow. This process was influential in creating knowledge and linking the reality to theory, and thereby improving what is known in relation to social innovation systems in the context of an African urban informal settlement.

1.7.1.2 Epistemology

According to Crotty (2003), epistemology is the way of understanding and explaining what one knows and how one knows what one knows. It influences how researchers structure their approaches to discover knowledge. Epistemology informs the methodology of the nature of knowledge, or describes what is deemed fact, and where knowledge is to be sought (Sarantakos, 2012). This perspective is concerned with the process of gathering knowledge and thereby developing new and improved theories and models. Epistemology entails the researcher reflecting on the existing theories and concepts, specifically with regard to the nature and origin of the assumptions underpinning those theories and concepts (Grix, 2002). Healy and Perry (2000) and Grix (2002) therefore attach the constructivism paradigm to the epistemological perspective of the research.

The constructivist researchers, also known as interpretivist researchers, aim to narrow the gap between empirical observations and abstract meaning using interpretive techniques. However, in some cases, interpretation may compromise the quality of the findings based on quantitative methods. Therefore,

constructivist researchers adopt other means of control by using multiple theories to analyse data. These types of researchers are certain that social reality is subjective and distinct, and that it is formed by the perceptions of the participants together with the values and aims of the researcher. Wisker (2008) and Blumberg, Cooper & Schindler (2011) further allude to two basic principles of the constructivist paradigm. Firstly, the community, participants or respondents provide the subjective meaning and construction of the social world. This is a result of the respondents being human and having a unique understanding and first-hand experience of the social world. Secondly, for constructivist researchers, the respondent is part of the subject that is under observation.

Constructivism and epistemology therefore both focus on the development and creation of knowledge by explaining the nature of knowledge and the way humans acquire knowledge. The knowledge acquired is based on people's experiences and perspectives and is guided by a certain framework informed by theory. Essentially, it is based on the 'how' and 'why' things are the way they are. In constructivism, knowledge is shared in a social context through interviews and reviews of the existing body of knowledge. The construction of meaning is transmitted within an essentially social context and this is through interviews and reaction papers. Constructivism and epistemology are based on knowledge building influenced by experiences and perceptions, so their method of collecting data informs the methodology and the method of acquiring this information through interviews and participant observations to advise informative sources such as case studies.

Currently, the existing knowledge on social innovation system frameworks is inadequate to account for the complexities of the African urban informal settlement. This study therefore applied a case study through rich qualitative data to gather the perceptions, interpretations and experiences of the respondents who reside in an African urban informal settlement. The data answer the 'how' and 'why' questions on the prevailing nature of social innovation systems in African urban informal settlements. The epistemological perspective and constructivism paradigm explore the application of qualitative methods in the social context through interviews, observations and review of existing work on the subject. Therefore, the research design and methodology applied in this study were guided by the research perspective and paradigm discussed above.

1.7.2 Research design and methodology

The research design process is guided by the philosophical assumptions that researchers undertake in a research study (Creswell, Hanson, Clark Plano & Morales, 2007). The researchers tend to incorporate their knowledge and paradigms into their study, which therefore influences how the study unfolds. The defining pragmatic perspective of the research applied is in turn also influenced by interaction between the ontological and epistemological assumptions, and the research methodology applied in the research (Creswell *et al.*, 2007).

According to Berg (2001), examining social settings and the actors within them requires a qualitative research approach that seeks answers. The research design for this study addressed how a social innovation system could be established to facilitate sustainable communities and cities in an African urban informal settlement with specific focus on access to renewable energy. The objective of this research design was to ensure that the

evidence obtained allowed for the answering of the research question in a clear and precise manner. Therefore, the research design required that the researcher look at the theory or research question, and then assess what type of evidence was required to answer the question in a convincing way (De Vaus, 2001).

According to Yin (2013), ‘how’ and ‘why’ questions are more exploratory. The preferred method of ‘how’ and ‘why’ questions requires the use of primary data such as obtained from case studies, surveys and programme evaluations. Furthermore, questions about how and why things came to be generally lead to the enquiry of what has taken place in the past and how the (current) situation (being studied) came to be. Therefore, the overall design of this study takes on a qualitative and exploratory nature. Qualitative methods are applied to fulfil the in-depth understanding by giving priority to saturation, thereby obtaining a comprehensive understanding by probing until new substantive information is found (Palinkas, Horwitz, Green, Wisdom & Duan, 2015). The qualitative research of Berg (2001) directs its focus on examining social settings and the actors within it in terms of how the actors arrange themselves and their settings. For this study, this entails understanding the way the populations within the informal settlement in question understand their surroundings through rituals, social structures, social roles, etc. This type of qualitative research approach will also enable the researcher to observe and talk to the informal settlement respondents to gain an understanding and perception of the way people structure and give meaning to their daily lives, particularly pertaining to the iShack Project.

Table 1.2 below illustrates the different types of research designs for qualitative research. The table shows the different types of research designs as follows: narrative research, case study, grounded theory, phenomenology and participatory action research. Out of all the listed types of qualitative research designs presented in Table 1.2, the case study research design was more fitting owing to the type of question that this study aimed to answer through in-depth questions. This study made use of a case study to evaluate the dynamics of the social innovation systems that enable the achievement of SDGs in informal settlements.

Table 1.2: Types of research questions, qualitative designs, and illustrative test interpretation examples

Type of research question	Qualitative design	Illustration of questions within test interpretation context
Chronological/story-oriented questions: Questions about the life experiences of an individual and how they unfold over time	Narrative research	What stories does a client tell about the test interpretation process?
In-depth, descriptive questions: Questions about developing an in-depth understanding about how different cases provide insight into an issue or unique case	Case study	How do four counsellors share problem-focused or potentially 'hard-to-hear' test results with clients?
Process questions: Questions about experiences over time or changes that have stages and phases	Grounded theory	What theory best explains the therapeutic effects of test interpretation?
Essence questions: Questions about what is at the core of everyone's experience about a phenomenon	Phenomenology	What does timing mean to counsellors who regularly share test results with clients?
Community action questions: Questions about how changes occur in a community	Participatory action research	How do community mental health centres better optimise their use of community psychological tests in day-to-day practice?

Source: Creswell et al., 2007.

The case study research design approach has been commended to produce saturated, in-depth data with an exploratory approach; however, there tend to be a few limitations that are as follows according to Zainal (2007):

- Case studies tend to lack rigour, in that often the case study researcher has been sloppy and has gathered equivocal evidence or biased opinions that may influence the findings and conclusions.
- Case studies tend to focus on one case, which makes it difficult to provide scientific generalisation owing to the small number of subjects used in the study.
- Case studies also tend to be too long, difficult to conduct and produce too much documentation. This becomes a concern in ethnographic or longitudinal studies, therefore creating difficulty to manage and organise data.

Despite these limitations, Flyvbjerg (2006) identified several key points illustrating case studies as an appropriate approach to addressing questions of an exploratory nature. The advantages of using the case study approach are as follows:

- Information used in the case study is gathered from the experts on the case (iShack Project) that is being studied, therefore the case study validates the findings and prevents generalisation by providing concrete examples.
- Case studies are a practical prototype of scientific work, as they reveal more information by involving more actors and more instruments.
- Case studies do not simply describe possible causes and the frequency with which they occur. The information used in case studies is from an understanding-oriented and action-oriented perspective, and case studies provide insight as they further reveal and clarify the more important issues and the deeper causes underlying a problem and its results.
- Case studies provide an insider's perspective on real-life circumstances and test the views closely in relation to the case as it takes place in practice. This further enables the researcher to validate and be corrected by the study respondents, thereby making discoveries that stem from intense observations, unlike data on statistics applied in large groups.
- The density of case studies is more useful for the practitioner and for social theory, compared to factual findings or the high-level generalisation of theory.

For this study, the case study research design was more fitting owing to the type of question that the study aims to answer. This research made use of a case study to evaluate the dynamics of the social innovation systems that enabled the achievement of SDGs in an African urban informal settlement. This approach seemed to be applicable for this study given its focus on the interaction between various participants who were trying to achieve the same objective of addressing a social problem in informal settlements at societal level. Studies by Sheikh (2014), Mehmood and Parra (2013), Flecha and Ngai (2014) and García, Eizaguirre and Pradel (2015) focused on community innovation, social innovation, community development and sustainability, which carry a similar theme to this study, and have also used the case study approach to arrive at their results and conclusions.

Case studies are relevant in studies related to the investigation of the nature of a system, i.e. the study could be on a group, an institution, or on participants (Welman, Kruger & Mitchell; 2009). Case studies were applied in this work as they were mostly suitable methodologies that could be applied to achieve the epistemological perspective. The case study aids in generating the theory from the qualitative data acquired from the research process. One of the gaps that were established in the literature review showed the scarcity of knowledge on the social innovation systems in the context of an African urban informal settlement. Therefore, the application of case studies for data collection enabled the achievement of rich data that could be used to inform theory. The data acquired from interviews, observations and reading past research on the social innovation system in an African urban informal settlement assisted in generating new and improved knowledge through thematic analysis (Hesse-Biber & Leavy, 2011).

1.7.3 Research methods

This study had an overall research design and methodology for data collection. However, the main objective was divided into three sub-objectives that were achieved through different methods such as literature review, interviews, observations, and thematic analysis. Each sub-objective of the study was fulfilled by following a specific method. The first sub-objective of this study aimed to examine the extent of social innovation systems to deliver SDGs in informal settlements. The research objective was achieved by undertaking a critical literature analysis of the types of innovations that could achieve SDGs from a social perspective through a literature review that was divided into two sections. The review specifically focused on innovations that were applicable to the social context and social innovation systems.

The review was divided into two methods: the conventional literature review and the systematic literature review. The conventional literature review, which was useful in gathering literature on the subject area by summarising and synthesising it, provided a comprehensive background for understanding seminal work and current knowledge, identifying of gaps, and highlighting the significance of new research (Cronin Ryan & Coughlan, 2008). This approach was useful in identifying the gaps in the existing body of knowledge, thereby allowing the researcher to determine or define the research question (Cronin *et al.*, 2008). This review method was applied purely to provide a brief background on the literature.

The second part of the review also intended to address the first objective, through a systematic review which focused on social innovation systems. The purpose of conducting a systematic review for this topic was to examine the theoretical and empirical evidence on the social innovation systems. This approach was instrumental in establishing the gaps in the existing literature. The systematic review enabled the examination of the social innovation system and social innovation initiative in an unbiased manner. Gopalakrishnan and Ganeshkumar (2013) point out that some of the disadvantages associated with systematic reviews may be those related to the selection of a specific location and selection of studies, heterogeneity, loss of information on important outcomes, irrelevant subgroup analysis, conflict with new experimental data, and duplication of publication.

The second sub-objective of this study was also addressed through a systematic review. The review focused on the empirical work on renewable energy activities in African urban informal settlements. The review embarked on a qualitative systematic review. This was done to assess the availability of literature on the concept of social innovation systems that facilitate sustainable communities in relation to renewable energy in African urban informal settlements. The purpose of the review was to establish the extent to which literature was devoted to the subject, and the gaps that existed therein. Establishing what had been covered on the subject and the gaps contributed in informing the next step (or objective) of this study.

The third sub-objective was achieved by conducting interviews, observations and reading several archival records on the subject. The interviews were conducted with experts on the iShack Project, who were part of the organisations and institutions that had participated therein. Householders or the beneficiaries and staff of

the iShack Project were interviewed and observed on a voluntary basis; while focus group interviews and one-on-one, semi-structured interviews (30 minutes to an hour long) were also conducted. The unstructured nature of the interviews held during the focus-group interviews helped to identify the gaps existing in the subject being studied (Berg, 2001; Mack, Woodson, MacQueen, Guest & Namey, 2005). The responses were recorded, and notes and pictures were taken during the interviews (Westoby, 2014).

The theoretical framework informed the data collection process carried out through semi-structured and unstructured interviews. This was the application of the deductive approach (Berg, 2001; Yin, 2013). The sampling method applied in fulfilling the second objective was purposive sampling and snowball sampling. Purposive sampling is deliberately selecting a specific group from which data will be sourced, while snowball sampling is the referral approach where potential respondents were introduced by existing respondents from observed households. The two sampling methods were relevant to this study, as the focus was on a specific region and actors participating in a specific activity. According to Mack *et al.* (2005), such sampling methods are achieved through specific data collection instruments, such as in-depth interviews and focus groups, complemented by specific instruments such as semi-structured and unstructured interviews.

1.8 Limitations of the study

This study mainly focused on the concept of social innovation systems and its relation to SDGs by directing its attention only to SDG 7. Owing to some of its characteristics, the concept tends to create the impression that it may or can be applied interchangeably with other concepts that are used to refer to social interventions, such as social enterprises, social entrepreneurship, social innovation, social responsibility, social development and community development. However, this study does not disqualify the possibility of the aforementioned concepts resulting in or creating socially innovative or similar outcomes. Rather, this study specifically focused on interventions that were referred to as social innovation systems, and as a concept that carries some distinctive traits. This was done to narrow the focus, and to contribute to the literature of social innovation systems. Therefore, the literature search, particularly ones that formed part of the systematic review, focused only on research that used the concept social innovation system or social system of innovation.

This study further aimed to contribute to the development of a concept which is in its development stages. It planned to do so through attaching this concept to other concepts, such as SDGs, urban areas and African informal settlements, by studying the characteristics of a specific social initiative. The study used one specific social initiative to study the nature of a social innovation system in a typical African urban informal settlement. This may have seemed insufficient. However, the informal settlement in which the focus of the case study was selected was deemed sufficient because of its typical nature in the African context as defined by the United Nations (2016), and Brown-Luthango, Reyes and Gubevu (2016). The case was selected because the informal settlement had the characteristics of an African urban informal settlement as discussed in Section 1.1 and Chapter 3 of this study.

1.9 Research strategy

Figure 1.3 illustrates the strategy and coverage of the study. In order to achieve the overall objective, the study began by providing an overview of the literature on urbanisation, the contribution of urbanisation to the formation of informal settlements, and the hindrances to achieving social stability and in turn realising SDGs through social innovation systems. The overview provided the background, the existing literature, the problem statement, the research objectives and the significance of the study. A review of the existing literature on innovation, innovation systems, social innovation and social innovation systems, and how these concepts relate to SDGs, was conducted. This was done in order to understand the characteristics of social innovation systems, and how they relate to and help achieve the SDGs. The review ultimately informed a framework that was applied in evaluating how social innovation systems can be used to achieve SDGs in urban informal settlements. In order to draw closer to the specific focus of SDG 7, a systematic review was conducted in order to understand the dynamics of accessing renewable energy in African urban informal settlements. The framework and the systematic review prompted the gathering of empirical evidence that informed the contribution of the study. A set of questions was devised for collecting data that was used to compile the case study. The case study provided empirical evidence on the actors functioning as social innovation systems in order to facilitate the social innovations in an urban African informal settlement called Enkanini in Stellenbosch, situated in the Western Cape province of South Africa. The case study served to establish which actors are necessary in the process of introducing, executing and monitoring social innovations in informal settlements in order to achieve SDGs with a specific focus on accessing renewable energy in informal settlements. Ultimately, the case study revealed how the existing social innovation systems in an African urban informal settlement could address SDGs. The findings generated from the analysis of the case study were applied in the evaluation and establishment of viable alternative social innovation systems approaches ensuring SDGs are achieved in African urban informal settlements. The findings further led to the discussion and the contribution of the study to existing research on social innovation systems and SDGs.

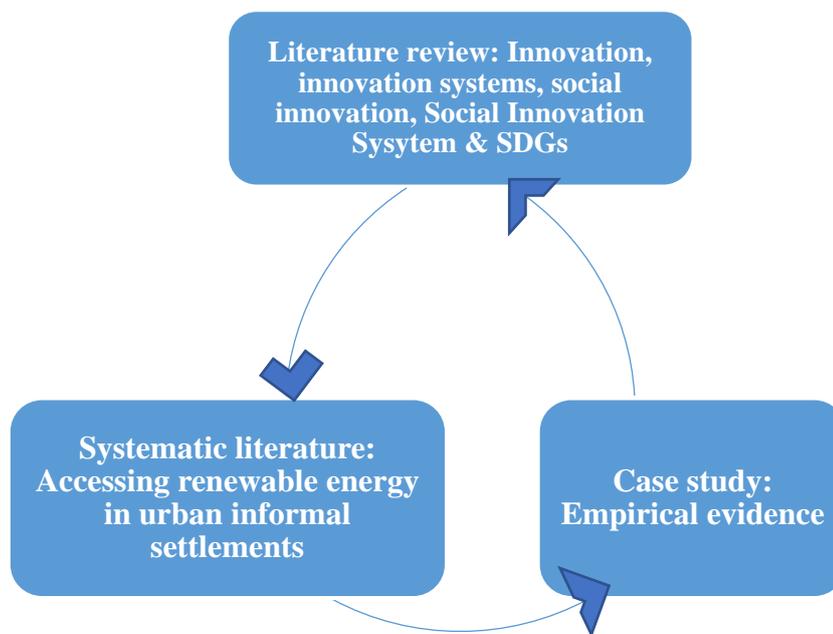


Figure 1.3: Layout of the research strategy

1.10 Thesis outline

The introductory chapter of this study, Chapter 1, provides a background of the research, indicating the objectives and significance thereof. This study aims to achieve three objectives and each objective has been developed into a standalone paper discussed in Chapters 2, 3 and 4. Chapter 2 achieves the first objective: to examine the extent to which social innovation systems can deliver SDGs. It addresses this objective with the aid of a literature review. The literature review was conducted by applying the conventional and systematic literature review method, focusing on concepts such as innovation, innovation systems, social innovation and social innovation systems. The literature set out in Chapter 2 reviewed the overlaps and similarities between the concept of social innovation systems and SDGs in order to establish a framework that would address the achievement of social innovation systems in African urban informal settlements.

Chapter 3 focuses on achieving the second objective. The second objective aims to establish the types of social innovation systems that facilitate sustainable communities in African urban informal settlements, specifically focusing on activities related to the production, use and availability of accessing renewable energy. The discussion in Chapter 3 is achieved through a systematic review of social innovation systems in African urban informal settlements. The objective of using the systematic review is to examine the existing literature on the manner in which social innovation systems facilitate sustainable communities in African urban informal settlements. This chapter gives specific focus on access to renewable energy were established. The analysis of the findings of the review is guided by the framework established in Chapter 2.

Chapter 4 focuses on the third objective, which aims to suggest viable alternative social innovation systems approaches ensuring SDGs are achieved in a specific urban informal settlement. This was achieved by presenting a case study on social innovation systems in the iShack Project, based in an urban informal

settlement, Enkanini in Stellenbosch. The framework derived with the aid of Chapter 2 and 3 was applied to evaluate the factors in the iShack project social innovation systems that can facilitate the SDGs for Enkanini urban settlement. Furthermore, Chapter 4 provides a discussion on the findings on how the availability of renewable energy helped achieve some SDGs in Enkanini urban informal settlement through the iShack Project social innovation system. The discussion in Chapter 5 is an overview of the contribution made by the study based on the findings established in Chapter 4. Chapter 5 also presents conclusions and the implications of the study, together with recommendations for further research.

Chapter 2: Achieving sustainable development goals through social innovation systems

2.1 Introduction

An innovation system comprises a collaboration of actors, organisations and institutions that interact with the intention to develop, diffuse and use innovations in order to improve competencies and socioeconomic conditions (Cozzens & Kaplinsky, 2009; Fagerberg, Mowery & Nelson., 2005; Lundvall, 2010; Spielman, 2005). The innovation process is determined by an innovation system which influences the development of innovation. Innovation can be related to economic, social, political, organisational and institutional factors (Edquist, 2005; Kraemer-Mbula & Wamae, 2010; Spielman, Davis, Negash, & Ayele, 2011).

Over the years, the interaction between innovation systems has been growing in developing and developed countries in different fields. However, innovation studies and activities are still largely devoted to science and technology. This was influenced by the perception that the science and technology activities take place in industrialised regions (Cozzens & Kaplinsky, 2009; Kraemer-Mbula & Wamae, 2010). Consequently, there has been less focus on innovation studies in informal and peripheral areas of developing countries (Berdegué, 2005).

The concept of innovation has evolved over the years and has spread its meaning to different categories, focuses and delineations. Literature on innovation has further stressed the importance of interaction between actors during any innovative endeavour, which is the systematic dimension (Fagerberg, 2004; Ronde & Hussler, 2005; Soete *et al.*, 2010; Edquist, 2011). Edquist (2011) categorises a system into constituents: the first is the components, and the second is the relation between them, whereby the components and their relations must form a coherent whole. Furthermore, a system has a function which should aim to achieve or perform something, and the system should easily be distinguished from the rest of the world. Fagerberg (2004) further identifies the system as having a better structure compared to a network, in that it is more continuous in nature. The structure facilitates certain patterns of interactions and outcomes. The systematic dimension is further determined by the context in which innovation takes place; hence, innovative activities are categorised according to delineation and purpose.

Freeman (2002) breaks down the innovation systems in terms of their spatial delineation, such as national, regional and local. This is done to substantiate how innovation systems could be influenced by their respective local characteristics through institutional and physical characteristics. Innovation systems have diverged into different schools of thought, as shown in Table 2.1 (Intarakumnerd, Chairatana, & Tangchitpiboon, 2002; Lyasnikov, Dudin, Sekerin, Veselovsky, & Aleksakhina, 2014; Soete *et al.*, 2010), namely regional (Cooke, 2001; Cooke, Uranga, & Etxebarria, 1997; Kubezcko Rametsteiner & Weiss, 2006), sectoral (Breschi & Malerba, 1997; Breschi, 2000; Malerba, 2002), and technological (Bergek, Jacobsson, & Sandén., 2008; Gosens Lu & Coenen, 2013).

Table 2.1: Types of innovation systems

Type of innovation system	Definition of the innovation system
National innovation systems (NIS)	National innovation systems are the interactive systems of existing institutions, such as private and public firms (either large or small), universities and government agencies aiming at the production of science and technology (S&T) within national borders. The interaction among these units may be technical, commercial, legal, social and financial. The goal of the interaction may be development, protection, financing or regulation of new S&T (Intarakumnerd <i>et al.</i> 2002).
Regional innovation systems (RIS)	Regional innovation systems approaches are based on a territorial concept and look at the innovation process either at the local or regional level. Regional innovation systems are therefore mainly characterised by actors located in a specific region. Furthermore, most functions of the innovation system are fulfilled by players in a specific region (Kubeczko <i>et al.</i> , 2006).
Sectoral innovation systems (SIS)	Sectoral innovation systems are based on a group of firms active in developing and making a sector's products and in generating and utilising a sector's technologies. Such a system of firms is related in two different ways: through processes of interaction and cooperation in artefact technology development and through processes of competition and selection in innovative and market activities (Breschi & Malerba, 1997).
Technological innovation systems (TIS)	Technological innovation systems are based on dynamic networks of agents interacting under an institutional infrastructure. This kind of system is involved in the generation, diffusion and utilisation of technology (Gosens <i>et al.</i> , 2013).

The concept of innovation has further evolved to purposes beyond economic and technological perspectives, such as social innovation (Baker & Mehmood, 2015; Cajaiba-Santana, 2014; Harrisson *et al.*, 2010). Social innovation consists of innovation activities resulting in, or which are intended for, social outcomes. For example, in a water-scarce society, a social innovation intended to address water scarcity by helping to save water would involve the introduction of a tap measuring the daily usage of water by each household, to help monitor water consumption. However, existing concepts and the development of concepts around socially innovative activities are still rooted in economic objectives that disregard pertinent innovation outcomes specific to non-economic outcomes. This challenge prevails in the execution of social innovation through economic and entrepreneurial means that are supposedly intended for social purposes. However, social innovative intentions and objectives tend to be rooted in, and dependent upon, economic and entrepreneurial objectives. Owing to their dependency and rootedness, socially innovative activities fail to address the specificities related to the execution of social objectives. Only recently, the concept of social innovation has developed to social innovation systems (Fulgencio & Fever, 2016). Social innovation systems acknowledge the networks and actors necessary to execute social innovations and social challenges (Fulgencio & Fever, 2016).

Furthermore, the concept of social innovation systems is still relatively has limited empirical evidence. The world has faced different, persisting social challenges that were addressed through the millennium

development goals, which expired in 2015. Thereafter, the SDGs were implemented as a continuation of the initial goals in 2016. This chapter examines the novel concept of social innovation systems and its characteristics. This chapter further establishes the similarities between social innovation systems and SDGs, thus focusing on the first objective of the study. Different existing innovation systems that are nation-, region- and sector-specific were largely focused and dependent on the economic outcomes through technological and entrepreneurial aspects. The objective of this chapter is to devise an innovative approach and framework to address social challenges (found in Section 2.8 of this chapter). This approach focuses on the way actors arrange themselves in an informal settlement system to achieve social objectives.

2.2 Methodology

The research objective was achieved by undertaking a critical literature analysis on the types of innovations that could achieve SDGs from a social perspective. The review specifically focuses on innovations applicable to the social context and social innovation systems. The keywords for the review were ‘innovation’, ‘innovation systems’, ‘social innovation’ and ‘social innovation systems’.

The review was divided into two methods: the conventional literature review and the systematic review. The first phase of the review, which is the conventional literature review, provided an overview of the concepts ‘innovation’, ‘innovation systems’, and ‘social innovation’. The conventional review method was useful in gathering literature on a specific subject area by summarising and synthesising it, thereby giving a comprehensive background for understanding seminal work and current knowledge, identifying the gaps, and highlighting the significance of new research (Cronin *et al.*, 2008). This approach was useful in identifying the gaps in the existing body of knowledge, thereby allowing the researcher to determine or define the research question or hypothesis (Cronin *et al.*, 2008). However, the weakness of this review approach was its tendency to use a randomised control trial, which may be difficult to conduct practically in the social sciences. Hence, it was suitable for restricted types of research questions (Victor, 2008). For this study, it was applied purely in order to provide a brief background to the literature.

Google Scholar was utilised to gather literature for the conventional method, and no period or region was applied for the search. Rather, the search targeted the classic articles on innovation, innovation systems and social innovation (Cronin *et al.*, 2008). The reason for not assigning time limitations to the search was to generate seminal, classic and recent work on innovation, innovation systems and social innovation. The use of Google Scholar was advantageous as it allowed the researcher to find a wider selection of literature, including articles, books and grey literature on the topic. This source further enabled the researcher to acquire articles that were cited the most frequently and an indication by whom they were cited. However, there were disadvantages in using Google Scholar as a main database. Firstly, the results generated varied in quality, so the researcher had to choose the most suitable for the purpose. Secondly, Google Scholar does not allow users to limit the search to either peer-reviewed or full-text material according to discipline. However, Google Scholar was useful as the results generated included grey literature. Some of the journals that contained the main studies for the conventional literature were the *Cambridge Journal of Economics*, the *Journal of*

Evolutionary Economics, the African Journal of Science, Technology, Innovation and Development, and the International Journal of Business Innovation and Research.

The second phase of this literature review was a systematic literature review, which focused on ‘social innovation systems’. The purpose of conducting a systematic review for this topic was to examine the theoretical and empirical evidence of the social innovation systems. In doing so, current research gaps were identified. The systematic review enabled the examination of the social innovation system and social innovation initiative in an unbiased manner. Gopalakrishnan and Ganeshkumar (2013) point out that some of the disadvantages associated with systematic reviews could be those related to the selection of a specific location and a selection of studies, heterogeneity, loss of information on important outcomes, irrelevant subgroup analysis, conflict with new experimental data, and duplication of publication.

The search engines used for the systematic review were Google Scholar, Science Direct, Scopus and Ebscohost. The focus of the review was based on peer-reviewed articles, handbooks, chapters of relevant books or studies that were related to ‘social innovation system’, ‘social innovation systems’ and ‘social innovation’ initiatives. The keywords for the search generated on social innovation initiatives were dictated by the literature on social innovation. The keywords informed by social innovation literature were as follows: ‘collective’, ‘community’, ‘non-profit’, ‘social enterprise’, ‘social’, ‘bottom-up’ and ‘transformative’. The keywords were coupled with the phrase ‘social innovation’ or ‘innovation systems’. This was done in order to ensure that optimum work on ‘social innovation’ initiatives and ‘social innovation systems’ was obtained from the search, as some work on social innovation tends not to be identified as, or coupled with, the term ‘social innovation’. These initiatives were identified by their intended purpose, which was synonymous or characteristic of social innovation. Furthermore, when reviewing abstracts and articles for the search, the requirement was that ‘social innovation systems’ or ‘social innovation’ initiatives were discussed in-depth in the article, and not merely mentioned in passing. This systematic review did not apply to any specific period or region, in order to combat biases. The non-selection of a specific period was deliberate in order to ensure that optimum data were generated from the search – by capturing the earliest work on ‘social innovation system’, ‘social innovation systems’ and ‘social innovation initiatives’.

A plethora of research, in the form of conference proceedings, peer-reviewed articles and book chapters, presented their empirical results through case studies. Case studies were used to present data that were acquired through observations, consultations, and other types of data collection methods such as focus group and in-depth interviews (Batle, Orfila-Sintes & Moon, 2018; Capaccioli, Poderi, Bettega & D'Andrea, 2016; Vasin, Gamidullaeva & Rostovskaya, 2017; Wasai & Nouman, 2016). Empirical evidence was also acquired through the analysis of existing literature in the form of historical or archival records and past peer-reviewed publications (Fulgencio & Fever, 2016; Phillips, Lee, Ghobadian, O'Regan & James, 2015; Shin, 2016; Van der Have & Rubalcaba, 2016). Consequently, most of the types of data used for most of the empirical evidence of social innovation systems or initiatives was qualitative in nature. The use of qualitative data in most studies could be due to the emerging nature of the field of social innovation systems and initiatives, which still requires

more exploratory types of studies to develop in-depth and primary arguments to support the findings. The results from the conventional literature review and the systematic review were organised into the following themes: innovation; innovation systems; social innovation; and social innovation systems. Each of these themes are discussed in the sections that follow.

2.3 Innovation

Lundvall (1992) related innovation to the combination of new ideas resulting in a new product or process. Foxon, Gross, Chase, Howes, & Arnall (2005) and Läßle *et al.* (2016) define innovation as an interactive, non-linear process where actors such as firms interact with various organisations in the form of research institutions, customers, authorities and financial organisations, together with institutions that represent regulations and culture. Schumpeter (1934, 1942) often came up in Fagerberg's (2004); Cozzens and Kaplinsky's (2009) and Varis and Littunen's (2010) definition of innovation. However, Schumpeter (1934) merely alluded to the concept of innovation by relating it to new products and processes. Furthermore, an innovation did not necessarily stem from an invention, but could also result from an improvement or the combination of existing knowledge and ideas (Fagerberg, 2004). The invention or improvement of new products and processes largely require a combination of knowledge, skills and resources from different sources. Fagerberg (2004) further established how innovation could stem from the introduction of something that is contextually new.

Though innovation is broken down into different types, such as product, process, organisational, market and functional innovations, there was a common focus on the integration and the combination of new and old ideas in order to devise the products and processes (Blankley & Moses, 2009; Cozzens & Kaplinsky, 2009; D'Este, Guy & Iammarino, 2012; Edquist, 2005). However, innovation is not only limited to the creation of a new product and process; it also takes the form of organisational arrangements and marketing improvement, as shown in Table 2.2 (Blankley & Moses, 2009; Edquist, 2011; Edquist, 2005; Lam, 2004; Nauwelaers *et al.*, 2013). Table 2.2 presents the different definitions of the types of innovation. It is divided in two columns: the column on the left shows the different types of innovation that were prominent in innovation literature, such as process, product, organisational, market, functional and value-added innovation, while the column on the right depicts the definitions of the respective types of innovation listed in each row.

Table 2.2: Types of innovation

Types of innovation	Definition of the type of innovation
Production	Product innovations are referred to as new goods and services introduced to the firm; or significant capabilities that will have an impact on the improvement of the product (Blankley & Moses, 2009; Edquist, 2005).
Process innovation	Process innovation is the improvement on the production methods, techniques and equipment. These improvements are changes that are intended to improve the quality and efficiency of a production innovation (Blankley & Moses, 2009; Edquist, 2005).
Organisational innovation	Organisational innovation relates to the changes made to the internal or external practices, arrangements and relations established to improve the innovative capacity, products and processes (Blankley & Moses, 2009; Edquist, 2005). In Lam (2004), organisational innovation refers to the creation or adoption of ideas that are new to the organisation.
Market innovation	Market innovations are the improvement of marketing strategies in the form of improved product design and packaging, promoting of products and services, and pricing of goods and services (Blankley & Moses, 2009).
Functional innovation	Functional innovation is the arrangement of a value chain leading to individual links in the chain, assuming new functions or outsourcing existing functions (Cozzens & Kaplinsky, 2009).
Value chain innovation	Value chain innovation is moving to a new sector of activity based on accumulated expertise (Cozzens & Kaplinsky, 2009).

The different concepts identified in Table 2.2 illustrate that an innovation could take different approaches. Some innovation approaches are attributed to the improvement of the actual products sold in the market, while others are more focused on the processes of improving the production process of particular goods. Improving the way a product is produced is a form of market innovation, while improving the appearance of a product is a form of product innovation.

According to the definitions in Table 2.2, production innovating is not only restricted to the improvement and the creation of new products. It further relates to finding new ways of improving the production process. Upgrading existing equipment or machinery so that the production process is quicker and safer for its users is an example of a process innovation. The improvement could focus on the production process, making the process easier, less expensive, and quicker or safer to use. However, other innovations focus on the creation and improvement of sales in the market.

Process innovations are new ideas that are aimed at improving the market arrangements and products of the enterprise. Therefore, process innovations could either be organisational or technological (Edquist, 2005). Essentially, an innovation process is related to the way in which firms interact or collaborate internally or externally to generate knowledge by applying existing know-how. This form of innovation process is related to the way in which firms and organisations interacted to respond to market conditions.

Cozzens and Kaplinsky (2009) defined functional innovation and value chain innovation as other forms of innovation that focus on the improvement of an organisational network. Functional innovation is related to outsourcing or expanding functions of the firm internally. This occurs when firms improve internal resources to produce their own output from beginning to end within and across their borders. Value chain innovation is therefore attributed to the expansion of the organisational network into different units or departments within firms.

The concept and the types of innovation are centred on activities influencing productivity, profitability and competitiveness in the firm or in the market. Innovative activities are general and required in most economic sectors; however, Läßle *et al.* (2016) and Freeman (2002) indicate that innovation differs according to different economic sectors (such as agriculture, manufacturing, finance), regions and countries. Läßle *et al.* (2016) further attribute the differences in innovative activities to the specificities of sectors and countries in terms of the prevailing policies, institutional settings, infrastructural environment and knowledge transfer mechanisms. Furthermore, there are aspects established to be common across all innovation activities regardless of sector and region. Different authors attribute innovation to more factors, such as skills and knowledge, governance, distance, some form of technology and technological infrastructure, territory and context.

Firstly, skills, knowledge and capabilities are regarded as a prerequisite for absorptive capacity for firms in order to achieve innovative results (Ronde & Hussler, 2005; Metcalfe & Ramlogan, 2008; Kraemer-Mbula & Wamae, 2010; Mas-Verdú, Ortiz-Miranda & García-Álvarez-Coque, 2016). According to Mas-Verdú *et al.* (2016), an educational attainment is primary to the innovative capacity of the business environment and the same goes for the combination of local knowledge and technological and organisational inputs in developed countries. In support of this, Nauwelaers *et al.* (2013) further express the importance of integrating the relevant technological and organisational technologies carefully with local knowledge and know-how relating to the specifics of the country or region. In addition to blending local knowledge with organisational inputs, technological inputs and expertise, the key was to facilitate the integration according to the specificities of the relevant project and countries.

Kraemer-Mbula and Wamae (2010) add that integrating technological learning and capabilities is not an automatic process in that much effort has to be put into the specificities. These researchers further add that the availability of skills attained through tertiary education enable opportunities that are helpful in changing the existing knowledge and skills supporting previous skills by generalising the use of the improved outcomes. Furthermore, Metcalfe and Ramlogan (2008) point out that the way the knowledge acquired is dependent on existing social processes through which people interact and communicate in the organisation as knowledge flows of information is organised through networking and outside sources.

Secondly, according to Kraemer-Mbula and Wamae (2010), Läßle *et al.* (2016) and Mas-Verdú *et al.* (2016), network formation largely depends on the distance between the actors sharing knowledge. Authors in innovation studies, such as Boschma (2005), Kraemer-Mbula and Wamae (2010), Broekel and Boschma

(2011) and Läßple *et al.* (2016), point out that the different forms of proximity that influenced innovative activities are in the form of relational or non-space proximity (social proximity; cognitive proximity; institutional proximity; and organisational proximity) and space proximity (geographical proximity). Being in proximity implies that there is ease and ability of reach between interacting objects (Boschma, 2005; Mattes, 2012).

Relational factors, or non-space proximity, are critical in determining access to, the use of, and the distribution of innovations. These factors of proximity are important for innovative interactions and arrangements. Non-space proximity factors are important to understand interactive activities and help to curb uncertainties. Social proximity alludes to the micro-level ties between actors established through informal interactions. Cognitive proximity refers to the manner in which actors share a common or similar understanding on a certain subject or matter, while institutional proximity relates to the rules and regulations guiding the interactions between the actors. Organisational proximity refers to the capacity of organisations or actors in the same firm or field to facilitate their activities jointly (Boschma, 2005; Knobens & Oerlemans, 2006; Mattes, 2012; Nauwelaers *et al.*, 2013).

Geographic proximity enables the actors to interact and share knowledge, thereby creating 'efficiency' in interaction. This form of proximity creates the advantage of frequent face-to-face contacts and reduces costs incurred in reaching and transporting objects and people between different positions (Boschma, 2005; Mattes, 2012; Nauwelaers *et al.*, 2013). This means the closer one is to a university, the better one would be able to access and acquire knowledge. Therefore, the formation of networks rests on the proximity that exists between actors in a network.

Thirdly, innovation literature illustrates technological inputs and technological infrastructure as some of the prominent factors enabling innovative activities in firms and organisations (Varis & Littunen, 2010; Alic & Sarewitz, 2016; Mas-Verdú *et al.*, 2016; Läßple *et al.*, 2016). The relation of innovative activities through technology is attributed to the ability to adopt, adapt and create products and process-related technological inputs, which Varis and Littunen (2010) alluded to as radical innovation. While there is vast literature based on innovation centred on technological activities, Läßple *et al.* (2016) broadly categorised innovation into technological (product and process) and non-technological (organisation and marketing) innovations. However, the narrowing of non-technological innovations and marketing by Läßple *et al.* (2016) contributed to the shortcoming of innovations to centre on well-established, industrial organisations or firms driven by economic means.

Fourthly, according to Kraemer-Mbula and Wamae (2010), D'Este *et al.* (2012) and Nauwelaers *et al.* (2013), firms are the primary location of innovation. One of the focuses of Varis and Littunen (2010) was on whether firms introduced novel innovations, and who their sources of information were. Findings for this study revealed that new product and process innovation was associated with firms' growth. Nauwelaers *et al.* (2013) further stipulated that to ensure successful innovations, firms engaged in various complementary activities such as facilitating interaction between innovation actors and supporting knowledge creation, diffusion and absorption.

The centrality of firms in innovative activities was also evident in the Nauwelaers *et al.* (2013) definition. Nauwelaers *et al.* (2013) stated that “an innovation is new to the world when the firm is the first to introduce the innovation for all markets and industries”. This, therefore, supports the prominent perception that the execution and establishment of innovations significantly relies on firms. However, no innovation takes place in isolation. Innovation is a collective, interactive and learning process between different actors at firm, organisational and institutional level (Edquist, 2005; Conroy, 2008; Lundvall, 2009).

Furthermore, the different definitions of innovation that have appeared in literature focused on activities that related to the firm or market. This was evident in the definition of Nauwelaers *et al.* (2013) which states that:

an innovation can be new to the firm, new to the market or new to the world. The first concept covers the diffusion of an existing innovation to a firm – the innovation may have already been implemented by other firms. Innovations are new to the market when the firm is the first to introduce the innovation on its market.

Lundvall (2009) and Varis and Littunen (2010) emphasise that innovative activities are specifically generated through sharing knowledge, but they still restrict activities to occurring among firms and organisations. Furthermore, definitions by Edquist (2011) and Nauwelaers *et al.* (2013) attribute the creation, execution and benefits of innovation to the market and the firm. This explains the definition of innovation discussed above illustrating that the existing conversation around innovation still does not encompass activities and actors not found in the market or firm.

Finally, in all these definitions of innovation, there are common concepts that are prominent. A combination of ideas (Soete *et al.*, 2010; Varis & Littunen, 2010), interactions between different actors (Soete *et al.*, 2010; Läßle *et al.*, 2016), improving products or processes (Edquist 2011; Nauwelaers *et al.*, 2013), and learning (Nauwelaers *et al.*, 2013; D’Este *et al.*, 2012) are some of the concepts and activities related to different types of innovation.

2.4 Innovation systems

According to Fagerberg (2004), Meadows (2008) and Edquist (2011), a system is a combination of components interacting within boundaries. Freeman (2002), Foxon *et al.* (2005), Woolthuis, Lankhuizen & Gilsing, (2005), Edquist (2011) and Soete, *et al.*,(2010) established the concept of innovation systems in order to study the productivity of interactive networks in production processes. According to Edquist (2011) and Soete *et al.* (2010), innovation systems are the determinants of the innovation process. Soete *et al.* (2010) further allude to the explicit importance of the ‘systematic’ interactions between various components of inventions, research, technical change, learning and innovation. Therefore, an innovation system comprises a set of structural elements, such as actors in the whole supply chain, networks, and institutions such as regulations, norms and cognition (Jacobsson & Bergek, 2011). Woolthuis *et al.* (2005) defines an innovation system as elements and relationships interacting in the production process. Foxon *et al.* (2005) identifies the functions that an innovation system serves as follows:

- To create and diffuse ‘new’ knowledge
- To provide direction to the search process among users and suppliers of technology influencing the direction through which actors organise their resources
- To supply resources in the form of capital, competencies and other resources
- To create positive external economies through the exchange of information, knowledge and vision
- To facilitate the formation of markets

Freeman (2002) identifies an innovation system as a network of institutions and organisations, both in the public and in the private sector, formally interacting while having a primary objective to distribute new technologies. Over time, the focus on innovation systems has diverged into different schools of thought, such as regional (Cooke *et al.*, 1997; Cooke, 2001), sectoral (Breschi, 2000; Malerba, 2002), and technological (Bergek *et al.*, 2008) innovation systems. Innovation systems studies and theory have been predominantly applied in technology-related policy making in developed and developing countries (Bergek *et al.*, 2008).

However, over the years innovation has been related to economic, social, political, organisational and institutional factors (Edquist, 2005; Kraemer-Mbula & Wamae, 2010; Spielman *et al.*, 2011). Additionally, innovation systems have been greatly influenced by their local, regional and national characteristics (Freeman, 2002; Kraemer-Mbula & Wamae 2010; Tödting & Tripl, 2011) and innovation systems literature relates overwhelmingly to industrialised and formal organisations and institutions.

The limited literature on innovation systems on household and community level in informal settings is attributed to the limited application of the concept of ‘innovation’ to the creation of new products and processes related to science and technology and policy making (Agwu, Dimelu, & Madukwe, 2008; Balzat & Hanusch, 2004; Kraemer-Mbula & Wamae, 2010; Läßle *et al.*, 2016). This resulted in a greater focus on developed economies, such as American and European countries, and less focus on developing countries, such as Asian and African countries (Balzat & Hanusch, 2004; Fagerburg, 2004; Lundvall, 2007; Intarakumnerd *et al.*, 2002; Shearmur, 2011). Balzat and Hanusch (2004) related innovation capacity to the ability to produce and commercialise the distribution of technology over a long period with the help of the country’s infrastructure. This definition limits the applicability and capability of innovative activities in developing countries with less advanced technological infrastructure and fewer systems. This definition of innovation further limits the innovative activities to actors that commercialise the innovations and technologies.

So far, in the agricultural and low-tech manufacturing sectors, the innovation systems approach is largely applied to policy making and development. One of the few examples in the African context on high-tech innovation systems in the agricultural sector was the case by Agwu *et al.* (2008). These researchers provide a summary of the innovation systems approach in agricultural development and the implications for agricultural extension in Nigeria. This case illustrates the importance of suitable innovation systems to create extension services in order to improve the use of technological packages among farmers through appropriate innovative partnerships (Agwu *et al.*, 2008).

According to Agwu *et al.* (2008) and Läßle *et al.* (2016), innovation activities may be limited not only to the agricultural and technological sectors, but be extended to organisational and institutional arrangements. The actors involved in the agricultural innovation system in Agwu *et al.* (2008) and Läßle *et al.* (2016) were research institutions, knowledge-diffusing and -producing institutions, financial bodies, farmers, NGOs and public institutions. Such a network is an example of an alternative arrangement where innovative results are realised through interactions such as relational factors (Schamp, Rentmeister & Lo, 2004). This created an advantage for actors where the access and use of the required technology hindered innovative activities. The actors in the innovation system described by Agwu *et al.* (2008) and Läßle *et al.* (2016) demonstrated a diverse network. However, their innovation systems rested on the diffusion of technology and having innovation as a product of science.

The relation of innovation to science and technology activities was also present in Freeman's (2002) article on innovation systems. In Carlsson (1997) and Breschi and Malerba (1997), innovation systems are also related to the dissemination of technologies. Innovation systems in developing areas with structural disadvantages could hardly rely on technological advantages within their immediate space. Hence, in Balzat and Hanusch (2004), national innovation systems in developing countries or remote areas are referred to as "National Learning Systems".

Actors in developing areas may not always have the luxury of local technological infrastructure. Therefore, they are left with the option of sourcing alternatives not requiring the robust use of modern science- and technology-related infrastructure. However, interventions in some rural areas, particularly in developing countries, struggled to achieve an ideal innovation system when they did not have proper research and development and science- and technology-related infrastructure (Virkkala, 2007; Agwu *et al.*, 2008; Lorentzen, 2010).

Kraemer-Mbula and Wamae (2010), Soete *et al.* (2010) and Nauwelaers *et al.* (2013) acknowledged that innovations should not be restricted to developed industrialised countries and technology-driven activities. The work by Kraemer-Mbula and Wamae (2010), Soete *et al.* (2010) and Nauwelaers *et al.* (2013) go as far as establishing innovation systems that accommodated complexities, such as developing unindustrialised areas, poor adopters of technologies and informal sector areas. Therefore, the innovation systems framework is not inclusive so far as the context in which innovative activities occurred. The following section looks at other types of innovation systems whose context differed slightly as to the reason for innovating and how innovations in their particular context were executed.

Sections 2.3 and 2.4 sought to define innovation and identify the characteristics and elements that make up an innovation system. In these two preceding sections, certain aspects of innovation and innovation systems seem to be biased or carry limitations in terms of what innovation is and what constitutes an innovation system. These factors are related to the actors that drive innovation, and the characteristics and outcomes of innovation. Freeman (2002) is one of the leading authors in the innovation field and hence his definition tends to be widely used and applied as the departure and reference point of many innovation practitioners and authors. However,

Freeman's (2002) definition of innovation still has some loopholes, and limits the activities of innovation in certain areas and/or which actors are involved in innovation processes. Owing to this definition and other definitions that emanate from it, innovative activities tend to be centred around the firm and specific actors that constitute formal bodies. Innovative activities are largely centred around formal organisations and institutions such as NGOs, markets, knowledge-producing and -diffusing institutions, research entities, and public and private institutions. Such definitions could imply that innovation only recognises and qualifies innovation activities and outcomes that occur at the level of a formal entity, and at organisational and institutional level. This may exclude innovative activities by private individuals in the innovators' private space and remote places that do not qualify as organisations or institutions. The prevailing definitions of innovation also imply that innovations are deemed valid and acceptable when they are products of the aforementioned institutions.

The preceding point further leads to the next limitation constituted in the definition of innovation and innovation systems. Definitions of innovation and innovation systems are largely attributed to processes that are productive, profitable and competitive in nature. Relating innovative activities and characteristics to profitability, competitiveness and productivity implies that innovation activities and processes should result in commercialisation and should therefore be able to generate some economic gain. This study focuses on innovations and innovation systems that do not necessarily intend to result in economic gains but rather achieve social gains or social improvement. Indeed, characterising innovation processes, outcomes and innovation systems as economically productive, profit-oriented and commercial limits the aspect of disseminating innovation outcomes for social progress or addressing social challenges without any economic intent.

In the definitions of innovation and characteristics of innovation systems, participation in commercial and economic activities has also been related to the distribution of new technologies involving technological infrastructure. In some cases, innovations addressing social challenges may only be concerned with the uptake and absorption of new knowledge and technologies. Varis and Littunen (2010) state that innovations include the ability to adopt and adapt products and process-related technological inputs. According to Varis and Littunen (2010), users and consumers of innovation are usually the absorbers of innovation by adopting and adapting existing innovation within their innovation systems within non-industrial and/or commercial spaces. Such perceptions further imply that innovative activities are only limited to markets and firms or for profit-generating activities. This disregards the consumer perspective of innovation. Furthermore, there is limited literature on the recognition of innovation activities taking place at community or household level which could result in socioeconomic improvement in poor regions. Thus, this should be further explored.

2.5 Social innovation and social entrepreneurship – the overlaps

Before further discussions on social innovation systems, it is essential to clarify the relationship between social entrepreneurship and the concepts of social innovation and social innovation systems. One of the objectives of this section is to understand the social aspects of innovation and entrepreneurial activity. The entrepreneurial aspect is drawn in as it seems to be attached to innovation activities and actors in literature. This section begins with the classification and discussion of social innovation and social entrepreneurship in order to understand the overlaps between the two concepts, and then continues to identify the overlaps between the two concepts. To build on this, the following section identified some of the main factors inherent in social entrepreneurship and social innovation.

2.5.1 Social innovation

Literature on social innovation has been growing over the past decade. The concept of social innovation has been applied to identify social activities in different respects, such as business development, community development and corporate improvement. The concept of social innovation has gained great attention from researchers, policy makers and practitioners. Therefore, social innovation as a concept has gradually acquired several meanings, resulting in considerable ambiguity (Harrisson *et al.*, 2010; Picciotto, 2015; Manzini, 2015).

Most of the definitions of social innovation provided in Table 2.3 also present the aspect of social change as a primary factor of social innovation. The centrality of social change is strongly driven by the urge to address societal problems equally benefiting the well-being of those benefiting from social change.

Table 2.3: Definitions of social innovation

Definition of social innovation	Author
Social innovation is an initiative taken by social actors to respond to a need while being supported through public recognition	Harrisson <i>et al.</i> (2010)
Social innovations are new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations.	European Commission (2013)
Social innovation is an initiative, product, process or programme that profoundly changes the basic routines, resource and authority flows, or beliefs of any social system (e.g. individuals, organisations, neighbourhoods, communities, entire societies). The capacity of any society to create a steady flow of social innovations, particularly those which re-engage vulnerable populations, is an important contributor to overall social and ecological resilience.	Huddart (2012)
Social innovation refers broadly to innovation in meeting social needs of, or delivering social benefits to, communities through the creation of new products, services, organisational structures or activities that are better or more effective than traditional	Moulaert <i>et al.</i> (2013)

Definition of social innovation	Author
public sector, philanthropic or market-reliant approaches in responding to social exclusion.	
Social innovation refers to innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly diffused through organisations whose primary purposes are social.	Mulgan (2006)
Social innovation takes form when a new idea establishes a different way of thinking and acting that changes existing paradigms through new social practices created from collective, intentional, and goal-oriented actions aimed at prompting social change through the reconfiguration of how social goals are accomplished.	Cajaiba-Santana (2014)
Social innovations are changes in the cultural, normative or regulative structures [or classes] of the society, which enhance its collective power resources and improve its economic and social performance.	Pol and Ville (2009)
Innovative activities and services are motivated by the goal of meeting social needs that are predominantly developed and diffused through organisations whose primary purposes are to address social problems.	Mulgan <i>et al.</i> (2007)
Social innovation concerns the implementation of new social and institutional arrangements, new forms of resource mobilisation, new answers to problems for which available solutions have proved inadequate, or new social aspirations (e.g. autonomy and empowerment). Therefore, social innovation responds to a context of crisis or to the incapability of the institutional framework to find satisfactory answers to acute problems, or to a context provoked by entirely new situations.	Klein, Fontan, Harrisson, & Lévesque (2012)

2.5.2 Social entrepreneurship

Granados, Hlupic, Coakes and Mohamed (2011) define social entrepreneurship as the activities developed by individuals or groups of people to create, sustain, distribute and/or disseminate social or environmental value in innovative ways through enterprise operations. There are various definitions of social entrepreneurship by various schools of thought. The main element that these scholars tend to have in common is to acknowledge the power of the two words ‘social’ and ‘entrepreneurship’ that make up this term. Some definitions tend to weigh more on the social aspect of the concept by alluding to the social outcome intended by the social enterprise. Johnson (2000) defines social entrepreneurship as an innovative approach to dealing with complex

social needs. In Peredo and McLean (2006), the social entrepreneur is defined as one who “relentlessly” pursues new opportunities to achieve a social mission and engages in “continuous” innovation.

Essentially, this concept has been used to refer to ventures that are intended to address social challenges in communities. However, the achievement and execution of social entrepreneurial activities also tend to be limited to social challenges addressed by organisations or enterprises, through which they achieve or create social outcomes. Some literature on social entrepreneurship draws from Schumpeter’s breakdown of entrepreneurship by alluding to ventures resulting in innovation and change. However, such social entrepreneurship ventures have been referred to as being motivated by enterprises driven and sustained by profits. It is evident that the literature on social entrepreneurship draws from, or rests upon, activities that drive change, and achieve social and innovative results. This therefore illustrates that there are some overlaps between social entrepreneurship and social innovation which will be discussed in the rest of this section. There are various factors that are similar between social innovation and social entrepreneurship; however collective action and being profit-driven seemed to overarch most of the factors. The rest of this section is divided according to these overarching, overlapping factors.

i. Intersectoral network group of actors that achieve social change

Theory on social innovation (Novkovic, 2008) and social entrepreneurship (Chikumbo, Öztürk & Tate, 2012; Seelos & Mair, 2005) state that activities are executed by collective actors. This shows that collective action and collective benefit appear to be central in social innovation and social entrepreneurship. The objective of social entrepreneurship (Light, 2006) and social innovation (Novkovic, 2008) is to achieve community improvement by creating sustainable jobs (Philip, 2003) and alleviating poverty (Simmons & Birchall, 2008) through bottom-up approaches. The collective action is largely intended to address and curb social challenges (Seelos & Mair, 2005). Light (2006) and Novkovic (2006) also alluded to social innovation as an act of social entrepreneurship driven by individuals for the benefit of the community at large. Therefore, social innovation is a process driven by social entrepreneurs through collective action, power and resources (Pol & Ville, 2009; Cajaiba-Santana, 2014). This largely involves innovative initiatives that intend to meet social needs by delivering to communities through the creation of new products, services and organisational structures. Social innovations may also be philanthropic or market-driven initiatives intending to respond to social exclusion through programmes implemented by different types of organisations (Picciotto, 2015). The actors are organisations working collectively with the aim of responding to social exclusion or simply social challenges.

Social change also seems to be the driver of social innovations. Chell (2007) points out that social entrepreneurs focus on bringing about improved social outcomes for a particular community or group of stakeholders, rather than generating personal wealth. Seelos and Mair (2005) emphasised the social entrepreneurship concept by alluding to a number of factors. Firstly, social entrepreneurship contributes to solutions to social problems by combining innovation, resourcefulness and opportunity. Secondly, it innovates by finding a new product, a new service, or a new approach to a social problem. Thirdly, it focuses primarily

on social value creation and, in that spirit, openly shares the innovations and insights of the initiative with a view to its wider replication.

Chikumbo *et al.* (2012) uses various examples to elucidate prominent types of social entrepreneurship evident especially in developing countries. These authors allude to the Grameen Bank founded by Muhammad Yunus. The bank established a microcredit model enabling poor people worldwide to access small loans in order to improve the economic well-being of their societies. Chikumbo *et al.* (2012) further considered informal and micro-enterprises as the major actors in maintaining the livelihood and survival of a significant South African population. This is one of the examples demonstrating that actions around social entrepreneurship tend to have social objectives coupled with strong intentions to create economic gains for communities or beneficiaries. Wallace (2005) identified social enterprises as those intending only to achieve social outcomes specifically established to benefit the community as a whole, where trading is the simplest manner in which this is achieved. Therefore, as businesses and companies, social entrepreneurship aims to achieve social change and economic progress by creating economic value where the conventional market systems have failed (Chikumbo *et al.*, 2012; Perrini & Vurro, 2006; Wallace 2005). This stems from addressing system failures such as poverty, unaffordable social services, and unemployment – failures that the conventional market and public entities have not been able resolve.

ii. Profit over social responsibility

According to Harrisson *et al.* (2010), there is no common or single interpretation of social innovation, as it is complex in nature, ambiguous and contradictory. One of the greatest ambiguities of social innovation and the social economy is the non-profit or profit-driven nature of the activities. Granados *et al.*, (2011) define social entrepreneurship as the activities developed by individuals or groups of people to create, sustain, distribute and/or disseminate social or environmental value in innovative ways through enterprise operations. According to Peredo and McLean (2006), when social entrepreneurs make their time and resources available to communities or society, this is referred to as displaying corporate social responsibility. Some firms would incorporate social objectives into their goals, though they are not the main priority (Peredo & McLean, 2006). Companies and firms achieve this by devoting some of their time and resources to communities as part of their donation to society. However, this donation tends to be done in such a way that the time devoted will not compromise the time devoted to profit-generating activities of the enterprise. Therefore, social entrepreneurs use businesslike innovative approaches to offer community services, and in this manner execute social innovations. Social entrepreneurs also endeavour to maximise revenue through applying principles from profit businesses, without neglecting their main profit objectives.

The objective of this section was to identify the relationship between social entrepreneurship and social innovation. From the factors identified in the preceding discussion on social entrepreneurship, it is evident that social entrepreneurs are actors that drive innovative social interventions. Just like social innovation, social entrepreneurs aim to address social challenges stemming from market failures. Social entrepreneurship and social innovation are both interventions which rely on the presence of non-profit organisations functioning in a network. Communities and societies are the main beneficiaries of interventions of social entrepreneurship

and social innovation. Phillips *et al.* (2015) suggests that social innovation and social entrepreneurship both focus on identifying problem-solving opportunities to meet social needs.

Therefore, from this discussion, it is evident that social entrepreneurship does not occur in isolation. Social entrepreneurship requires the collaboration of actors striving to work towards a common objective. Phillips *et al.* (2015) identified the collaboration of actors where, for instance, social entrepreneurs participate in order to drive change and innovation. Such activities and models stem from the collaboration of ideas in order to bring about innovation and change. However, Phillips *et al.* (2015) also identified the challenge caused by the various institutional arrangements that the collaborating social entrepreneurs bring to the interaction. Social entrepreneurs are usually organisations and enterprises functioning under their own established institutional arrangements; therefore adjusting to different institutional arrangements of various actors in the collaborative effort tends to be challenging to some of the social entrepreneur partners.

2.6 Social innovation systems – systematic review search results

This section provides a summary of some of the prominent factors characteristic of the search results. The summary of the results was divided according to descriptive data, methodologies applied in the studies, and thematic areas of the studies found in the systematic review search. Table 2.4 illustrates the number of publications that met the criteria from the databases used for this search. There was a variation in the publications generated, as some did not necessarily give in-depth discussion on the subject of social innovation systems, but rather briefly mentioned the phrase ‘social innovation systems’ in the text. However, most search results on social innovation initiatives made use of terms synonymous with social innovation.

Table 2.4: Systematic search results

Search engine	Total results generated from the database	Studies (published in English) related to ‘social innovation systems’ and ‘social innovation’ initiatives	Duplication of publication
Google Scholar	199	66	0
Science Direct	223	38	3
Scopus	188	71	4
Ebscohost	210	16	0
Total	820	184	7

Google Scholar generated 199 results, where a combination of 67 studies focused on either social innovation systems or social innovation initiatives. The search continued to Science Direct and Scopus, where 41 studies out of 223 search results were related to the search criteria, and 188 results were generated from Scopus and 71 peer-reviewed articles focused on research related to social innovation systems and social innovation initiatives. Ebscohost generated 2 349 625 results; however, the search only reviewed up to 210 search abstracts. The review on Ebscohost was cut off after the first seven consecutive pages of the results, as most

relevant results were found only on the first three consecutive pages. Therefore, 16 relevant results were generated from Ebscohost. The total number of results generated from the databases were 820, of which 184 were relevant. Three duplicates were found in Science Direct, and four duplicates were found in Scopus as those results were already sourced from Google Scholar.

Most peer-reviewed journal articles containing the studies for the systematic review were sourced from *Technological Forecasting and Social Change*, *Research Policy*, *Technology in Society*, *Journal of Cleaner Production*, *Technovation*, *Ecology and Society*, *Technology Innovation Management Review*, *International Journal of Project Management* and the *International Journal of Business Innovation and Research*. Other results were book chapters and conference proceedings. Google Scholar had the highest number of relevant and in-depth results, while Ebscohost produced the fewest results.

Figure 2.1 illustrates that most of the empirical studies were also spread across different regions of the world, such as Europe (22), mostly in Germany; American countries (14); followed by India (8); China (7); Africa (6); and the United Kingdom (5). The focus of the studies on social innovation initiatives seemed to be more biased towards Europe, and Germany to be specific; followed by American countries where USA, Mexico and Brazil were leading. The results also pointed to an emerging interest in China, India, Africa and the UK.

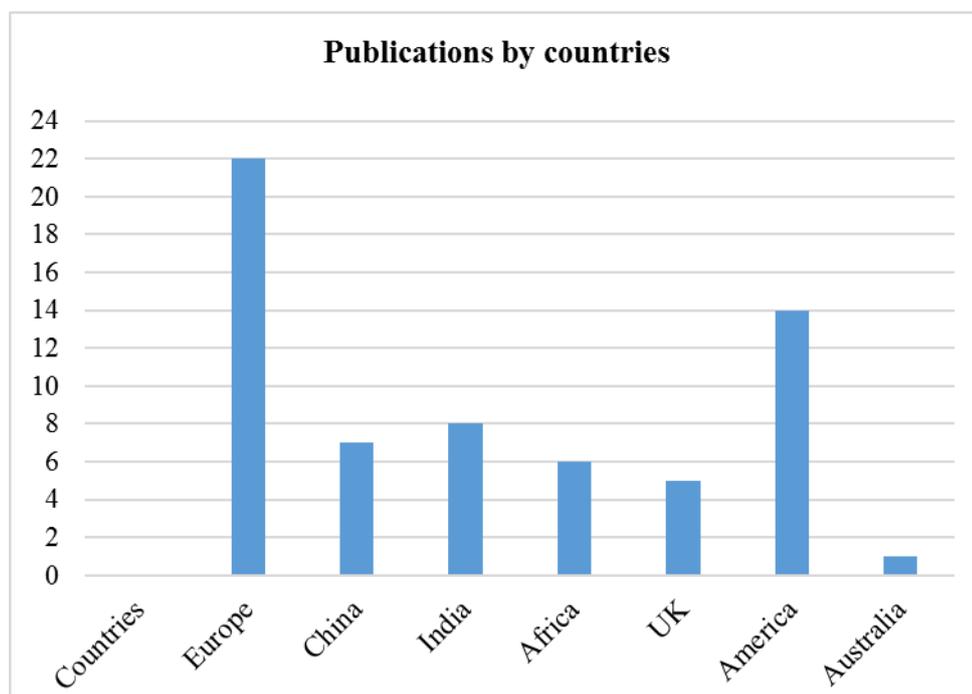


Figure 2.1: Number of publications according to countries

According to the results generated from the search, the earliest publication on social innovation initiatives was published in 1999. Figure 2.2 shows that the growth rate of the publication on social innovation systems and initiatives related to social innovation was low from 1999 to 2007. Only one publication per year was found between 1999 and 2001. There were no publications traced between 2001 and 2004; however only one

publication was found in 2005 and three in 2006. From 2007 there was a slow, yet inconsistent, growth of four publications in 2007, three publications in 2008, three publications in 2009, seven publications in 2010 and four publications in 2011. Publications grew consistently from 11 in 2012 to 46 in 2017.

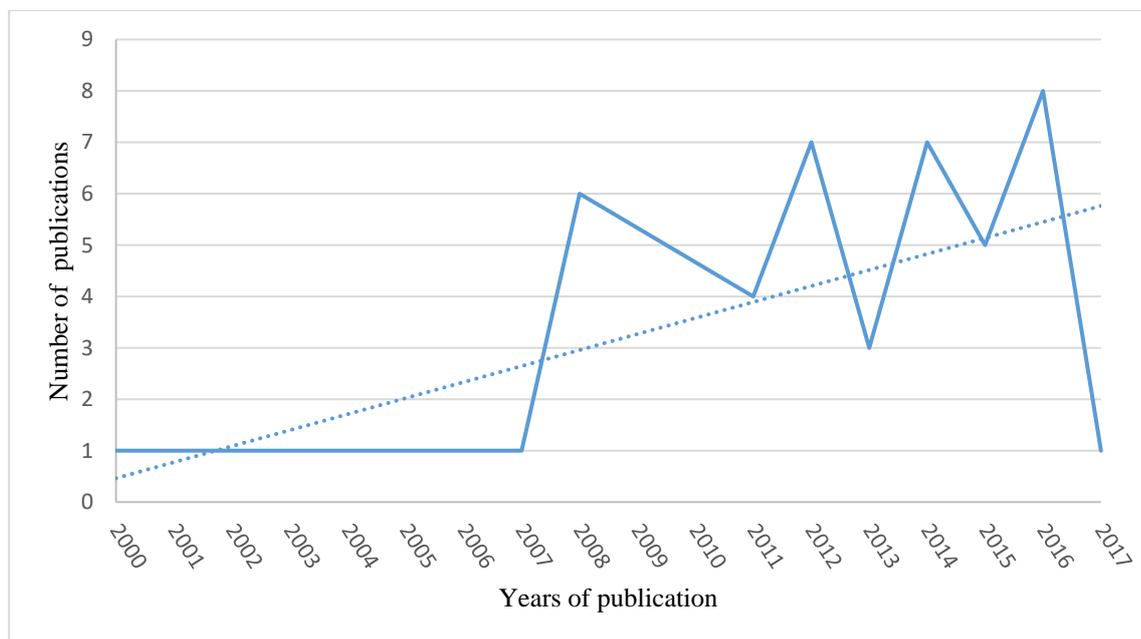


Figure 2.2: Number of publications (in English) related to ‘social innovation systems’ and ‘social innovation’ initiatives over the years

2.6.1 Thematic areas

By now it should be evident that the emergence of the concept of social innovation systems emerged from the concepts of social innovation and innovation systems. These two concepts have been discussed in the sections preceding this section. This section provides a summary of the prominent factors or schools of thought that have emerged and were common in some of the studies on social innovation systems. The following factors were the main emerging factors in the literature that was sourced from the systematic review of social innovation systems. These emerging factors were discussed as the thematic areas of the review and are as follows: the definition of a social innovation system; social transformation; the systematic nature of a social innovation system; governance; the community; and learning as an aspect of social innovation systems.

i. Defining a social innovation system

Authors such as Light (2006), Novkovic (2008) and Satgar (2014) identified the importance of collective action and interaction in social innovation initiatives. These authors alluded to how social innovation outcomes were better realised through a network of actors. However, they did not refer to the exercise or initiative as an innovation system. It was only in 2000 when this concept emerged, in Jessop (2000). Jessop (2000) made a brief or single mention of a social innovation system in his study on how business and markets should continuously innovate by improving business practices through the knowledge economy. This innovative knowledge-sharing would require the government to encourage sustained, innovative information-sharing

through industrial policy. Various studies have discussed social innovation initiatives and actors collaborating to address social needs and challenges; however there was a low number of studies on the results of a systematic review which could be defined as a ‘social innovation system’. Essentially, the concept of a social innovation system⁶ was developed to refer to innovations that intended to address social challenges and grew after 2008 (Harrisson *et al.*, 2010; Moulaert *et al.*, 2013; Picciotto, 2015). The few authors that explicitly define a ‘social innovation system’ commonly refer to it as an innovative system whose activities are intended for social benefit (Huddart, 2012; Fulgencio & Fever, 2016; Phillips *et al.*, 2015). Fulgencio and Fever (2016), Huddart (2012) and Phillips *et al.* (2015) identify a social innovation system as a system that intends to focus on a social problem or challenge that will realise social benefits.

However, the conceptualisation of the system by the different authors is devoted to different perspectives of addressing social challenges. The perspective of the social innovation system held by Huddart (2012) and Godin (2010) both give precedence to the importance of policies addressing social challenges. Huddart (2012) identifies the importance of correcting the results of “maladaptive institutions” by addressing social conditions that might, for example, negatively affect literacy rates or pose a threat to the general health of the society through outdated policy frameworks. Similarly, Godin (2010) identifies social innovation systems as innovation systems characterised by R&D, which leads national policies articulating new demands thereby responding to social welfare.

On the other hand, Fulgencio and Fever (2016) and Phillips *et al.* (2015) focus on the manner in which actors address the social challenges through collective learning. Phillips *et al.* (2015) further identify the social innovation system as comprising subsets of individual and independent actors. Fulgencio and Fever (2016) also have a different perspective on targeting social issues, as their focus is on the ‘interconnection’ of things or actors in the creation, execution and use of innovation targeted to address social issues or needs. Therefore, the pioneers of defining a social innovation system identify the policy framework, collective learning and the manner (creation, execution and use) in which actors innovate as the integral facets of innovation.

ii. Social transformation

Creating transformative results came across as a significant aspect of socially innovative initiatives (Avelino *et al.*, 2014; Avelino *et al.*, 2017; Cipolla *et al.*, 2017; Swilling, 2016). In Avelino *et al.* (2014) and Avelino *et al.* (2017), social innovation is coupled with innovation systems in order to achieve social transformation, which is considered as ‘transformational social innovation’. Therefore, Avelino *et al.* (2014) and Avelino *et al.* (2017) define transformational social innovation as the process through which social innovation challenges, alters and/or replaces dominant institutions. The attribute of transformational social innovation systems to alter or change existing institutions was also evident in Bouchard *et al.* (2015). However, Bouchard *et al.* (2015) explains that change or transformation would be related to social innovation if the pattern of dissemination and growth depended on interorganisational relations or the capacity to connect social challenges to local

⁶ May also be referred to as social innovation initiative(s) in this study.

dynamics, thereby establishing new institutional frameworks or development models. Therefore, Avelino *et al.* (2014), Bouchard *et al.* (2015) and Avelino *et al.* (2017) implied that social transformation should be coupled with a change in the current or existing institutional arrangements.

Furthermore, Swilling (2016), Avelino *et al.* (2014), Avelino *et al.* (2017) and Cipolla *et al.* (2017) present transformational social innovation frameworks by integrating concepts such as social innovation, systems innovation, game changers and narratives of change. Avelino *et al.* (2017) elaborate on the elements of transformational social innovation as follows:

- Social innovations challenge/alter/replace existing social relations and practices, primarily by co-producing new social relations, involving new ways of doing, organising, framing and knowing.
- System innovation does not relate only to a specific level of change (i.e. societal (sub)-systems), but it is about a particular type of innovation challenging institutional stability in the societal context.
- Game changers include demographic developments (e.g. aging population), ecological phenomena (e.g. climate change, biodiversity loss), sociotechnological trends (e.g. the ICT revolution), social movements (e.g. the environmental movement or the sharing economy), and socioeconomic and political challenges (e.g. the economic crisis, and subsequent unemployment, welfare state pressures, and social system reform).
- Narratives of change, empowerment, and disempowerment in transformational social innovation.

Swilling (2016) and Cipolla *et al.* (2017) apply the transformational social innovation framework in the context of urban informal settlements, but focus on the game changer theory. In contrast, Swilling (2016) proposes new categories of game changers in the African urban informal settlement context through the transdisciplinary approach by applying the transformational social innovation framework. Similarly, Cipolla *et al.* (2017) applies the transformative social innovation approach by using the game changer theory to address the social challenges of Brazilian informal settlements through their social innovation initiatives. Cipolla *et al.* (2017) mainly focuses on developing and expanding on the game changer theory, rather than testing or expanding the social innovation systems theory. Findings by Cippolla *et al.* (2017) reveal the policy measures used to address the social challenges in the Brazilian informal settlements to be the game changers themselves. Only in Angelidou and Psaltoglou (2017) was transformational social innovation coupled with sustainable development initiatives in urban settlements, yet not necessarily in the context of African urban informal settlements. Angelidou and Psaltoglou (2017) likewise attribute the ability to transform to social innovation when some form of technology is involved.

iii. The systematic nature of a social innovation system

Björk, Hansson, Lundborg and Olofsson (2014), Mehmood (2016) and Surie (2017) view the social innovation system as an ecosystem of social entrepreneurship. Surie (2017) used this concept to refer to the social innovation system as a complex ecosystem or a network of “adaptive systems composed sub-systems, building blocks and mechanisms that allow linkages to form diverse agents to interact and co-evolve dynamically

leading the emergence of order and self-organisation”. Thus far, authors in the social innovation systems field established that a social innovation system cannot exist without the formation of a network. Various authors in social innovation-related initiatives identified different factors constituting a social innovation system.

Phillips *et al.* (2015) and Cetinkaya (2012) refer to a social innovation system as a network comprising social enterprises and social entrepreneurs with the aim of driving corporate social responsibility. Cetinkaya (2012), Björk *et al.* (2014) and Surie (2017) establish that a social innovation system is a complex actor network interrelated to, and constantly evolving with, a variety of actors, organisations and institutions. Furthermore, though the social innovation system was characterised as a network always changing, it requires long-term involvement of well-established actors (such as universities, the state and firms) (Juego, 2009; Svidroňová, Meričková, Nemeč & Kuvíková, 2017) and context-specific systems (Schwarz & Howaldt, 2010; Maye, 2018).

Björk *et al.* (2014) and Surie (2017) and Westley, Antadze, Riddell, Robinson & Geobey (2014) identify social innovation as comprising two levels: the macro and the micro. The micro level referred to the organisation-level operations, while the macro level referred to the country-level operations. The micro-level actors of the social innovation system facilitate the entry of social entrepreneurship organisations and social entrepreneurs serving the needs of rural communities, and technology platforms diffusing entrepreneurship skills, thus multiplying the level of interactions in the community and facilitating linkages with external organisations which provide access to additional resources (Surie, 2017). Conversely, the macro level of the social innovation system functions to establish new government institutions which focus attention on new policies and regulations generating institutional support for linkages supporting new interactions and capabilities (Surie, 2017).

According to Phillips *et al.* (2015), the social entrepreneurs and social enterprises in the social innovation system were mostly influential in addressing social issues and promoting social development through top-down interventions. This would be when corporate enterprises imposed interventions where social challenges existed. Fulgencio and Fever (2016) further describe the assessment of social innovation systems in the form of networks, which not only constituted institutions in the public and private sectors for social innovation, but small firms, social entrepreneurs and the participation of members of society.

iv. Governance as an aspect of the social innovation system

Fulgencio and Fever (2016) present four categories of a social innovation system. The categories were as follows: institutional, organisational, both institutional and organisational, and social. Since a social innovation system is a system derived from the innovation system, the organisational and institutional factors were inherent in them (Coriat & Weinstein, 2002; Phillips *et al.*, 2015). Coriat and Weinstein (2002) identify institutions as the rules of the game through which actors operate and coordinate themselves, and therefore institutions govern the roles of the actors within the system. The rules accepted by the individual actors are meant to reduce uncertainties.

Furthermore, Juego (2009) identifies social innovation system as a more capable system than innovation systems that were focused on a specific sector or the improvement of a certain technology. This is because, such innovation systems might be less targeted at innovation that is intended to benefit society, whereas social innovation systems could accomplish the governance of innovation by society as a result of the institutional synergies necessary for socially embedded innovative activities and economic development being present. Maye (2018) similarly emphasises the importance of governance in socially embedded systems. He alludes to an example of smart technologies intended as a solution to a city's food challenges when combined with social innovation. According to Maye (2018), in such a case, flexible modes of governance would be inclusive, technologically and socially oriented, and linked to specific contexts.

v. *The community: A focal point of the social innovation system*

According to Huddart (2012), social innovation systems are an investment in society's adaptive capacity and future well-being by multi-sectoral participants. Various authors in social innovation systems theory, including Juego (2009), highlighted 'social' in 'social innovation systems' and deliberately refer to the intention of the innovation to implicate society. Fontan, Klein & Tremblay (2008), Huddart (2012), Fulgencio and Fever (2016), Konsti-Laakso and Rinkinen (2016) and Martinez, O'Sullivan, Smith and Esposito (2017) refer to communities and societies as substantial actors in social innovation systems. Konsti-Laakso and Rinkinen (2016) identify that the existence of a social problem requiring the attention of a social innovation system stems from the existence of a community.

Konsti-Laakso and Rinkinen (2016) use a case study of an initiative called "*The bee of communal economy*" to demonstrate the importance of community involvement in a social innovation system. The initiative was launched through a joint activity between the community, non-profit organisations and a research unit hosting other social innovation initiatives. Martinez *et al.* (2017) further demonstrate the importance of the community's participation by identifying the community's willingness to go beyond expectations in order to ensure new forms of relationships, collaborations and motivating connections with various social actors in the local community, in government and in other non-profit sectors.

The participation of the community whose social challenges are being addressed is crucial if a social innovation system is to achieve the intended goal (Sinclair, Mazzei, Baglioni & Roy, 2018). According to Mehmood (2016), the participation of the community contributes to the resilience of the system through bottom-up creativity between the community and other actors involved, as it contributes to the improvement of social relations, and it supports sociopolitical empowerment and therefore achieves the basic needs of the community. Martinez *et al.* (2017) have a different point of view as far as the role of community in a social innovation system is concerned: they contend that the social outcomes realised from the social innovation system are not intended to benefit private individuals or firms, but the community as a whole. Thus literature demonstrates that the bottom-up presence of the community makes a significant contribution to the social innovation system.

vi. Learning as a driver of innovation in a social innovation system

Various authors of social innovation systems literature concur that, as a transformative tool, the social innovation system is a good source of creating a collective learning environment, raising the consciousness of all the actors in the society, and building trust resulting in the productive sharing of knowledge between actors (Fulgencio & Fever, 2016; Franz, Hochgerner & Howaldt, 2012; Juego, 2009; Lan, Zhu, Mangalagiu & Thornton, 2017; Melro & Oliveira, 2017; Phillips, 2015). Through its collective and participative nature, the social innovation system creates a learning economy, as it is a learning process in itself (Juego, 2009; Lan *et al.*, 2017). In order to demonstrate the learning characteristic of a social innovation system, Svidroňová *et al.* (2017) make use of a case study based on a social housing initiative. Through the long-term community work and participation of future residents, the social housing initiative realised positive spillovers of education to future residents in their homes as one of the main factors supporting the spread of innovation. Therefore, it is evident that the participatory nature of social innovation systems coupled with empowerment and learning could be sources and results of social well-being (Franz *et al.*, 2012).

2.6.2 Gaps in the social innovation system

This review demonstrates a growing interest in the social innovation systems literature in various sectors. The literature generated from the systematic review show that a great deal of literature on social innovation systems are based on the European, American, United Kingdom and Indian contexts. Africa is one of the regions that receives the least attention in social innovation systems cases. A fraction of the results presents empirical evidence on social innovation systems in developing countries. The low contribution of social innovation systems in the context of developing countries highlighted a bias towards the developed country context. A significant number of studies present social innovation systems in developed countries such as Turkey (Suerdem, Yeniciglu & Demir, 2017), Scotland (Sinclair *et al.*, 2018), Australia (Taylor *et al.*, 2018) and Denmark (Jensen & Brandi, 2018). This demonstrates a poor concentration of social innovation systems in developing countries and contexts. The biased nature of the concentration on social innovation systems in developed countries has also resulted in a biased and narrow focus on certain sectors and types of regions.

Results of the systematic review show that vast research on social innovation systems apply various ICT infrastructure to address social challenges (Bhatt, Ahmad & Roomi, 2016; Carberry, Bharati, Levy & Chaudhury, 2019; Priante Filho *et al.*, 2013; Suerdem *et al.*, 2017). Such a biased presentation of studies on social innovation systems does not present a wider focus on this field. Social problems such as unemployment, an aging population and inadequate housing may be common to developing and developed countries. However, the infrastructure, social demographics, educational attainment and institutional arrangements may differ between communities in developing and developed countries. Therefore, the widening of the focus of social innovation systems to the context of developing countries could spread the relevance of such systems to social challenges that are more inclusive. This wider scope could also contribute to the main objective of this work, which aims to apply social innovation systems to achieving SDGs in developing countries.

Cipolla *et al.* (2017) apply a bottom-up social innovation initiative, which they related to ‘bottom-linked’ social innovation initiatives. According to Cipolla *et al.* (2017), the bottom-up innovation occurs when citizens or communities are co-creators of solutions to their social problems. Westley *et al.* (2014) and Surie (2017) also alluded to the bottom-up nature of social innovation systems. However, the composition of the social innovation systems applied in Björk *et al.* (2014), Westley *et al.* (2014) and Surie (2017) do not include the community or beneficiaries of the social innovation initiatives as actors who were co-creators or producers of solutions to their social challenges. For example, the Swedish social innovation system in Björk *et al.* (2014) consisted only of academic institutions, and support and public organisations that imposed social innovations, but did not co-create the social innovation products with the beneficiaries. Surie (2017) also presented a grassroots or bottom-up social innovation system; however, the beneficiaries of the social innovation are merely consumers rather than co-creators of their solutions.

The main objective of this work was to align the social innovation systems to the current development agenda, the SDGs. It is vital that the social innovation system gives a wide focus on social challenges that prevail. The literature search for the systematic review on social innovation systems presents a very low volume of literature devoted to social innovation systems that focus on sustainable development methods or, what would be even more useful, the SDGs. Studies by Mehmood (2016) and Surie (2017) present literature on social innovation initiatives that focused on sustainable development methods, but not on SDGs. Mehmood (2016) focused on United Kingdom-based towns, while Surie (2017) presented sustainable development initiatives in rural India. The social innovation initiatives that focused on sustainable development however did not focus on addressing a spillover of SDGs that result from their initiatives but rather provided a narrow focus of addressing a particular objective. Furthermore, the studies lacked variety in the presentation of different types of regions in which social innovation initiatives are focused on sustainable development. Therefore, the following section presents the similarities and relation between SDGs and social innovative initiatives.

The existing framework on social innovation systems accounts for the various aspects of innovation systems in that social innovation systems theory borrows from the various types of innovation systems by accounting for the spatial aspect of the innovation, and the economic, sectoral and social aspects of innovation systems. The social innovation systems framework that exists is still at an abstract or theoretical stage in that it has not been applied in a practical setting that lacks proper social intervention where a system constitutes actors from various sectors. The sectoral innovation systems account for actors that focus on innovation systems intended to gain innovative results in specific sectors. An example of a sectoral innovation system would be in the form of different stakeholders in the health sector consisting of medical practitioners, pharmacists, professionals that deal with medical equipment, professional nurses and researchers in the public health sector who are determined to improve the services in their sector. Likewise, a regional innovation system might aim to realise innovative outcomes in specific regions. For example, an innovation system would only comprise actors that are physically based in a specific area or region, such as an urban area or a rural area, a continent or a province.

This literature review also tries to understand the overlaps between social innovation and social entrepreneurship. Understanding the relation between the two concepts was instrumental in demonstrating how these two concepts stem from a combination of economic and social objectives. The existing conceptualisation of social innovation systems has brought together all the various forms of innovation. However, the innovative objective in the current literature is neither necessarily economic, nor sectoral, nor does it focus on actors in one specific region.

The discussion on social innovation and social entrepreneurship showed that the social entrepreneurship actors involved tend to be more profit-driven, making the social objective less of a priority. This runs the risk of less time and effort being invested in addressing a social objective and greater focus being directed at profit generation. Therefore, the objective of this work was to establish a system or approach whose focus was less on profit or financial gain and largely on improving social outcome through innovative methods. Being innovative in this case could mean a system that requires the involvement of professionals and technological resources to benefit a collective, rather than meaning a mere social improvement that benefits a single entrepreneur.

This section has identified the prevailing factors of social innovation systems, while also demonstrating the limitations of the existing social innovation systems. The section also assessed the overarching factors of the social innovation systems that are relevant to the focus of the study. These overarching factors are: social innovation systems; social transformation; the systematic nature of a social innovation system; governance; the importance of the community; and learning. These factors are factored into the social innovation systems framework that is used in this study. However, even though these factors of social innovation have been identified as important factors for the social innovation systems framework, they are not sufficient to achieve the objective of this chapter as they do not account for the achievement of SDGs in the context of the informal settlement. The rest of the sections of this chapter do that.

2.7 Social innovation systems as a catalyst for sustainable development goals

From the outset, the definition of social innovation systems demonstrates the attributes matching those of SDGs. According to Huddart (2012), social innovation systems are designed to address maladaptive institutions, outdated policy frameworks and disruptive means, in order to improve outcomes on social issues such as population increase, environmental degradation and health threats. Similarly, the intention of SDGs is to address the corrosive effects of socioeconomic development on the environment, through addressing the socioeconomic needs of the present generation, without compromising the ability of future generations to meet their needs (United Nations, 2016; Allen *et al.*, 2016). Therefore, the two definitions demonstrate a common objective of correcting socioeconomic effects on the environment.

Similar to the aim of some social innovations (Huddart, 2012; Moulaert *et al.*, 2013) and social innovation systems (Fulgencio & Fever, 2016; Huddart, 2012), the aim of the United Nations (2016) with the SDGs (1–9) is to address the needs of poor communities to support the development of all countries. This objective is

contained in SDG 11, which is to renew and plan cities and other human settlements in a manner fostering community cohesion and personal security, while stimulating innovation and employment. Angelidou and Psaltoglou (2017) focus on local development agendas of cities and urban spaces by coupling sustainable development approaches with socially innovative methods through the growth of networks, giving priority to sensor, entrepreneurial, collaborative and sharing citizenship. Therefore, the similarities between sustainable development and social innovation systems rest on their common primary objective of addressing the mistakes caused by human activity to society and the environment, and to provide institutions and engines to meet these objectives. The social dimension is one of the main attributes of SDGs and social innovation systems contributing to the innovative capacity. Huddart (2012) demonstrates a social innovation system based on shared values, which comprises organisations advancing environmental and social goals in collaboration with communities through sharing their resources with the community sector partners through strategic alliances, funding, and skills and technology transfer. Huddart (2012) also discusses intersector partnerships that innovate under challenging social conditions, environmental conditions and competition, and whose constraints are addressed through new government partnerships and ideas supporting collaboration and innovation.

In social innovation systems, governance and institutional relations are facilitators of innovative actions applied to achieve social and environmental innovation (Huddart, 2012). SDG 16 envisages peaceful and inclusive societies based on respect for human rights, the rule of law, good governance at all levels, and transparent, effective and accountable institutions (United Nations, 2016). Simply put, governance refers to the manner in which government policy and intervention contribute to sustainable development and social innovation systems. Governance in the form of government participation appears as an integral element of social innovation systems (Huddart, 2012; Mehmood & Parra, 2013). Furthermore, governance is not only dedicated to public and general participation and reporting (Mehmood & Parra, 2013). Governance in social innovation regulates the participation and therefore power through ensuring SDGs are distributed at all levels of the system through public empowerment and wider engagement of civil society. Therefore, through social innovative networks, institutions are better able to facilitate adaptive governance.

SDG 9 of the SDGs aims to achieve the building of resilient infrastructure to promote inclusive and sustainable industrialisation and to foster innovation, while SDG 16 aims to promote peaceful and inclusive societies for sustainable development, to provide access to justice for all, and to build effective, accountable and inclusive institutions at all levels. According to García *et al.* (2015), inclusion is one of the primary factors of social innovation, contributing to creativity through collective action and participating in a network. According Mumford and Moertl (2003), social innovation is a form of creativity encouraging the formation of new institutions, new industries, new policies and forms of social interaction. Creativity is achieved through adapting and merging existing and new ideas and finding new and improved ways of interacting. Sustained creativity also contributes to sustainability through new ideas, resilience and adaptation. André and Abreu (2009) back up the importance of creativity and adaptation in social innovation by referring to the ways in

which governance promotes creativity, together with social inclusion and empowering vulnerable actors through creative governance models in the form of new policies, projects, practices and people.

SDG 17 focuses on strengthening the means of implementation and revitalising the Global Partnership for Sustainable Development (United Nations, 2016). According to Mumford and Moertl (2003), external involvement of actors could contribute to sustainable learning, thereby avoiding lock-in and low innovative capacity in the system. Social innovation systems arise from the interaction of diverse external actors possessing different types of expertise and knowledge. Mumford and Moertl (2003) elaborate on the innovative results of how scientific management, the spread of the mass production industry, the need to rely on a relatively unskilled and poorly educated immigrant workforce, and the increased complexity of production technologies prove to create conditions resulting in a structure provided by attractive scientific management to future users. In this way, external interaction results from diverse inclusion of actors and approaches in reaching new solutions and improved inclusion.

Innovation rests on sustained external interaction for various reasons common to innovation, such as learning, adaptation, and growth or expansion. Literature on social innovation prioritises the formation of external interaction for sustained innovative learning and capacity building. Learning is an integral part of innovation, as it continuously spurs the generation of new information and ideas. Learning and inclusion of diverse actors further appear to be a common factor in ensuring preventative measures in development initiatives. This principle gives rise to factors such as collective participation, adaptation and the generation of new ideas through learning, which are common to both sustainable development and social innovation systems.

SDG 15 focuses specifically on managing forests sustainably, halting and reversing land and natural habitat degradation, successfully combating desertification, and stopping the loss of biodiversity. All these efforts combined aim to ensure that the benefits of land-based ecosystems, including sustainable livelihoods, will be enjoyed for generations to come (United Nations, 2016). The World Conservation Strategy stresses the following: “We have not inherited the earth from our parents, we have borrowed it from our children”, thus introducing a notion very similar to intergenerational equity (Harding, 2006). Social innovation theory focuses on the continuity of sustainability devoted to prolonged innovativeness. This innovativeness is inclusive of the environment, and is balanced with local heritage, culture, economic practices and ecological balances.

Mia'heme (2013) and Hahn and Knoke (2010) demonstrate the commonality of the intergenerational aspect in sustainable development practices and social innovation systems through scenarios of equity and participation. Mia'heme (2013) uses a social innovation system example of a community that collaborates to improve community members' access to accommodation in order to meet the needs of poor families. The project resulted in long-term community building through improved housing, which spilled over to neighbourhood infrastructure, including improved roads and stormwater drainage, as well as a piped water system. This initiative contributed to environmental conservation that was implemented to prevent flooding and water harvesting.

Hahn and Knoke (2010) propose sustainable forestry approaches through participatory elements which lead to intergenerational and intragenerational fairness. This approach is meant to feed into long-term and future-oriented management in consideration of future generations. Hahn and Knoke (2010) attributed the qualities of equity and fairness to inter- and intragenerational approaches. Mehmood and Parra (2013) concur with the attribute of equity and fairness that was achieved through the inter- and intra-generational principle of creating social innovative initiatives. They refer to the intergenerational principle as the team spirit inherent in the objective to satisfy human needs by communities or societies. This is achieved by connecting the rights of contemporary societies with past and future generations. Intragenerational equity occurs when the needs of present societies aim to achieve fair distribution of resources for the well-being of nations and communities.

Without disregarding the importance of fairness and participation in the intra- and intergenerational principle, the examples by M'ia'heme (2013), Hahn and Knoke (2010) and Mehmood and Parra (2013) also demonstrate that lifelong learning and continuity are necessary for sustainable development and social innovation systems, especially during and after the inception of the development initiative. These examples also demonstrate that innovation rests on sustained external interaction for various common reasons such as learning, adoption, and growth or expansion.

SDGs 1–8 ensure access to socioeconomic services and resources for all. These goals constitute the ending of poverty and hunger, and promoting food security, health and well-being, equitable and inclusive education, gender equality for women and girls, improved sanitation, affordable energy and access to decent work. According to Degert *et al.* (2016) and Mehmood and Parra (2013), the interactive nature, the grassroots approach, achievement of local objectives from a global perspective, equity (fairness) and equality (participation) are some of the inherent factors in sustainable development literature. Additional to these factors are social exclusion, social capital and governance (Manzi, Lucas, Lloyd-Jones & Allen, 2010).

Manzi *et al.* (2010) and Bailey (2010) concur with the statements above, attributing sustainable development to the strong sense of support from different actors at all levels: community, local, regional and national governance. This corresponds with the importance of the interaction extended to the actors that are required in the developmental process. Therefore, the collective and interactive aspect of sustainable development resonates with the importance of the inclusion of all actors and the fulfilment of the extensive community needs required for the achievement of social, economic and environmental objectives. This type of collective inclusion resonates with the importance of participation, equality and equity. Much of the development literature further linked the equity and equality to heterogeneous actors, the participation and inclusion of which largely ensured trustworthy interactions that could achieve social, economic and environmental development.

Collective action, equity, equality, participation and inclusion are also popular in people-centred development and sustainable development. People are central actors to sustainable development as the development was intended for the people but also in strong consideration of the environment. Furthermore, sustainable development gave priority to society level goals, which concerned the people. Mehmood and Parra (2013) and

Hulgård and Shajahan (2013) relate the execution of social and people-centred goals to social innovation and governance. Social innovation also holds similar attributes through the primary focus on basic needs, improvement of the quality of the environment, social relations, governance, empowerment and social justice (Hulgård & Shajahan, 2013; Mehmood & Parra, 2013).

The similarities between the SDGs and social innovation systems were inherent in most of the sustainable development goals. These similarities rested largely on their common primary objective of addressing the global challenges caused by human activity in dealing with society and the environment, and the availability of institutions and engines to meet these objectives. The social dimension was one of the main attributes of SDGs with social innovation systems therefore contributing to the innovative capacity. Just like other forms of innovation, social innovation takes place through a system of collective actors and ideas. The social element refers to the manner in which actors or firms organised themselves and carried out the production and integration of new knowledge in a collective manner. The social element is also qualified through a social activity structured at a systemic level, rather than through individual actors, therefore resulting in one of the three social structures, namely cultural, normative and regulative (Guico, 2011; Pol & Ville, 2009).

In addition to collective action and social purpose, Gerometta, Haussermann and Longo (2005) categorise social innovation according to three dimensions: the satisfaction of human needs (content dimension); changes in social relations, particularly concerning governance (process dimension); and improvement in sociopolitical capability and access to resources (empowerment dimension).

This section demonstrates the significant overlaps between social innovation systems and SDGs. Going forward, it is important to note overlaps between social innovation systems and SDGs in the context of urban informal settlements. This is demonstrated in the following section.

2.8 Linking urban informal settlements to social innovation systems

Some literature on innovation activities focuses on the informal sector; however there is very limited literature on innovation activities and social innovation systems focused on informal settlements. Kraemer-Mbula (2010, 2016), Guttentag (2015), Sheikh (2014) and Daniels (2010) give attention to innovative activities in the informal sector. Kraemer-Mbula and Wamae (2010) acknowledge that innovations in non-developed, unindustrialised areas and informal sectors spread across various sectors, such as manufacturing, social services and the financial sector. Kraemer-Mhula (2010) focused considerably on the innovative activities in the informal economy in terms of technology use and capabilities, knowledge use and transfer/share, and the development of the informal sector, including the various informal enterprises contained in it.

It should be borne in mind that the focus of this study was narrowed to social innovation activities in informal settlements, and rather than being limited to entrepreneurial objectives, the study investigated social objectives such as addressing the lack of social services. Existing literature on innovative activities within the informal sector predominantly focuses on entrepreneurial activities in the informal economy (Links, Hart & Jacobs, 2014; Wamae, 2010). Most literature on innovative activities deals with the interactions whose objectives are

largely profit-driven, and therefore entrepreneurial in nature. Thus far, Cozzens and Sutz (2012)⁷ have given attention to innovation activities in informal settlements. However, the framework of Cozzens and Sutz (2012) on informal settlement innovations is built on only some of the criteria upon which research on innovations in informal settings should be based. The criteria are as follows: focus on the grassroots; look for both women and men as innovators; describe, do not prescribe, the roles of formal organisations as they appear in informal settings; ask, do not assume, that systems of interaction exist; keep the larger picture of economy and society in mind; and try to understand how innovation in a given informal setting interacts with other sources of knowledge.

Based on the criteria of Cozzens and Sutz (2012) and Fulgencio and Fever (2016), as well as the collective literature discussed in this chapter, this study developed a transformative social innovation systems approach as a means of achieving SDGs. Figure 2.3 shows the composition of a transformative social innovation system aiming to achieve SDGs specific to the context of the social problem and the type of setting, which in this case is informal settlements. This stems from developing countries tending to have a different composition of organisations and institutions and different approaches to addressing social challenges. The SDGs applied to both developed and developing countries. According Allen *et al.* (2016), the sustainable development goals represent a rather wider spectrum, integrated, complex and challenging agenda for countries to implement. This approach acknowledges that social innovation systems have to be adaptive in order to address SDGs. Hence, there cannot be a one-size-fits-all approach to addressing social problems.

⁷ According to Cozzens and Sutz [check spelling] (2012), informal settlements are places where marginalised people live and work. In this case, the focus is on innovation in the parts of the informal economy that intersect with the lives of marginalised households and communities.

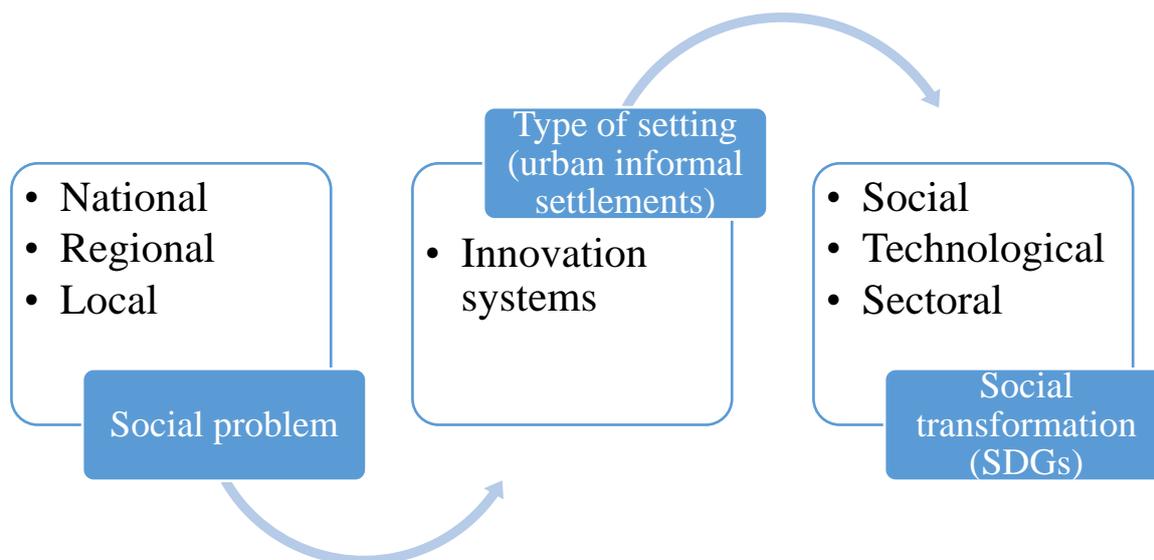


Figure 2.3: Transformative social innovation system for urban informal settlements

Figure 2.3 depicts a transformative social innovation system framework for this study. The framework aims to achieve SDGs in urban informal settlements. The framework has a transformative character owing to its objective to alter existing social relations and practices by challenging institutional arrangements – thereby addressing a social problem (Avelino *et al.*, 2014, 2017; Swilling, 2016; Cipolla *et al.*, 2017). This framework was informed by the review conducted in Sections 2.7, 2.8 and 2.9. The basis of this framework stemmed from the social innovation systems framework by Fulgencio and Fever (2016). The framework recognises the national, regional and local level of innovation systems, as shown in innovations systems literature, as well as in the conceptualisation of social innovation systems by Fontan *et al.* (2008), Fulgencio and Fever (2016), Zajda (2016), Verschraegen and Sabato (2016) and Hou and Han (2016).

Figure 2.3 is divided into six elements conjoined by feeder arrows. The first element (on the left) illustrated the spatial aspect of the framework comprising three types of innovation systems: national, regional and local. These types of innovation system appeared to be the crucial elements of innovation, social innovation systems and the transformative social innovation approach. They represented the importance of the spatial dimension of social innovation systems. This spatial observation related to social innovation systems is evident in the work of Fulgencio and Fever (2016), Zajda (2016), Verschraegen and Sabato (2016), Hou and Han (2016), Klein *et al.* (2015), Avelino *et al.* (2014) and Avelino *et al.* (2017). The spatial approach acknowledges that the innovation process is affected by national, regional and local contexts, as well as by circumstances such as policy and infrastructure. Furthermore, the spatial aspect of innovation systems stems from regional characteristics (Cooke *et al.*, 1997; Cooke, 2001; Kubezko *et al.*, 2006). Actors may decide to be part of an innovation system because of the advantages of being in the same physical space or region. Spatial conditions, such as physical infrastructure and the ease and convenience of contact, also tend to be influential in the

establishment of a regional, national or local innovation system. Doloreux and Parto (2005) allude to the manner in which actors or enterprises in a metropolitan area tend to find it easier to innovate collectively as this offers spatial, technological and institutional proximity. Doloreux and Parto (2005) further allude to the factors encouraging the interaction of organisations within the same space, such as cities or regions, to act as actors of confluence. This is firstly because they follow specific rules. Secondly, they commonly possess material and tangible elements, and, thirdly, they change continuously owing to the learning processes and the acquisition of expertise, cooperation and networks around them coupled with their strategies. Likewise, organisations in the southern African region would find it more convenient to interact owing to certain characteristics which are common in their countries of origin. Therefore, the spatial aspect of the innovation system represented the flow of information, resources and efforts among the actors (individuals, enterprises, organisations and institutions), contributing to the national, regional and local level of innovative process, activities and outcomes.

Below the cell depicting the types of spatial innovation systems (national, regional and local) is the second element, the 'social problem'. A brief summary of the major factors that arose in the above-mentioned discussions is provided in order to avoid repetition of Sections 2.3, 2.7.1 and 2.8. It was established that social innovation, innovations in informal settlements (Cozzens & Sutz, 2012) and social innovation systems stem from the urge to address some kind of prevailing social problem whether at the national, regional or local level. The aspect of addressing a social problem through a social innovation system and social initiative arose as the main focus or outcome of the initiative (Fulgencio & Fever, 2016, Phillips *et al.*, 2015, Huddart, 2012). The social aspect further stems from the objective of achieving collective gains or creating a social innovation system inclusive of the community in the innovation process, as well as collective beneficiaries of the social initiatives (Fontan *et al.*, 2008; Fulgencio & Fever, 2016; Huddart, 2012; Konsti-Laakso & Rinkinen, 2016; Martinez *et al.* 2017). According to Avelino *et al.* (2014), Avelino *et al.* (2017), Cipolla, (2017) and Swilling (2016), addressing a social problem should result in some form of social transformation. Such would be the case if the transformation is related to social innovation and the execution relies on interactions related social challenges to local dynamics, thereby achieving new institutional or development frameworks (Bouchard *et al.*, 2015).

The third element in the framework is 'innovation systems' and was discussed in Section 2.4. Addressing any social problem demands a component of an innovation system formed by organisations and the institutions. This stems from the network formation, activities and roles in the network (Avelino *et al.*, 2014; Avelino *et al.*, 2017; ; Björk *et al.*, 2014; Fulgencio & Fever, 2016; Surie, 2017; Westley *et al.*, 2014). The organisations are the actors present and active in the network, while institutions are the institutional arrangements designed to ensure steady and consistent execution of social innovations (Huddart, 2012; Fulgencio & Fever, 2016, Avelino *et al.* 2017). Huddart (2012) further referred to this process as "addressing complex problems from multiple perspectives, using a range of means to transform problems and their contexts into matrices for new understanding, new approaches, and potentially, the emergence of new systems".

The fourth element of the framework illustrates the type of setting in which the social innovation system occurs, namely an urban informal settlement. The characteristics of an informal settlement are discussed at length in the introductory section. Essentially, informal settlements are unplanned residential settings in which there is uncontrolled inflow of population and erection or building of houses. The houses are predominantly constructed of metal sheets or mud bricks. Informal settlements are rife with high levels of socioeconomic problems, and a lack of social infrastructure. Settlements are of an informal nature and are established in urban areas where innovation systems are created by social entrepreneurs, organisations, institutions, local associations and the community (Cetinkaya, 2012; Phillips *et al.*, 2015). Adding the informal settlement factor in the framework was evident in the application by Swilling (2016) and Cipolla *et al.* (2017) of the transformative social innovation framework. Angelidou and Psaltoglou (2017) coupled social innovation and sustainable development with urban settings, positioning citizens as the main actors or beneficiaries in different capacities.

The fifth element of the transformative social innovation system for the urban informal settlement framework groups together ‘social’, ‘technological’ and ‘sectoral’. Fulgencio and Fever (2016) elaborate on these factors as being a balance between profit-making activity and the increased involvement of the society. This literature review established that innovation has mostly been attributed to economic and profit-generating-related activities and sectors – the application and improvement of technological activities but not including the society. In this case, this implies that the society should govern the market. There should therefore be less focus on the profit-making activity, and increased involvement of the society, which is the social innovator and leader of the innovation process. Therefore, this framework accounts for society as the main actor in the innovation system, where the focus is not on individual needs, but rather on the needs of the society as a whole. Finally, the last element illustrates ‘social transformation (SDGs)’, indicating the ultimate objective of the framework, which is addressing the SDGs and thereby achieving social transformation of urban informal settlements.

2.9 Conclusion

The purpose of this chapter was to examine critically the extent to which social innovation systems could deliver SDGs in urban informal settlements. Upon discussing the various aspects of the different types of innovation, this chapter conceptualises the achievement of SDGs in an urban informal settlement through social innovation systems. Literature reviewed in this chapter largely demonstrates innovation activities predominantly related to entrepreneurial aspects in formalised and developed contexts. However, with the aid of some of the innovation, social innovation and social innovation systems literature, this chapter further demonstrates the importance of the context-specific approach to innovation. This chapter was able to drive the focus of the study in terms of the context of informal settlements. The framework devised in this chapter also establishes a social innovation systems approach that would be specific to the social problem, requiring and comprising specific skills and resources. Therefore, the framework establishes a social innovation systems

approach which could evolve, depending on the complexity of the social problem in complex settings such as informal settlements.

The social innovation system is a type of social innovation in which some form of economic activity is a means to realising the objective or outcome of the initiative. Most of the innovations discussed above were largely intended for economic benefit and would be driven by entities that are interested in economic gains that would eventually realise spillovers in the form of social benefits. Therefore, the social innovation system for this work sourced its foundation from the existing social innovation systems framework by Fulegicio and Fever (2016). What is unique about this approach is that it accounts for the urban informal settlement through actors in various sectors. The actors are mainly non-profit-driven organisations that are not interested in economic gains, but rather social outcomes for the beneficiaries and the urban informal settlement. This social innovation system also introduced the aspect of informal settlement by accounting for the nature of the social systems and arrangements that are inherent in informal settlements and the urban type of setting in which the social innovation system outcomes occur. This work focuses on the urban informal settlement owing to its complex nature of spiralling complex social issues.

Chapter 3: Accessing renewable energy through social innovation systems to create sustainable communities in African urban informal settlements: A systematic review

3.1. Introduction

This chapter aims to achieve the second objective of this study: to establish the social innovation systems that facilitate sustainable communities and cities in African urban informal settlements, specifically focusing on access to renewable energy. The literature review in Chapter 2 establishes social innovation systems as the interconnection of things or actors in developing, diffusing, and utilising innovation targeting social issues or needs (Fulgencio & Fever, 2016). Huddart (2012) also identifies social innovation systems as systems designed to address maladaptive institutions, outdated policy frameworks, and disruptive means in order to improve outcomes in respect of social issues, such as population increase, environmental degradation and health threats. A framework coupling SDGs and social innovation systems in urban informal settlements was therefore established. This was done in order to couple this novel concept with the current development agenda, together with a specific focus on renewable energy.

The behaviour of a state's energy system rests on the quantity, infrastructure, use, supply and quality of energy, which, in turn, influences technical, economic, political and social changes (Sokona, Mulugetta & Gujba, 2012). The provision of energy has been a challenge across Africa, and it has been predicted that it will be a continuous problem up to 2030 (Brew-Hammond, 2010). Sokona *et al.* (2012) attribute this to the poor availability of modern electricity and to the burgeoning population of the continent. In comparison to northern Africa, the sub-Saharan African region has the highest, and rising, population still relying on traditional biomass, which demonstrates the poor provision and access to energy (Brew-Hammond, 2010). The poor availability of energy has resulted in obstacles to achieving development and ensuring the well-being of the continent at large. In order to combat the spiralling energy crisis, renewable energy was presented as a viable alternative option to the energy crisis for the poor.

This chapter undertakes a systematic review in order specifically to understand the extent of studies on coupling the concept of social innovation systems with SDGs and renewable energy activities in African urban informal settlements. Existing systematic reviews conducted on the work related to social innovation systems by Fulgencio and Fever (2013) and Fulgencio and Fever (2016) cover a broader focus whose outcome contributed to the theoretical development of the concept. However, other non-systematic review contributions to social innovation systems literature are diverse. They range from theoretical and conceptual contributions to empirical work related to project and organisational management (Hobbs, Aubry & Thuillier, 2008), territorial dynamics and regional innovation systems (Fontan *et al.*, 2008; Pohl, 2015; Verschraegen & Sabato, 2016; Zajda, 2016), technological innovations (Huddart, 2012) and sectoral innovation systems (Aubry, Hobbs & Thuillier, 2007; Viquez-Abarca, 2012).

Despite the existing studies, social innovation systems literature is still rather niche, and hence there is a need to examine the extent to which it is aligned with SDGs in addressing social issues and needs. This systematic review focuses on the empirical work on renewable energy activities in African urban informal settlements. Thus far, literature reveals that social innovation systems theory is still in its early and developmental stages but is one of the integral approaches to addressing socioeconomic challenges. For these reasons, social innovation systems, African urban informal settlements and renewable energy are the overarching elements of this chapter.

3.2 Methodology

The review embarked on a qualitative systematic scrutiny. This was done to assess the availability of literature on social innovation systems facilitating sustainable communities in relation to renewable energy in African urban informal settlements. The purpose of the review was to establish the extent to which literature has been devoted to the subject, and to discover the gaps that exist therein.

No particular period was assigned to the search. This was due to the need to ensure a wide coverage of results. The selection process of abstracts and introductory chapters focused mainly on peer-reviewed articles, grey literature and book chapters published in English. The focus of the literature was on renewable energy activities in the urban informal settlements of towns and communities in African countries.

The inception of this review was achieved through applying the “quick and easy” search technique and the ‘building block’ search technique (Dinet, Favart & Passerault, 2004; Sternfeld, 2010). The quick and easy search technique was applied with the aid of the Stellenbosch University library homepage search, and some of the databases. Google Scholar, Scopus, EBSCOhost, Sabinet and Science Direct databases were used for the search. The quick and easy search technique was applied in order to obtain an overview of the work published on the subject from multiple databases. The building blocks search technique required the creation of a table showing possible synonyms for the search, also known as the Boolean search (Arnold & Voss, 2004; Dinet *et al.*, 2004; Sternfeld, 2010). The Boolean search allowed for the combination and use of the keywords established through conjunctions such as ‘and’ and ‘or’ and modifiers such as ‘not’ to produce as many relevant results as possible (Benson & Magee, 2013). Table 3.1 shows the additional keywords for the search used along with the phrase ‘social innovation system’. Through the Boolean search, the keywords were presented as follows: ‘social innovation systems’ OR ‘social innovation’ AND ‘renewable energy’ OR ‘green energy’ OR ‘sustainable energy’ OR ‘clean energy’ AND ‘African’ OR ‘Africa’ AND ‘urban informal settlements’ OR ‘informal settlements’ OR ‘slums’ OR ‘shacks’ OR ‘low-income households’).

Table 3.1: Keywords and synonyms for the systematic review search

AND

KEYWORDS					
Social innovation systems		Renewable energy	African	Urban informal settlements	OR
S Y N O N Y M S	Social innovation	Green energy	Africa	Informal settlements	
		Sustainable energy		Slums	
		Clean energy		Shacks	
		Energy			

3.3 Research outcomes relating social innovation systems to renewable energy and urban informal settlements in Africa

Based on the selection criteria of this study, the results from all the search engines combined generated 26 relevant results. The results had to be on research focused on addressing a social challenge in an African urban informal settlement. Owing to the lengthy nature of the results, the list of the results generated from the search is contained in Appendix 1. Firstly, none of the results necessarily fit the search criteria in relation to ‘social innovation systems’ coupled with the other concepts listed in Table 3.1. However, most of the results were generated from the search conducted on ‘social innovation’ coupled with the concepts contained in Table 3.1. While going through abstracts and introductory sections of the chapters and articles of the search results, the search further scouted for research containing the words ‘social innovation’, as well as other concepts synonymous with social innovation. The results further contained work which used concepts synonymous with social innovation initiatives, such as ‘bottom of the pyramid’, ‘community development’, ‘inclusive participation’ and ‘collective action’ (García *et al.*, 2015; Pansera & Owen, 2015).

The assessment of the relevant articles sourced from the search was done according to the elements of the transformative social innovation system for urban informal settlements framework established in Section 2.9 of Chapter 2 of this study. Already two components of the framework, the social problem and whether the community is in an African urban informal settlement, were evident in the results during the selection phase. Therefore, the analysis of results for this systematic review firstly focused on the spatial nature of the social innovation system applied to address a certain social problem in an African urban informal settlement. The

second component of the analysis focused on the types of renewable energy prevalent in African urban informal settlements. Thirdly, the analysis focused on the composition of the social innovation systems established in an urban informal settlement through social, technological and sectoral innovations. Lastly, the analysis discussed the relevance to which the interventions aimed at addressing the challenges were able to achieve some SDGs.

Table 3.2: Results generated from the databases used for the search

Database	Results
Google Scholar	14
Scopus	4
EBSCOhost	0
Sabinet	3
Science Direct	2
Total	23

3.3.1 Spatial characteristics of innovation addressing energy crises in African urban informal settlements

Local level innovation systems are more popular in addressing most of the energy crises faced by African urban informal settlements (Dobson, Nyamweru & Dodman, 2015; Toomey, 2010). Local activity is evident in local- and community-led cooperative associations and household level interventions (Aitken & Jones, 1997; Brown Leary, Davies, Batchelor, & Scott, 2017; Dobson *et al.*, 2015; Toomey, 2010). In Dobson *et al.* (2015), the local-level intervention is realised through the Ugandan informal settlement called Kawempe. Kawempe informal settlement's community members joined together to manufacture briquettes from recycled material for cooking and selling. Most of the local- and community-level interventions are aimed at addressing the lack of social services, including energy, to generate income to improve their livelihoods (Toomey, 2010), unclean and expensive cooking methods (Brown *et al.*, 2017; Caniato; Carliez & Thulstrup, 2017). Some interventions focus on improving energy use and preference (Aitken & Jones, 1997; Brown *et al.*, 2017; Kimemia & van Niekerk, 2017; Jiusto & McCauley, 2017) and the affordability of energy sources (Van Horen, 1994; Kivuitu & Njino, 2013; Ogunsola, 2017).

Regional actors involved in addressing challenges are meant to address the accessibility of the required energy in African urban informal settlements. The regional actors are in the form of metropolitan municipalities, provincial level associations and NGOs (Aitken & Jones, 1997; Otsuki, 2016). Regional or provincial level interventions are driven by challenges related to accessing electricity and different forms of energy for cooking in urban areas (Jiusto & McCauley, 2017), energy-use preference (Aitken & Jones, 1997) and energy generation through biogas methods (Otsuki, 2016). One example of a regional level intervention is evident in Otsuki's (2016) regional level innovation system which comprises the local NGO, city council and regional UN-HABITAT for Kibera in Kenya. The intervention entailed the production of sustainable renewable energy for the Kibera informal settlement through biogas for cooking sourced from sanitation waste materials.

The function of (inter)national level interventions are evident through national and multinational organisations offering humanitarian support to African urban informal settlements. National level interventions focus on the creation of safe cooking equipment, methods and sources. Kimemia & van Niekerk (2017) focus on nationally approved stoves by the South African Bureau of Standards. This intervention focuses on the application of a national standard approval for non-pressure paraffin stoves and heaters by replacing them with liquid petroleum gas stoves and solar power for off-grid lighting, thereby decreasing the prevalence of shack-fires in South African urban informal settlements.

3.3.2 The types of energy inherent in African urban informal settlements

Interventions related to accessing energy sources in African urban informal settlements are related to making available safer, affordable and accessible sources of energy. The sources of energy in question cut across the different sources of energy used for either cooking, heating or lighting. The sources of energy that proved to be undesirable in respect of safety were candles, 'imbaula' (wood fire in a tin), kerosene (paraffin) and illegally connected electricity (Jiusto & McCauley, 2017; Van Horen, 1994; Mathenge, 2013). Sources of energy used for lighting in African urban informal settlements are predominantly candles and illegal electricity connections. However, these sources (although affordable compared to electricity) are established as unsafe, unsustainable and unreliable as they could result in fire. In the case of illegal electricity connections, unaffordability and disconnection due to overloading are major challenges.

Apart from lighting, other sources of energy, such as open wood fire and kerosene are mostly used for cooking and heating up homes during cold days. The disadvantages identified with using kerosene and open wood fire is the effect it has on the taste of the food and the unhealthy fumes emitted. The fumes emitted have negative effects on the general health of those in close proximity to the fire.

Solar energy, biogas, electricity and liquid petroleum gas are suggested as safer and more sustainable sources of energy (Brown *et al.* 2017; IMIESA, 2013; Kimemia & van Niekerk 2017; Taylor & Peter, 2014). Taylor and Peter (2014) and Brown *et al.* (2017) attribute the safety of off-grid renewable energy technologies to its ability to generate energy that is safe and affordable for cooking and lighting. However, Taylor and Peter (2014) also highlight the importance of establishing network infrastructure for local generators to sell excess energy to a wider population. Therefore, the impact of creating safe and affordable energy is mostly coupled with ensuring its availability to the wider population. Brown *et al.* (2017) and Kimemia & van Niekerk (2017) further refer to the use of electricity, solar energy and liquid petroleum gas in African urban informal settlements as the safest, cleanest, most affordable and most sustainable sources for cooking and lighting.

3.3.3 Social innovation systems applied to address the poor access to energy in African urban informal settlements

Literature presents a significant variation in the composition of the actors found in the social innovation systems applied to address or correct the accessibility of safe, sustainable and affordable renewable energy sources and infrastructure in African urban informal settlements. The variation of the innovation systems lies either in a top-down approach or a bottom-up approach. Top-down approaches were evident in the international

humanitarian interventions by international organisations (Caniato *et al.*, 2017; Otsuki, 2016). International humanitarian organisations execute renewable energy interventions in African urban slums independently from, or in partnership with, the beneficiary country's social associations, university or city councils, and community (Van Horen, 1994; Toomey, 2010). Other top-down approaches are evident at regional level interventions when city councils or city metropolises independently execute measures to improve the accessibility of safe, affordable and sustainable energy sources and infrastructure. In contrast, bottom-up approaches are evident when community associations, community-based organisations or cooperative groups independently execute and implement measures to correct or address the poor accessibility of safe, affordable and sustainable methods to access energy.

3.3.4 Sustainable development goals achieved through addressing poor access to renewable energy in African urban informal settlements

Literature presents efforts and interventions dedicated to addressing poor access to renewable energy in African urban informal settlements and positive spillovers for their beneficiaries and communities. Caniato *et al.* (2017) and Otsuki (2016) demonstrate how interventions to address challenges related to accessing renewable energy sources and infrastructure in African urban settlements ensure food security for the poor. The intervention is largely driven by the realisation that the inability of poor people to meet their energy needs for cooking had the potential to impact negatively on food and nutritional security, not only in use but on sustainable food systems through safe methods and infrastructure. Therefore, Caniato *et al.* (2017) and Otsuki (2016) illustrate that achieving food security through accessible renewable energy resulted in the realisation of two SDGs, namely 1 (no poverty) and 2 (zero hunger).

Methods used to address poor access to renewable energy in African urban informal settlements have positive spillover effects on creating sustainable cities and communities, by fulfilling SDG 11 (which is investment in public transport, creating green public spaces, and improving urban planning and management in participatory and inclusive ways). Firstly, Otsuki (2016) demonstrates that curbing energy poverty in African urban informal settlements could be realised from the coproduction of services through sanitation infrastructure. In an informal settlement called Kibera in Nairobi, Kenya, fumes produced from the sanitation waste were used as biogas for cooking. The provision of sanitation infrastructure not only had positive spillover effects on the food security systems through the biogas it produced being used for cooking, but also contributed to the creation of sustainable cities and communities. Secondly, the realisation of SDG 11 is evident in the cases presented by Kimemia & van Niekerk (2017) on curbing informal settlement fires through making safer energy options available. SDG 11 entails creating cities and human settlements which are safe, resilient and sustainable. Curbing informal settlement fires is achieved through replacing unsafe energy sources, such as candles and illegal electricity connections, with approved stoves and solar energy in South African urban informal settlements. This intervention resulted in the creation of safer environments or homes especially for children, who were mostly vulnerable to burns from shack fires (Kimemia & van Niekerk, 2017).

SDG 8 focuses on promoting sustained, inclusive and sustainable economic growth, full employment and decent work. Factors involved in SDG 8 are evident in the case presented by Kivuitu and Njino (2013). They demonstrate the establishment of inclusive and business perspectives and opportunities for shared values intended for the young, poor citizens living in urban informal settlements of Kenya. This is a business intervention which gave young Kenyan informal settlement dwellers the opportunity to supply cooperatively or sell kerosene at affordable prices to their communities.

The objectives of SDG 8 (which are to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all) are also evident in the cases presented by Battiston (2015) and Dobson *et al.* (2015). Battiston (2015) presents a case on the implementation of bamboo planting and training activities established in Kenyan informal settlements. The project aims at promoting and increasing the use of bamboo as an environmentally friendly and renewable source of energy. The goal of using bamboo as an environmentally friendly energy source contributes to the improvement of the environment, while supporting the livelihoods of the Kenyan urban informal settlement through establishing income-generating activities and employment opportunities. Dobson *et al.* (2015) also presents a case on a Ugandan informal settlement called Kisenyi III savings group. The Kisenyi III savings group embarked on briquette making from recycled wasted material as a livelihood-improvement and income-generating project.

Furthermore, the interventions found in Battiston (2015), Dobson *et al.* (2015), Brown *et al.* (2017) and Caniato *et al.* (2017) (already discussed in the paragraphs above) present the provision of clean and environmentally friendly energy sources contained the objectives encompassed in SDG 15. SDG 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and stop the loss of biodiversity.

Lastly, SDG 17 aims to strengthen the means of implementation and revitalise global partnerships for sustainable development. The provision of energy sources in African urban informal settlements results in the creation of local, regional and (inter)national partnerships and networks through systems established in the process of producing, executing and implementing renewable energy systems. The creation of systems at different spatial levels (local, regional and (inter)national) to address the social problem due to energy poverty in African urban informal settlements is discussed at length in Section 3.3.1 of this chapter. Creating systems, networks and partnerships between countries, regions and communities to address social challenges is one of the core aims of SDG 17.

3.4 Social innovation systems facilitating sustainable communities in African urban informal settlements through renewable energy

The main objective of this chapter is to establish the social innovation systems that facilitate sustainable communities and cities in African urban informal settlements, with a specific focus on accessing renewable energy. Through a systematic review, this study acquired literature on socially innovative interventions, community development, and bottom of the pyramid interventions aimed at addressing the complexities and

attributes of accessing energy in African urban informal settlements. The results analysed through the aid of the transformative social innovation system for urban informal settlements established in Section 2.9 reveal a number of things.

Firstly, the findings revealed in literature on social innovation systems are still very limited, particularly in the context of African countries and creating sustainable communities in informal settlements through renewable energy. This also shows that the relation of social innovation systems theory is still largely related to business-related and capitalistic interventions in firms at organisational level. Secondly, social innovation systems literature and activities were still perceived to be coupled with, and influenced by, technological infrastructure. However, addressing complex social challenges through capitalistic approaches may not extend to the communal benefit of the community at large (Huddart, 2012). Thirdly, literature on social innovation systems reveal that social innovation systems activities stem from the application of social innovation to address complex social challenges (Huddart, 2012). One of the main attributes of social innovation also stems from bottom-up approaches (Light, 2006; Novkovic, 2006). In the existing research on social innovation systems, it is briefly mentioned that such systems are only coupled with top-down approaches, which are not solely intended for community benefit. This is therefore not in response to Huddart (2012) and Fulgencio and Fever (2016) that social innovation systems should be aimed at societal level benefit rather than individual and entrepreneurial gains. Fourthly, a brief mention of social innovation systems also comes up in Figueroa-Armijos and Valdivia (2017) and Mosimege, Wiebesiek, Makgamatha, Moodley & Winnaar (2016) when addressing the complex social challenges inherent in rural settings. This finding further revealed that complex developmental social challenges requiring innovative solutions are largely perceived to be in rural areas.

However, in the absence of studies related to social innovation systems in the context of accessing renewable energy in African urban informal settlements, the next option for the search was to resort to sourcing work on 'social innovation' coupled with the concepts presented in Table 3.1. The key factors such as affordability, safety, accessibility of the energy sources and forms emerge as instrumental for accessing renewable energy through social innovative interventions to achieve sustainable communities in the form of African urban informal settlements.

The spatial factors predominantly focus on actors, communities, organisations and institutions addressing access and availability of the variety of energy sources specific to the needs of the community. Section 3.3.2 further demonstrates that the need and accessibility of different sources of energy is affected by its affordability, use and safety to the ultimate user and the community at large. The results further demonstrate that the need to address the accessing of renewable energy in African urban informal settlements is dependent on social innovative systems implementing a combination of top-down approaches, when (inter)national and regional actors are involved, and bottom-up approaches, when the community or local-level actors are the main initiators of the intervention.

The achievement of the SDGs is an integral part of achieving sustainable communities through accessing energy in African urban informal settlements. The analysis in Section 3.3.4 demonstrates that quite a number

of SDGs are achieved through socially innovative initiatives to access varieties of renewable energy in African urban informal settlements. Therefore, the overall results reveal that attaining social innovation systems meant to facilitate sustainable communities through accessing renewable energy should at least achieve certain SDGs that are related to the following characteristics and goals:

- Food security
- Sustainable, safe and inclusive methods to access and produce energy
- Economically inclusive, viable and uplifting methods to execute and implement energy
- Environmentally friendly and sustainable energy sources
- Establishing innovative local, regional and (inter)national systems or networks that facilitate the production, execution and implementation of renewable energy

The framework established in Chapter 2⁸ on accessing renewable energy presents positive spillovers for informal settlement communities. These spillovers are a combination of the improvement of communities through social, economic, inclusive, participatory, communally beneficial and ecological methods and systems as summarised in this section.

3.5 Conclusion

Evidence gathered on existing work focusing on a social innovation system for sustainable communities in African urban informal settlements through renewable energy has proved to be extremely limited, to almost non-existent. This further showed the limited current contribution to literature devoted to socially innovative activities in complex communities such as African informal settlements. The little contribution on the subject of social innovation systems focuses on rural areas. The existing work on social innovation systems focusing on rural areas may result from the perception that rural areas are more in need of socially innovative solutions, compared to other categories of communities. Further, this does not imply that rural areas are not faced with complex social or socioeconomic challenges. However, research on African urban informal settlements identify the need to split the focus on addressing social and socioeconomic challenges in urban informal areas (Brew-Hammond, 2010; Cobbinah *et al.*, 2015).

This chapter discovers the biased nature of existing literature related to the concept of social innovation systems in African urban informal settlements. Although some literature contains discussions applying concepts related to social innovation initiatives in relation to creating sustainable communities in African urban informal settlements to access renewable energy, in Chapter 2 the literature review establishes that there is no attribution of social innovation systems to urban informal settlements literature, which was mirrored in this chapter. Currently, the global discussions on the development agenda strongly vouch for addressing complex social challenges such as accessing social services through SDGs. Therefore, the combination of focusing on complex areas such as African urban informal settlements and complex social challenges through the social

⁸ Transformative social innovation system in urban informal settlement

innovation systems approach in accessing a complex social service, which is energy, could be a good way of dealing with complex development challenges. In addition to the transformative social innovation systems in the urban informal settlements framework established in Chapter 2, this chapter was instrumental in establishing the important attributes facilitating access to renewable energy, thereby creating sustainable communities in African urban informal settlements.

Though this chapter revealed the limited literature on social innovation systems and SDGs, the findings of this chapter were instrumental in adding the African perspective to the transformative social innovation system in the urban informal settlements framework. This was possible to help understand the characteristics of African urban settlements and how social challenges can be addressed through different methods. However, the literature presented in this chapter demonstrates the very biased nature of social innovation systems in the energy space of informal settlements through top-down approaches. Top-down approaches or development projects occur when the beneficiary accepts help or solutions from external actors without beneficiaries being involved in the planning and conceptualisation phase (Hazeltine, 2003). This is also not to say that the current literature does not address the current development agenda. Some SDGs are achieved through the provision of the different kinds of energy without being explicitly mentioned. However, they should be aligned with the perspective of the innovation system approach as it is not very linear but adapts to the prevailing needs of the circumstance.

Chapter 4: Establishing social innovation systems to facilitate access to renewable energy in an urban African informal settlement: The case of the iShack Project

4.1 Introduction

The socioeconomic development challenges stemming from the urbanisation in urban areas are introduced in Chapter 1. These are coupled with other means (MDGs, non-government organisations and cooperatives) through which some of the socioeconomic development challenges are addressed. Upon establishing the shortcomings, the new SDGs were introduced as an improvement on the MDGs, and therefore demanded innovative approaches to achieve them. Informal settlements are identified as one of the pressing consequences of urbanisation that give rise to a myriad of socioeconomic development challenges (Cobbinah *et al.*, 2015; Zhang, 2016).

The study suggested social innovation systems as a systematic approach to address the socioeconomic challenges existing in an African urban informal settlement. The review in Chapter 2 elaborates on why and how social innovation systems could be applied as the most suitable approaches to execute SDGs in urban informal settlements. This would be achieved through introducing a conceptual framework as an approach to test the theoretical approaches. In Chapter 3, the framework is instrumental in creating a contextual understanding of the social innovation systems and their role as contributors to achieving sustainable communities in accessing renewable energy, thereby achieving SDGs in African urban informal settlements. Against the backdrop of the existing literature, Chapter 3 was able to bring the framework from Chapter 2 into context through highlighting the necessary factors instrumental in accessing renewable energy in African urban informal settlements. The objective of this chapter is to address the third objective of this study: namely to propose the viable social innovation systems approaches that can support achieving access to renewable energy through the iShack Project in Enkanini informal settlement. The selection of the innovation system that would be fit for the research was informed by the definition on social innovation systems. According to Huddart (2012); Phillips *et al.* (2015) and Fulgencio and Fever (2016), a ‘social innovation system’ is commonly referred to as an innovative system whose activities are intended for social benefit. Therefore, the iShack Project was found to be a fitting case to analyse the social innovation system for this research for the following factors. Firstly, it is a social initiative that aims to address a social problem. Secondly, it is an initiative based in an African urban settlement. Thirdly, the functioning of the iShack Project resulted from a collaboration of the informal settlement community and organisational and institutional organisations. This chapter begins by giving a brief background of the iShack Project and the method applied to collect data that would help establish a social innovation system in an African urban informal settlement. The data collected informs a case study on the iShack Project.

The conceptualisation of the iShack Project began in early 2011 (Keller, 2012). Its establishment was inspired by the need to address the challenge of providing safe energy in informal settlements. The pilot data collection on the iShack Project took place in Enkanini informal settlement, based in Stellenbosch in the Western Cape province of South Africa. Enkanini informal settlement was formed in 2006. It was formed when a group of 80 young people, who previously resided in the neighbouring township of Kayamandi, received permission to erect shacks on open land next to Kayamandi township. Since then, the population of the settlement has been growing exponentially. For 2015 and 2016, the population was recorded at 5 000, with approximately 2 500 shacks (Annecke & Hattingh, 2016), while a population of 4 500 was reported in 2012 rising to approximately 8 000 in 2015 (Kovacic, Smit, Musango, Brent & Giampietro, 2016). Figure 4.1 depicts part of Enkanini informal settlement in May 2017, a settlement of shacks constructed with corrugated iron sheets.



Figure 4.1: A view of part of Enkanini informal settlement in 2017

After the settlement of the first 80 people, the numbers in the settlement swelled exponentially, creating a challenge for the Stellenbosch Municipality. The municipality explored methods of managing the fast-growing number of shacks in the settlement through demolishing some of the shacks – but without success. Instead, the growing population in the informal settlement began to voice their need for social services such as sanitation, water, electricity and proper housing (Kovacic *et al.*, 2016).

Stellenbosch Municipality attempted to provide social services for the Enkanini informal settlement dwellers; however, endeavours were challenging and insufficient due to the growing population in the settlement. Enkanini is situated on a steeply sloped piece of land that was a nature reserve. The nature of the land has apparently hindered the construction of long-term social infrastructure, such as houses

and facilities for the supply of water, electricity and proper sanitation (Kovacic *et al.*, 2016). Because settlement on the nature reserve was declared legal for human habitation in 2016, the Stellenbosch Municipality provided 60 public toilets with running water in five ablution blocks, of which almost half were not in working condition at the time of data collection. During the data collection period for this study, over 100 shacks were still (and perhaps more) metres away from the nearest water and sanitation facility. The informal settlement had five open waste-skips which were collected irregularly by the municipal waste collectors. During the time of data collection, waste sites were overflowing, with no sign of regular (weekly) waste collection. Indeed, residents revealed that the municipality had not collected waste for two months.

The characteristics of the Enkanini informal settlement are similar to those of an African urban informal settlement as presented in the empirical work by Toomey (2010), Kimemia & van Niekerk (2017) and Brown *et al.* (2017). The provision of housing in the Enkanini informal settlement had not yet been addressed. The average waiting period for government-subsidised housing in the Western Cape is 32 years (Annecke & Hattingh, 2016). Owing to the illegal nature of the Enkanini informal settlement before 2016, the municipality did not prioritise the provision of social services, such as housing and electricity infrastructure for the inhabitants. The informal settlement had no grid-electricity connection. In the Western Cape, the waiting period for electricity provision tends to range from 7 to 9 years (Annecke & Hattingh, 2016). Households in the community rely on various sources of energy, including illegal electricity connections sourced from the neighbouring Kayamandi township, paraffin and candles (bought from local shops), solar energy, wood (collected from the neighbouring nature reserve), and liquid petroleum gas for cooking (Smit *et al.*, 2017; Kovacic *et al.*, 2016).

Various case studies emerged from the iShack Project with a specific focus on upgrading the informal settlement. Wessels (2015) and Skåre (2016) focused on community engagement through using the transdisciplinary research which mostly focused on the involvement of the community members in the establishment of the iShack Project, as well as the community-level entities involved. Radmore (2015) focused on microfinancing as an alternative for service delivery configurations – as a means to create economic and energy resilience. Smit *et al.* (2017) and Kovacic *et al.* (2016) also touched on the contribution of the iShack Project to energy consumption and demand patterns of the Enkanini informal settlement. The contribution of the existing studies on the iShack Project significantly dealt with the upgrading of the informal settlement through community participation. Furthermore, existing studies on the iShack Project predominantly focused on the internal economic aspects of the iShack Project.

However, the case study for this research takes a different approach to the existing case studies on the iShack Project. The case study for this research focuses on the establishment of the iShack Project as a social innovation system which could be used to address socioeconomic challenges of the informal settlement community. By applying the transformative social innovation system for an African urban

informal settlement used to access renewable energy, this case study assesses whether the iShack Project qualifies as an urban informal settlement that can achieve SDGs through transformative social innovation systems enabling access to renewable energy.

The data collection process for this case study is also different to other approaches, as it used a case study providing in-depth insights of the iShack Project. It further provides insights from different bodies of knowledge and approaches. Other studies that have undertaken case studies on the iShack Project largely focus on community level engagement of the iShack Project community. This study goes so far as understanding the dynamics between the various organisations and institutional arrangements inherent in and throughout the iShack Project. This case also tries to understand the daily administration of the iShack Project. The case study approach is more appropriate for this work in order to understand the role of the actors involved. The focus of this research is more concerned with the history, objectives and the experiences of the actors involved in the intervention. Wessels (2015) focuses on community engagement through using transdisciplinary research mostly focused on the involvement of the community members in the establishment of the iShack Project, as well as the community-level entities involved.

4.2 Research methodology and research design

This section elaborates on the design and approaches applied in gathering the data informing the case study for this research. This section substantiates why and how the instruments applied are suitable for fulfilling the design chosen for this study. It further demonstrates the approaches utilised to analyse the research objective for this chapter. It contains the research design, research instruments, sampling, analysis approach, limitations, and validity and reliability of the method applied to achieve the third research objective.

4.2.1 Case study research design

The case study and analysis took the form of a single-case format. The analysis presented the case study in a single story (Yin, 2013). It summarised the lessons and findings from the cases in one report. This was done by organising the findings according to the variables or themes this study presented in the section above. Willis (2014) alluded to the single-case study as an approach to providing a nuanced, evidence-rich and holistic account of a specific phenomenon. By reviewing literature on single-case studies compared with other forms of case studies, Gustafsson (2017) identified the attributes listed below as advantageous of a single-case study. Compared to the multiple-case study method, single-case studies are able to produce better theories as a result of the following (Gustafsson, 2017):

- Focusing on multiple-case study methods may result in less time to focus on observations.
- Single-case studies are confident in their representativeness.

- Single-case studies are a better option when the focus of the study is on a specific group or on a single organisation or entity.
- The application of a single-case study enables the researcher to question or contest old or existing theories and to explore thoroughly new data that were gathered during data collection.
- The single-case study enables the researcher to acquire a deeper understanding of the subject.

The single-case study approach tends to be perceived as inadequate to inform research conclusions and recommendations particularly for quantitative research specialists. However, the use of single-case studies has been applied and backed up by several authors and in practices in legal and clinical fields. Mariotto, Zanni and Moraes (2014), Iversen (2013) and Kennedy (1979) discussed the benefits and outcomes of single-case studies, and this approach has been used to inform and generate credible research outcomes. The use of single-case studies has been criticised for its focus on one case; however, in order that the single-case generates the desired outcomes, certain aspects have to be inherent in the data collection process. Iversen (2013) revealed that the data collection process of the case study tended to allow numerous contacts with the respondents, enabled a length of time to be spent with the respondents, or allowed the making of numerous observations of one respondent. This method acknowledges that no object is identical to another; there are a few standard characteristics, so it is advisable to measure interventions or to test the outcomes of the interventions at different phases. This is an approach used in single-case studies and is referred to as a single-case method where observations and interviews are conducted on the difference between phase A and B (A-B), A-B-A or A-B-A-B.

Another approach that could be followed is the multiple-baseline design. This design tends to allow different respondents within the case to offer levels of comparison of effects or perspectives of the intervention. Each respondent's baseline provides a comparison with other respondents, as well as a source for possible variables which may have arisen in the comparison (Iversen, 2013). Multiple-design-cases studies investigate the same behaviour for all individuals conducted across behaviours or situations with the same individuals or across individuals. These multiple-case designs have been used for groups of individuals. In multiple-design cases the data are collected over time, and the case can be acquired from different respondents, a single individual or a group of people in which the individuals in a group may change. The length or duration of the project is not necessarily important in a single-case study, but rather the repeated observations and recordings, as well as where the collected data were compared across different experimental conditions (Iversen, 2013).

Iversen (2013) stated further that single-case studies were not necessarily meant or designed for hypothesis testing and inferential statistical testing, but for analysis of behaviour of individual's subjects, and for development of methods that can help individuals adopt appropriate behaviour.

Therefore, assumptions of inferential statistics for group comparisons with independent comparisons, random selection of subject's and random allocation to treatment onset and offset are not achieved in single-case research methods.

The use of single-case studies has been attributed to its inability to be generalised. According to Kennedy (1979) and Mariotto *et al.* (2014), single-case studies could be generalizable if ample information were provided in the case. Unlike laboratory-controlled experiments where the phenomena were removed from their environment, case studies emphasise the context in which the phenomena were embedded. Single-case studies allow for a more detailed understanding of the circumstances in which the phenomena occurred, thereby making it more reliable. Mariotto *et al.* (2014) further pointed to the generalisation derived from the comparison between two cases could be less reliable than those advised by in-depth analysis of a single-case study. Practitioners in the medical field tend to make use of, and refer to, single-case studies in order to generate theory. This was achieved through focusing on understanding the specifics of the particular case. In this way the single-case study would stand a better chance of enabling the creation of more complicated theories than multiple cases. This is because single-case researchers are able to fit their theory precisely to the many details of a particular case. Kennedy (1979) further observed that a single-case study may bring an important contribution to theory development if the particulars of the case were seen as opportunities to advise or lead to further adjustment in an already perceived understanding of reality. Mariotto *et al.* (2014) further added that the single-case study offered organisations valuable inputs assisting in the organising and interpreting of experience in order to build a shared understanding of the organisation.

The single-case study approach was relevant for this study, as the study focused on a specific social initiative, the iShack Project, which is situated in an informal settlement. The application of the social innovation systems approach is a rather novel approach in research. Therefore, the single-case study approach enabled the researcher to acquire in-depth evidence which informed new and nuanced knowledge on the subject. Owing to the novel nature of the focus of this research, the single-case study method further enabled combined methods (observations, interviews and literature review) for collecting data, thereby acquiring in-depth and rich data, which would inform future research, while also providing a deeper understanding of the subject.

4.2.2 Research instruments

This study deals with the nature of the social innovation system, and it has already been established (in Chapter 1) that case studies are relevant for studies related to the investigation of the nature of a system, i.e. the study could be on a group, on an institution, or on participants (Welman *et al.*, 2009). Data that informed the case study for this research were sourced from several sources as evidenced in Table 4.1 below. The type of data used to inform this study was primary and secondary data. The primary data collection method was in-depth and open-ended focus group interviews and observations, while

secondary data were desktop literature from peer-reviewed, academic and grey literature (Yin, 2009). Table 4.1 elaborated on the purpose of the different types of instruments used to collect the data for the case study. In Table 4.1 below, each instrument listed was coupled with the purpose or role it fulfilled in the data collection process for this study. Detailed descriptions of how each source of evidence in Table 4.1 were applied in this study may be found in Section 4.2.2.

Table 4.1: Research instruments applied in case study evidence collection

Source of evidence	Purpose
Interviews	Acquire the expert's (interviewee's) knowledge and opinion on the subject and events (they are usually the key informant). Interviews are an important source for case studies as they provide more insight on the human and behavioural events.
Observations	Provide additional information on the context of the type of setting or neighbourhood or organisation under study.
Documentation	Verifies correct spelling and names of people and organisations, to corroborate information from other sources, to find inferences and clues for investigations.
Archival records	Usually quantitative information or records used in conjunction with other sources of information.

Source: Yin, 2009.

4.2.3 Data collection

The iShack Project was an innovative project distributing renewable energy to households in Enkanini informal settlement. The iShack Project manager assigned daily tasks to the operations manager for observation and interviews during the fieldwork. During the field observations, the iShack Project solar system installers and iShack Project agents, who were residents of Enkanini informal settlement, were observed and interviewed. During these observation sessions, households that had just received solar systems, and those who required maintenance on their solar systems, were visited. This was helpful in managing the respondents as well as accessing the willingness of respondents to participate freely in interviews.

During data collection, the transformative social innovation system for an African urban informal settlement framework established in Chapters 2 and 3 of this study informed the questions asked during the interviews. The questions were related to the factors that make up the framework in Chapters 2 and 3. The area of study was clearly specified, which included manageability in terms of the number of sites, accessibility of the community and the residents (i.e. prospective respondents), as well as the willingness of respondents to speak freely with the interviewer (Bowen, 2005). This section provides feedback on the study. The research interview questions presented in Appendix 3 were structured

according to the elements of transformative social innovation systems for an African urban informal settlement framework. The questions dealt with the following:

Question 1: The first element of the framework focused on the delineation of the innovation. The question was about the background and purpose of the initiative, as well as organisations and institutions involved at local, regional and (inter)national level informing the nature of the social innovation system.

Question 2: The second element of the framework focused on the social problem addressed by the social innovation. Therefore, this question probed the role of the initiative or organisation addressing the social problem for the African urban informal settlement.

Question 3: The third element of the framework focused on the composition of the innovations system and the characteristics thereof. The question firstly probed the different roles of participation in terms of the organisations informing different purposes in the social innovation initiative. This question primarily focused on the networks and collaborations of the initiative or organisations which informed the formation of the innovation system. This element secondly asked questions related to the adaptation and learning that informed the innovative nature of the initiative. The third question related to governance and regulations that informed the institutional and organisational arrangements inherent in the innovation system.

Question 4: The fourth element of the framework ensured that the case study was conducted on a typical African urban informal settlement. This element was taken care of in the inception stage of data collection; the selection of the type of setting was already selected and validated. Cozzens and Sutz (2012) conceptualised informal settlement innovation as initiatives focused on the grassroots; and looked at both women and men as innovators. The initiative described, not prescribed, the roles of formal organisations as they appeared in informal settings. They asked whether systems of interaction existed, rather than assuming that they did. The focus of the initiative was largely on the economy and society. Lastly, the informal settlement innovation initiative aimed to understand how innovation in a given informal setting interacted with other sources of knowledge.

Question 5: The fifth element of the framework focused on three factors of social innovation, namely the social aspect which established whether the initiative aimed to make a profit or not from its activities. Secondly, the fifth element identified under which of the various sectors the different actors in the composition of the innovation system were categorised. This element further probed the technological elements of the innovative initiative.

Question 6: The sixth element of the framework focused on the sustainable development goals achieved through the initiative. The study specifically focused on SDG 7, which focuses on accessing affordable

and clean energy. This element further checked whether the factors established (in Chapter 3) as necessary in ensuring affordable and clean renewable energy were accessible in an African urban informal settlement.

All the research questions and their sub-questions were addressed by the primary data. Secondary data were used to confirm some of the data gathered during primary data collection. Most of the secondary data, and some of the data collected during interviews under the first question, were applied in the background of the case study, such as the demographics, population, history and geographical setting, composition and intended objectives of the iShack Project. The rest of the interview questions (2 to 6) were largely addressed by the primary data gathered from interviews, focus groups and observations, but secondary data were also applied for validation or confirmation purposes, where necessary. Questions 2 to 6 helped reveal the unique dynamics of the social innovation systems in the Enkanini informal settlement that this study investigated.

i. Interviews

All interviews were conducted face-to-face with the respondents, as well as through focus groups. Each face-to-face interview session began with a closed question, followed by open-ended questions (unstructured questions) to obtain further clarity on experience-driven responses (see Appendix 3). Babbie (2013) recommended that during interviews, questions be phrased in the simplest form possible in order to suit the respondent's needs in the form of language and simplicity. Interviews were the key source of data collection. The face-to-face and focus group interviews were conducted between April and 30 May 2017.

a) Face-to-face interviews

The face-to-face interviews were conducted with 10 key respondents from organisations, institutions and households involved in the iShack Project through voluntary participation. The 12 key respondents were as follows: one iShack Project manager from Stellenbosch University Research Centre, one enumerator from Slum Dwellers International, one iShack Project operations manager, one iShack Project administrator, two iShack Project solar system installers, two iShack Project maintenance workers and two interviewees at Enkanini Research Centre with assistant researchers, a social innovation specialist and a social entrepreneur. The unstructured nature of questions during the interviews (face-to-face and focus group) helped inform the unknown gaps that existed on the subject being studied (Berg, 2001; Mack *et al.*, 2005). The respondents were selected in terms of their prolonged closeness to the iShack Project. Informants were specialists with different experiences flowing from their various capacities in which they were part of the iShack Project. Some respondents were present from the inception of the project in the planning and execution phases, through their involvement in research and employment. Some respondents had been beneficiaries of the iShack Project. Therefore, the respondents

selected for the data collection qualified to give in-depth knowledge and a wealth of experiences and perceptions of the iShack Project in order to understand the social outcomes of the initiative. Notes and recordings were taken during the interviews.

Arrangement of face-to-face interviews entailed contacting the prospective respondents via e-mail and cell phone messaging, as well as calling for follow-up. The first contact made via e-mail included the interview questions (with a summary of the object of the research) and the consent form for the research. This was done to enable the prospective respondent to be familiar with the research, the requirements and their contribution thereto. The interviews were conducted at sites with which the respondents were comfortable. The venues of the interviews ranged from coffee shops, the Sustainability Institute of Stellenbosch University on the outskirts of Stellenbosch, and the iShack Project hub and Enkanini Research Centre) in Enkanini informal settlement. The initial pilot visit took place at the Enkanini Research Centre in Enkanini informal settlement in November 2016. The Enkanini Research Centre assistant researcher introduced the researcher to the iShack Project manager, with whom the initial interview for the research was conducted during the first week of April 2017. The iShack Project manager was one of the key informants for this research, as he provided referrals to other key informants who were relevant to the study. The duration of the interviews ranged between one hour to an hour-and-a-half. The face-to-face interviews targeted key informants involved in the establishment and current operations of the iShack Project.

b) Focus group interviews

The three focus group interviews that were conducted each consisted of 10 respondents. According to Hovmand (2013), a group of 10 people was the appropriate size for a focus group as it enabled an equal contribution from participants in the group. The focus group respondents (who were 30 in total) were current residents of Enkanini informal settlement. Focus group interviews were conducted over three days and were facilitated by five Stellenbosch postgraduate researchers of the School of Public Leadership (on energy use in the Enkanini informal settlement. The Enkanini Research Centre research assistants, who were residents of Enkanini informal settlement, recruited the three focus groups of 10 participants each. The focus group interviews took place at the Enkanini Research Centre. The three focus groups were divided according to the different categories of household-level energy use in the informal settlement. The categories were as follows: solar users, indirect electricity users, and non-solar combined with non-indirect electricity users. Solar users were community members who exclusively, dependently used the iShack Project solar system in their homes. Indirect electricity users were community members who exclusively made use of illegal electricity connection in their homes. Non-solar users and non-indirect electricity users were the residents who were not connected to

any form of energy source. The groups were asked about their motivations for selecting the source of energy they used at home, their views on the source of energy they used, and their knowledge and views on the iShack Project solar systems. At the end of each day, after the interviews and observations had been conducted, the researcher would have a discussion with the operations manager in order to corroborate the data collected. The operations manager also read through the research report for the case study before analysis of the data commenced. This ensured the accuracy of the information that was reported.

ii. Observations

Field observations were made every time data collection occurred in the field. Field visits were conducted with the assistance of the Enkanini Research Centre assistant researcher, the iShack Project manager's referral to the iShack Project operations manager and the agents from January 2017 until May 2017. The field visits took place during solar system installations, inspections, maintenance visits, weekly workshops and marketing visits by iShack Project staff. Further details on these visits by iShack Project staff are explained in Appendix 2. The solar system installations, handovers, and installation inspections were conducted by the iShack Project operations manager and the solar system installers. The iShack Project agents conducted marketing and maintenance visits to households with the solar panel clients and prospective clients. Observations were done at the iShack Project hub during the daily operations and customer services interactions. Other observations were done during workshop training sessions with the iShack Project manager and the iShack Project agents.

iii. Documentation and archival records

The iShack Project was an initiative that received positive attention from various audiences. The variety of audiences ranged from academic scholars, such as Stellenbosch University researchers, and representatives of non-governmental organisations (NGOs), local and provincial municipalities, and other informal entities and settlements. There was also attention via social media and the media. Interest from the different audiences resulted in research on the iShack Project which was recorded and published for public use and attention. The following research was used as archival records during the data collection process. The research listed below was used to inform the background of the iShack Project case study for this study. Publications used to validate or corroborate some of the timelines of the establishment of the iShack Project include research by Annecke and Hattingh (2016); Keller (2012); Radmore (2015); Skåre (2016); Swilling *et al.* (2013); Swilling (2014); and Wessels (2015).

4.2.4 Sampling

The sampling method applied was purposive sampling and snowball sampling. Purposive sampling entails deliberately selecting a specific group from which data is sourced, while snowball sampling is the referral approach of knowing about potential respondents from existing respondents (Palinkas *et al.*, 2015). The two sampling methods were relevant for this study as the focus was on a specific region and

actors participating in a specific activity. According to Mack *et al.* (2005), such sampling methods are achieved through specific data collection instruments, such as in-depth interviews and focus groups, which are supported by specific approaches, such as conducting semi-structured and unstructured interviews.

Owing to the qualitative nature of the study where greater emphasis was placed on a specific community, purposive sampling seemed to be a better fitting sampling method as opposed to random sampling. Purposive sampling placed an emphasis on the quality, rather than on the quantity, of the information gathered. The objective of using purposive sampling was not necessarily to maximise numbers, but rather to collect as much information on the subject as possible (Bowen, 2005). Palinkas *et al.* (2015) further added that the purposive sampling method is advantageous as it assists in identifying and selecting the specific individuals or groups especially knowledgeable on the subject of interest. Therefore, the two sampling methods allowed for the relevant respondents to be accessed and to willingly participate in the data collection.

4.2.5 Limitations

The limitations of studies of the dynamics and functions of innovation resulted in the development of limited indicators which are predominantly related to the measurement of innovation activities. Owing to such limitations, the studies and measures were biased towards certain criteria. Bund, Gerhard, Hoelscher & Mildenerger. (2015) extended the measurement and indicators of social innovation to that of a local setting by adapting the blueprint social innovation by Bund, Hubrich, Schmitz, Mildenerger & Krlev (2013). However, Bund *et al.* (2015) linked the poor measurement instrument or framework for social innovation to the lack of data applied to this blueprint measurement tool to achieve a dynamic social innovation measurement tool that could measure social innovation activities with dynamic characteristics. Because the blueprint social innovation instrument was not the first framework developed to study the impact of social innovation, this study adapted the framework by integrating parts of different social innovation measurements and frameworks from different perspectives of social innovation. This was done with the intention of achieving a dynamic tool to identify the impact of social innovation at different levels.

One of the main instruments of this study was to source information from residents from different categories of energy use. Sourcing optimum information for data was further done through focus group interviews, which required the respondents' dedicated contribution by sharing their experiences on the use of the energy source provided by the iShack Project. However, owing to the language difference between the main facilitator and the respondents, the facilitator was sometimes unable to grasp the respondents' views optimally. To address this challenge, the research assistants were asked to translate the questions and answers between respondents and the focus group workshop facilitators.

The case study focused on one informal settlement. The single-case study is notorious for its poor applicability for generalisation. This shortcoming was addressed through spending a prolonged time in the field and accessing key respondents who were long-time members of the project and the community studied.

4.2.6 Triangulation

Triangulation is the application of more than one method to collect data (Bowen, 2005). Section 4.3.1 outlines the different sources from which the data for this study were sourced. Coupled with interviews, the data collection for this study entailed attending meetings and training sessions, informal visits and a formal visit with the iShack Project staff members while they conducted their installation and maintenance visits around the community. Formal and informal interviews were also conducted with informants, as well as direct observations and the viewing of physical artefacts. This was coupled with paying attention to rigour and trustworthiness by taking notes and photographs (when the interviewees agreed to this) during interviews, and observations through prolonged engagement in the field with the key informants. Information collected during interviews and observations were validated by confirming the data with the iShack Project manager and operations manager after every data collection session, coupled with reading academic and grey (including social media) literature on the iShack Project. Confirmation of the data collected and observed each week was discussed with the operations manager. The operations manager read some of the fieldwork weekly reports in order to confirm and make additional notes where there were gaps. Installers were asked about the procedure and frequency of installing and using the solar panels and the challenges related to the installation. Users were asked about using the solar system. This was related to the costs and affordability, the difference that the solar system made for them as consumers. Observations entailed accompanying installers during inspection and installation visits. Problems included the time it took to get the solar system to the users, the procedure of installing, and the challenges faced to find the shack of the prospective user. Further details on this are set out in the fieldwork summary report in Appendix 2, while questions asked during the interviews are provided in Appendix 3.

4.2.7 Validity

Validity demonstrates the credibility of the data collected for study (Creswell & Miller, 2000). Different forms of validity are relevant to certain types of studies and data collected to answer research questions. As has been established, the objective of this research was to study social innovation systems in an African urban informal settlement with a specific focus on provision and access of renewable energy. The study object was a social initiative called the iShack Project based in an urban informal settlement. With the help of various actors, the aim of the iShack Project was to provide affordable electricity, a scarce social service in the urban informal settlement community of Enkanini. Various organisations and actors supported the iShack Project.

i. Construct validity

Construct validity is the use of multiple sources to acquire evidence (Tellis, 1997). Therefore, the study made use of multiple sources of evidence during data collection. In order to maintain a solid chain of evidence, the researcher conducted one-on-one interviews with different key informants; went on field observations in the community where the iShack Project is based (Enkanini informal settlement); and read various past academic and non-academic work on the iShack Project. Focus groups were also used to acquire more data, as well as validate existing data collected. Social media and the iShack Project website were instrumental in tracking and validating the development timeline of the iShack Project. Lastly, one of the key informants, namely the current iShack Project manager, agreed to review the case study report once it was complete.

ii. Internal validity

Internal validity stems from the specification of the unit of analysis as theories are developed, and data collection and analysis in turn test those theories (Tellis, 1997). The type of case study undertaken for this research was of an exploratory nature. Therefore, the relevance of internal validity did not apply. Internal validity largely applies to studies aiming to establish a causal relationship between variables.

iii. External validity

According to Yin (2009), external validity could be achieved through theoretical relationships, where such generalisations could be extended to other similar cases. External validity, in this case, could apply to the type of unit of analysis used for the case study, in that it would be used to draw data that would be used to test the existing theory around social innovation systems in urban informal settlements. The data collected for the case study were from a social initiative based in a typical South African urban informal settlement. Enkanini informal settlement was largely characterised by a lack of social services, unemployment, and poor infrastructure. Therefore, the data and findings drawn from the case study could apply to any urban informal settlement in the African context.

4.3 Analysis

This study followed both the deductive and inductive approach. In a deductive approach, researchers apply some thematic framework stemming from a theoretical perspective, while the inductive approach entails researchers immersing themselves in the data as a means to identify new themes that are meaningful to the objective of the research (Berg, 2001). Therefore, in most cases, coupling the deductive and inductive approaches results from the need to compare theory to real life perspectives and circumstances. The deductive approach was applied in the interviews, while the inductive approach was applied in the data analysis. The interviews took the form of unstructured and semi-structured interviews. The unstructured and semi-structured nature of the interviews was instrumental in informing the unknown gaps existing in the subject being studied (Berg, 2001). This was to find out the specific

conditions inherent in the social innovation systems informing sustainable development goals at Enkanini informal settlement.

The findings and analysis were informed by the framework devised in Chapters 2 and 3. However, the main objective of the inductive approach was to identify the emerging themes from the data (Bowen, 2005; Yin, 2013). The emerging themes, together with the theoretical background, became the major findings of the study. The findings helped to identify the contribution of social innovation systems in achieving SDGs at Enkanini informal settlement.

All the interviews were conducted face-to-face. However, a semi-structured interview coupled with an unstructured interview approach was used in order to obtain quality information, and to ensure that all the themes of the transformative social innovation system for an African urban informal settlement framework were covered according to the questions articulated in Section 4.2.2. Notes were taken during the interviews (Westoby, 2014). These interviews were transcribed and analysed according to the themes of the transformative social innovation system for the African urban informal settlements framework. This was done to identify findings related to the establishment of factors entailing a social innovation system in Enkanini informal settlement.

The first variable of the transformative social innovation system for the urban informal settlements framework was the spatial dimension of the social innovation system. This variable focused on the motivations for the inception of the initiative, spatial dimension, which acknowledges how the innovation process is affected by the national, regional and local contexts and circumstances such as policy and infrastructure.

The second variable of the transformative social innovation system for urban informal settlements focused on the social problem addressed by the study. In Chapter 2, it is established that social innovation and social innovation systems stem from the urge to address a prevailing social problem, whether at the national, regional or local level. Therefore, this variable focused on, or aimed to understand, the type of social problem addressed by the intervention.

The third variable of the framework for this study were the actors (organisations and institutions) that formed the innovation system. This variable focused on the contribution and purpose of the organisations and institutions in terms of their roles and activities in the innovation system. The organisations were the actors present and active in the network, while the institutions were the institutional arrangements designed to ensure the steady and consistent execution of social innovations (Huddart, 2012; Fulgencio & Fever, 2016).

The fourth variable focused on the type of setting in which the social innovation activity took place. The type of setting was of an informal nature and was established in an urban area. The social innovation

intervention was inclusive of social entrepreneurs, organisations, institutions and local associations, and the community (Phillips *et al.*, 2015; Cetinkaya, 2012).

The fifth variable of the framework comprised social, technological and sectoral aspects. Fulgencio and Fever (2016) elaborate on this section as a balance between profit-making activity and the increased involvement of the society. Society comprises the social innovators and the leaders of the innovation process. This variable accounts for society as the main actor in the innovation system; thus the focus was not on individual needs, but rather on the needs of society as a whole.

The sixth variable was social transformation intended for the achievement of SDGs through accessing renewable energy in an African urban informal settlement. This variable alluded to the ultimate objective of the sustainable development goals, namely achieving social transformation of informal settlements.

4.4 Can the iShack Project be considered a social innovation system? – A case study⁹

The case study was broken down into the different themes and variables (as elaborated upon in Section 4.2.2 and 4.3, respectively) that informed the framework of this study and were applied during the data collection. Six variables, as stipulated in Section 4.3 of this work, guided the analysis. The analysis is arranged according to the chronological order of the questions and elements of the framework, as discussed in Section 4.2.2. A summary of the research data is presented in Appendix 2. This section thus presents the main findings of the case study that were drawn from the themes of the study. The section provides a discussion of the characteristics of the iShack Project that qualify it as a social innovation system.

4.4.1 Spatial dimension of the iShack Project

This section addresses the first element of the framework. The establishment of the iShack Project was an initiative that saw a collaboration of actors based at all spatial levels: national, regional and local. The iShack Project was initiated and executed at a local level in Stellenbosch and the benefiting Enkanini informal residents were physically based in the same locality of Stellenbosch (Doloreux, Dionne & Jean, 2007). The execution and uptake (including the pilot data collection) of the initiative both occurred in the same town or local space of Stellenbosch. The innovation system driving the iShack Project demonstrated a strong foundation and contribution of local-level participation, particularly during its inception and sustainability phases. This is evident in the nature of sustained contributions and involvement in ensuring that the iShack Project achieved its goals through a joint collaboration of the Enkanini informal settlement residents, the local municipality and Stellenbosch University.

⁹ Part of the summary of the results may be found in Appendix 2.

Therefore, the available local-level infrastructure and the ability to address some of the local challenges were sustained by joint interaction of local actors: the local university, local municipality and local residents of the Enkanini informal settlement. In this way, the local level actors within the innovation system carried the responsibility of a more hands-on and sustained-presence approach for the iShack Project. This was achieved through available resources and infrastructure. The infrastructure took the form of engineering infrastructure, the equipment used for research, and erection of the iShack Project. Coupled with this was the knowledge acquired and increased physical interaction between the local actors.

Evidence collected on the iShack Project illustrated that the local level of the innovation system served a different purpose from the regional level. The regional level was prominent in the contribution of the policy making for this project. The regional level, referred to in a spatial dimension, was defined as the space beyond local boundaries, but not at the national level (Freeman, 2002; Doloreux & Parto, 2005). In such a case, it would be the provincial level. The regional dimension of the social innovation system was subsequently evident in the contribution made by the provincial Department of Environmental Affairs, together with the provincial office of the Development Bank of Southern Africa through the Green Fund. The inception and the objective of the iShack Project was to contribute to the improvement of the national housing policy, namely the Upgrading Informal Settlement Policy. This policy is at national level and aimed at improving the social infrastructure of informal settlements in all provinces of the country through the facilitation of the municipality. This was a significant factor, which fed into the regional aspect of the innovation system.

The national dimension of the innovation system was largely evident only during the inception of the project through financing and profiling community engagement. In the case of the iShack Project, the national level actors were entities that performed at national and international level. According to Freeman (2002), the international entities would be functioning at the supranational level. These actors were Slum Dwellers International and the Bill and Melinda Gates Foundation.

4.4.2 Addressing the social problem

This section addresses the second element of the framework. The conceptualisation of the iShack Project stemmed from the need to address social infrastructure dealing with social problems resulting from the inability to access social services at Enkanini informal settlement. Residents of the Enkanini informal settlement indicated a variety of benefits and disadvantages of using solar systems. However, solar energy was largely associated with safety and affordability of energy. The safety factor stemmed from the decreased shack fires and fumes inhaled from the various sources of energy used, such as candles and paraffin stoves. The unsafe nature of the energy sources also included illegal electricity connections that caused shack fires. In this way, the respondents indicated that the solar systems had a positive impact on their families', and especially their children's, health.

The availability of solar energy is a hindrance to electricity connection especially if it would be provided by the government. (Non-solar user combined with indirect electricity user, 2017)

Any innovation across sectors, whose intention is to address any social injustice. (Social entrepreneur, 2019)

The provision of solar energy was accepted by the users and non-users of solar energy at Enkanini informal settlement as a feasible option of energy, though not as the main source. This was because of the safety of solar energy compared to candles and illegal electricity connections that were used in the informal settlement. However, the introduction of the solar system prompted different perceptions among community members of Enkanini informal settlement. There was a strong perception from the Enkanini informal settlement community members that solar energy was provided as an interim option for accessing electricity while Enkanini informal settlement dwellers waited for the Stellenbosch Municipality to supply electricity. This was partly the reason why the pilot implementation of the solar systems did not generate a positive reception from the Enkanini informal settlement community members. Some community members showed a positive reception, while others were sceptical about the solar systems. Those who were sceptical interpreted the provision of the solar system as a delay mechanism by Stellenbosch University to hold back the supply of proper electricity. Some of the Enkanini informal settlement community members were against the installation of the solar systems, because the solar panels were installed at a fee. There was a perception that the electricity supplied by Stellenbosch Municipality would be installed and supplied at no fee. One participant mentioned the following:

It becomes too expensive to use electricity. We cannot manage the electricity connection or usage. It doesn't last the whole month – maybe 20 to 23 days. But it is reliable in winter, unlike solar. (Solar user combined with indirect electricity user, 2017)

Solar energy was also labelled as an affordable option of energy compared to illegal electricity, candles and paraffin. These sources of energy were identified as having inconsistent prices, as they were seasonally expensive and unsustainable. The cost of other sources of energy (electricity, paraffin, liquid petroleum gas) fluctuated according to increased demand, especially during the winter season. Therefore, the prices of electricity, paraffin and gas were significantly higher in winter. Solar energy was therefore identified as an affordable and safe source of energy as its price was constant. However, its disadvantage was that its availability was hindered by changes in weather. During the cold and rainy season, the availability of solar energy was negatively affected.

4.4.3 Organisational and institutional arrangement of innovation system

This section addresses the third element of the framework. As defined in the introduction section, institutions, as used in this context, encompass organisations (both national and international), the stakeholders who interact with them, the processes by which they reach decisions, and which have an impact on progress towards sustainable development, and the activities they undertake to implement their goals. This includes multilateral agreements on economic, social and environmental issues, and domestic legislative instruments (OECD, 2001). The prototype of the cost-effective, environmentally friendly and minimal functionsolar system was piloted at Enkanini informal settlement on 20 shacks in 2012. This pilot was facilitated through the sponsorship of the Bill and Melinda Gates Foundation in June 2012 through the Sustainability Institute of Stellenbosch University. The Bill and Melinda Gates Foundation was the main funder of this pilot project. The Sustainability Institute hosted the research (that was funded by the National Research Foundation) of the project and facilitated the roll out of the project into the Enkanini informal settlement.

After the pilot phase, a more positive reception of the iShack Project came from the media, Development Bank of Southern Africa, Department of Environmental Affairs and the Stellenbosch Municipality. In 2013, the Stellenbosch Municipality further assisted by providing the transfer of the free basic electricity subsidy to non-grid-connected shack dwellers. In 2014, the Development Bank of Southern Africa, together with the Department of Environmental Affairs, sponsored the Green Fund. The intention of the Green Fund was to support green businesses. The fund was able to finance 2 400 solar systems. The company Specialised Solar Systems supplied the solar panels. Figure 2 depicts a Specialised Solar System installed in a shack. The funding from the Green Fund assisted in buying vehicles and equipment for the iShack Project, the setting up of the iShack Project hub, and the recruiting and training of the staff for the iShack Project (Swilling *et al.*, 2013). The Stellenbosch Municipality further wrote a letter of support to the Department of Land Affairs to assist in an application for land tenure. At present, the inhabitants of the Enkanini informal settlement have been granted permission to live in the settlement and are no longer regarded as illegal dwellers.

Cozzens and Sutz's (2012) factor for informal settlement innovation of prescribing different roles of formal organisation was evident in the organisational and institutional arrangement of the iShack Project. The prototype of the cost-effective, environmentally friendly and minimal functional solar system was piloted at Enkanini informal settlement on 20 shacks in 2012. This pilot study was facilitated through the sponsorship of the Bill and Melinda Gates Foundation in June 2012 via the Sustainability Institute. The Bill and Melinda Gates Foundation was the main funder of this pilot project. The Sustainability Institute hosted the research (funded by the National Research Foundation)

and facilitated the roll out of the project into the Enkanini informal settlement.



Figure 4.2: Installed Specialised Solar System

During the pilot and the roll-out phase, there was a bigger need for community engagement. Slum Dwellers International is an international organisation that facilitated the intervention of community engagement during the inception of the iShack Project. Slum Dwellers International collaborated with the Community Organization Resource Centre (CORC), a non-governmental organisation that supported the social processes of community-based organisations striving to work for themselves. Slum Dwellers International was involved with the iShack Project only from 2011 to 2012. It was involved in the enumeration process, community-planning process, mobilisation of the community, and creating a savings plan for the community during the implementation of the solar panels by the iShack Project. The enumeration entailed a community-driven census focusing on the socioeconomic and demographic profiling of the community, tenure status, the level of services and development aspirations of the community. Slum Dwellers International also assisted in counting available social services, such as toilets and running water, among a certain group of people.

The iShack Project arose from a network of international, national and local organisations and institutions whose joint focus was to ensure that the iShack Project delivered safe and affordable solar energy to the Enkanini informal settlement. The different organisations provided different forms of significant support during different phases of the iShack Project. The involvement of the different actors in the system ranged from the conceptualising the iShack Project, providing funding and subsidising energy and institutional support. The first phase was the conceptualisation and piloting of the project. This phase was executed through the interactions between the Sustainability Institute of Stellenbosch University and the Enkanini informal settlement residents who helped during the construction of the iShack Project shack and the two shacks for the pilot. The National Research Foundation was instrumental in the funding and conceptualisation of the research project.

The second phase was the execution by the Stellenbosch Municipality, Slum Dwellers International, Bill and Melinda Gates Foundation, Kayamandi Development Forum and Department of Environmental Affairs, together with the Development Bank of Southern Africa. The Sustainability Institute and the Enkanini informal settlement residents were the centre of the iShack Project. The Bill and Melinda Gates Foundation, the Development Bank of Southern Africa and the Department of Environmental Affairs jointly provided funding support, but only at the inception of the project.

The structure of the iShack Project innovation system had a combination of actors that were involved in long-term interactions and on an ad hoc or short-term basis. Slum Dwellers International and Kayamandi Development Forum provided institutional support for the innovation system of the iShack Project. However, the institutional support was not provided on a long-term basis, but only at the inception of the project. The Sustainability Institute and the Enkanini informal settlement are actors who have maintained long-term interactions with the iShack Project. The actors who have maintained long-term interactions are located in close proximity to the iShack Project. Being in close proximity to the iShack Project has resulted in prolonged interactions and better relations through the time spent interacting with the project. Being in close proximity to the iShack Project has enabled ease and convenience of engagement.

The organisational arrangement and network for the iShack Project depended on the Sustainability Institute. The Sustainability Institute is the centre of the iShack Project's innovation system, especially for recurring, day-to-day running, skills improvement and administrative support. The iShack Project was established through the Sustainability Institute and still relies on this entity to continue to provide solar systems on a long-term basis.

4.4.4 The informal nature of the settlement

This section addresses the fourth element of the framework. Cozzens and Sutz (2012) alluded to informal settlement innovation aspects as initiatives that focused on the grassroots; and looked for both

women and men as innovators. During the introduction of solar energy into the informal settlement, Slum Dwellers International facilitated the community planning process. This entailed the involvement of the community in the spatial planning of the informal settlement landscape. The community members were involved as they were the only ones who were able to understand their social interaction within their spaces. This process entailed working with local leadership to try to access the neighbourhood and households in the settlement through workshops and educational excursions of the iShack Project. However, some of the complaints from the community members were related to lack of leadership as demonstrated here:

There is lack of leadership; the community needs to elect a representative to bring our complaints to the municipality. We have street committees, but they are not representing us. (Indirect electricity user, 2017)

If there is no cultural capital, then we cannot achieve social innovation as it affects decision making and plays a big role in a small community. (Social innovation practitioner and specialist, 2019)

Residents stated that lack of leadership influenced their inability to access energy as there was a lack of communication between stakeholders such as street committees and ward councillors in the municipal chamber. This was attributed to the fact that people who were not local residents represented the Enkanini informal settlement community at the municipal chamber while the residents were not the decision makers participating and representing them at council level. The lack of communication with the councillor therefore raised the need to vote for a councillor who was a community member so that there would be accountability and face-to-face interaction between the community and the councillor.

Local politics play a big role in South Africa. (Social innovation practitioner and specialist, 2019)

The community further raised the need to elect someone who was not politically involved to represent them at council level as an approach to address the lack of representation. Residents stated that it was imperative to establish a locally based and formed structure instead of having the Khayamandi Development Forum representing them. Khayamandi Development Forum could not properly represent Enkanini informal settlement as the Khayamandi Township already had proper infrastructure such as roads, lights and toilets, and hence Enkanini informal settlement should have its own organisation.

The settlement also struggled to form local institutional arrangements, such as forums or associations, owing to the lack of trust among community members. The lack of trust was evident in their inability to facilitate a savings scheme. The savings scheme was to help raise money to buy solar systems for the households of the members participating in the scheme. Furthermore, the settlement had accepted social innovations from external organisations, instead of creating its own solutions and executing its own social innovations. The lack of trust among the informal settlement members was further attributed to

the high rate of mobility of residents who were moving in and out of the settlement. There were residents who were new to the settlement, while others had lived in the settlement for over five years. Some residents did not know how long they would be living in the settlement, as they were prepared to move to any other town or part of the province where there were better prospects of employment.

4.4.5 Balancing profit making and social involvement

This section addresses the fifth element of the framework. Since the installation of the solar systems was rolled out in 2013, agents who were community members were recruited and trained to work as staff at the iShack Project for a monthly salary. The agent's position required that he or she be a member of the Enkanini informal settlement community with a matric level education, and had knowledge of, or experience in, mechanical work. The project further created a variety of jobs for the residents of the community and trained at least 14 residents in a variety of skills, including installation of solar panels and maintenance and administrative skills. Currently, the iShack Project employs six Enkanini informal settlement residents as staff, two of whom are solar panel installers and four agents responsible for solar panel maintenance, marketing, customer care and administration related to the daily operation of the iShack Project.

During the training sessions, the iShack Project manager largely encouraged marketing of the solar systems and their gadgets. The encouragement of marketing was intended to assist in generating an inflow of income into the iShack Project. However, the sales of the gadgets were close to non-existent. The iShack agents and the solar system users thought the gadgets were quite expensive. Other income-generating methods ranged from maintenance visits to household visits by agents. Agents assisted during installations from time to time for a commission. Most of the income-generating activities were largely beneficial for the agents and installers, and these were some of their main sources of income. Figure 4.3 shows an iShack Project agent conducting maintenance on a Specialised Solar System.



Figure 4.3: An iShack agent conducting maintenance checks on the Specialised Solar System

The iShack Project did not necessarily come across as a profit-making entity, but rather as an entity that solely generated income to be able to carry on with service delivery or to keep afloat. It relied on income generated from maintenance calls, appliance purchases, solar system installations and monthly payments for the previously installed solar systems. Therefore, the income-generating aspect of the iShack Project appeared to be of equal importance to societal involvement. The beneficiaries of solar systems had to be committed to their monthly payments to ensure the iShack Project survived to be a sustainable employer and service provider. The iShack Project agents had to ensure beneficiaries of solar energy were committed to their payments, which would, in turn, ensure that more residents were connected to solar systems and that convenient services continued to be provided to the community.

Social innovation is achieved when the social benefits override the private benefit. (Social innovation practitioner and specialist, 2019)

Any innovation across sectors whose intention is to address any social injustice and inequality... (Social entrepreneur, 2019)

However, balancing the income-generating aspect with societal involvement came across as a challenge for the iShack Project. The agents constantly needed to keep up and push sales on appliances to generate income for their salaries. This was a challenge as some of the iShack Project agents displayed their inability to generate and manage the inflow of income independently. The iShack Project agents needed to be monitored by management to keep afloat. In addition, consumers of the solar panels defaulted on monthly payments, which then hindered the income generation for the iShack Project.

4.4.6 The iShack Project created social transformation and sustainable development goals through safe, clean and affordable renewable energy

This section addresses the sixth element of the framework which is social transformation. This variable alludes to the ultimate objective of achieving sustainable development goals, thereby achieving social transformation for informal settlements. The objective of the iShack Project resonates with sustainable development goal 7, which is to achieve the availability of safe, clean and affordable energy for all.

Solar would be more attractive if it could be upgraded to connect other appliances. Solar is not a very strong source of energy. I would not use it as my main source of energy. (Indirect electricity user, 2017)

However, all residents who used, and did not use, solar energy identified it as the safest option of energy to use, compared to all other options of energy available in the community. They stated that solar energy was safe for their children and families, as it did not cause fire and consequently deaths. Residents felt that solar energy was a safe option to use around children, especially those without supervision. Residents who used solar energy, as well as those who did not, identified solar energy as an environmentally friendly source of energy, as it did not emit harmful fumes. For those who used other sources of energy apart from solar energy, affordability was given as justification:

We use paraffin for lighting and cooking. It is easy to get, nearby, it is not cheap and makes the house warm. But paraffin smells bad; it is easy to get burnt; it brings a bad smell to food; and it is very dangerous. (Paraffin user, 2017)

We use gas to cook food. It is fast. It does not smell nor smoke, so it does not affect the taste of food. Gas lasts longer so value for money. It can cause fire if you leave it opened and leak if children play with it. You can't see how much you have, and it is very heavy. (Liquid Petroleum Gas user, 2017)

However, solar energy was critiqued in the following ways:

It [indirect electricity] is not safe. When it gets in contact with corrugated sheet it can cause fire for someone inside the shack. Solar and paraffin is cheaper. We go to our neighbours for connection. It is expensive; it is R350, R400 and more. I would go for solar. (Indirect electricity user, 2017)

Solar is affordable. We use solar for lighting, TV, [to]charge cell phone and to play music. It is safe and it does not cause fire. It gives brighter light than candles. You cannot cook with it and it goes off when there is not light. You cannot run your business, you cannot connect the fridge and use it to connect welding machine. (Solar user, 2017)

While residents mentioned that solar energy was affordable compared to electricity connections, users of indirect electricity connections complained that this source of energy was expensive and unreliable. This group stated that indirect electricity was expensive, as it cost R350 or R400 and more per month, but it did not last them until the end of the month. Indirect users had to pay more towards electricity connections before the month ended. The availability of solar energy was a solution to their problem of access to electricity. This group further stated that government was slow to provide services, and though there were street committees, there were no services: they, for instance had a dumpsite crisis and no water.

The factors that affected the attractiveness of the solar systems were the safety and affordability of solar energy. The respondents mentioned using solar energy was a safe option for their children and families as it did not cause fire. However, there were quite a few challenges related to using solar energy. The first disadvantage of solar energy was its unreliable nature as a source of energy, especially during the cold and rainy seasons.

Solar would be more attractive if it could be upgraded to connect other appliances. Solar is not a very strong source of energy. I would not use it as my main source of energy. (Indirect electricity user, 2017)

Solar energy was perceived as a source of energy that is not good enough for household use, as it could not cover all the basic needs required for energy. Solar energy could not connect most essential household appliances such as refrigerators, stoves and irons. Thirdly, solar energy was not a reliable source of energy as it would not be beneficial for entrepreneurial ventures such as a shebeen [bar], which would require a refrigerator. Users of solar energy expressed their dissatisfaction about the unreliable service provided by iShack Project agents, as they took too long to respond to complaints and maintenance calls.

Other sources of energy, such as paraffin and liquefied petroleum gas, emitted fumes harmful to the health of the users, and affected the taste of the food when used for cooking. Solar energy was identified as the healthiest option. This was because solar energy did not cause fumes, and could therefore be used at night while people slept. Thirdly, affordability was a pressing factor when it came to accessing

energy, as liquid petroleum gas was associated with unreliable access, and price increases tended to be associated with electricity and liquid petroleum gas.

Literature reviewed in Chapters 2 and 3 demonstrated the overlap between the objectives of the sustainable development goals and those of the social innovation systems. Sustainable development goals 1 to 8 focus on achieving access to socioeconomic services, and thus overlap with the primary objective of the iShack Project which is a social innovation. The iShack Project primarily provided a socioeconomic service resulting in human health and well-being, affordable energy and access to energy, which reflected some of the sustainable development goals (namely 1 to 8). This overlapped with social innovation factors of collective action, equity, equality and participation equality, and participation and inclusion, to achieve people-centred development and sustainable development (Degert *et al.*, 2016; Läßle *et al.*, 2016; Hulgård & Shajahan, 2013; Mehmood & Parra, 2013; Powell & Grodal, 2005; Stattman & Mol, 2014; Rasul, 2016).

The iShack Project overlaps the SDG goals substantially in that it additionally supports the following sustainable development goals:

- Goal 9 focuses on building resilient infrastructure, promoting inclusive and sustainable industrialisation and fostering innovation. The solar systems are a solid and durable form of equipment as they have withstood all types of harsh weather since they were installed. As a source of clean energy, solar energy was an innovation made available to all informal residents in Enkanini at an affordable monthly fee to ensure inclusive accessibility.
- Goal 11 focuses on renewing and planning cities and other human settlements in a way that fosters community cohesion and personal security, while stimulating innovation and employment. The Upgrading Informal Settlement Policy is a South African housing policy aimed at improving human settlements in the country. The policy was influential in the establishment of the iShack Project. It contributed to the iShack Project by improving human settlement through providing solar energy in the informal settlement, while simultaneously fostering innovation and employment for the residents of the informal settlement.
- Goal 15 focuses specifically on managing forests sustainably, halting and reversing land and natural habitat degradation, and combating desertification and the loss of biodiversity. Solar energy is green energy, and therefore resonates with the objective of reversing negative effects upon nature.
- Goal 16 focuses on promoting peaceful and inclusive societies for sustainable development, providing access to justice and building effective, accountable and inclusive institutions. After the initiation phase of the iShack Project, the Enkanini informal settlement residents complained about poor representation through local forums and by councillors at municipal level. However, the establishment of the iShack Project was assisted by the availability of

institutional representation and support from Slum Dwellers International and the Kayamandi Development Forum. The institutional support achieved peaceful and inclusive community engagement during community unrest when the solar energy was introduced.

- Goal 17 focuses on strengthening the means of implementation and revitalising global partnership for sustainable development. The establishment of the iShack Project was a product of an innovation system comprising a partnership between actors who operated locally, regionally, nationally and internationally, i.e. organisations and institutions such as the Bill and Melinda Gates Foundation, Slum Dwellers International, Stellenbosch University (Sustainability Institute) and the Enkanini informal settlement community.

In conclusion, this section analysed the iShack Project case study according to the framework adapted for this study. Therefore, as a method to achieve social transformation through safe, clean and affordable energy, the iShack Project has been successful. The objective of the analysis was to filter through the reality of the subject of analysis in order to establish the typical characteristics of a social innovation system in an informal settlement. Therefore, during the analysis there were key points (discussed in the following section) which the framework did not explicitly focus on. These factors emerged from each section or the thematic areas which were instrumental in identifying the leading factors demonstrating how the iShack Project bears the characteristics of a social innovation system with distinct traits due to the nature of the setting in which it occurred. These emerging traits were therefore instrumental in identifying a social innovation system in an urban informal settlement. The following section elaborates on the emerging factors identified during the analysis.

4.5 Achieving social innovation systems in an urban informal settlement: Emerging factors

Theory on social innovation systems discussed in Chapter 2 and empirical work on an African urban informal settlement discussed in Chapter 3 of this study was instrumental in guiding and leading the way of defining the empirical perspective of whether the iShack Project could function as a social innovation system or not. Therefore, with the aid of this analysis, it was possible to zoom in on the nature of an urban informal settlement and the prevalence of emerging factors. Factors such as locality, accessibility, affordability, trust and safety arose as the additional influential characteristics in an urban informal settlement social innovation system. Despite that, the iShack Project reflected some characteristics similar to the existing theory on social innovation systems. However there were emerging characteristics not in the existing research, but inherent in the iShack Project case study. The emerging factors are discussed below through comparing theory with empirical findings to discover the emerging and unique qualities of the iShack Project social innovation system, and to establish a transformative social innovation system for African urban informal settlements to access renewable energy.

4.5.1 Research and development and science and technology through accessibility and sustainability

Firstly, literature on the spatial nature of innovation revealed that innovation relies highly on factors such as research and development (R&D), science and technological (S&T) inventions, industrialisation and the introduction of new ideas to a certain context (community, industry and firm) (Agwu *et al.*, 2008; Lorentzen, 2010; Virkkala, 2007). Data on the iShack Project innovation system proved the importance of research and development and science and technology-related infrastructure for the establishment of the iShack Project. The contribution resulted from the collaboration of the research and development activities and science and technology-related infrastructure of the Sustainability Institute, and the Engineering Department and School of Public Leadership of Stellenbosch University played an integral part in establishing the solar system piloted by the iShack Project.

Secondly, the physical location of the iShack Project hub and the Sustainability Institute within the same local space proved that interactions and relations built over time were crucial factors in ensuring the sustainability of the initiative. This observation is consistent with Doloreux *et al.* (2007), Zajda (2016) and Angelidou and Psaltoglou's (2017) observation that actors in close proximity of each other have the ease of establishing sustainable social relations and interactions in order to establish innovative interactions within the same vicinity. Doloreux *et al.* (2007) and Zajda (2016) used a rural area as an example of a locality to establish the convenience of an innovation system through an agglomeration. By coupling social innovation and urban sustainable, collective and local development, Angelidou and Psaltoglou (2017) referred to a case as local when activities and services operated within cities through communities and networks, thereby promoting local solutions affected by, and which could address, global environmental matters. The advantage of proximity and locality played a significant role in the case of the iShack Project.

Therefore, in the case of the iShack Project, sustainability was evident in the assured longevity of the initiative, coupled with ease of access and use of the solar system for the intended beneficiaries. This ease of reach and access through proximity was improved by educating the local prospective users (beneficiaries) about the social innovation (iShack Project). This was achieved through employing agents (local community residents) to install, market and educate their fellow Enkanini residents of the solar system and the benefits of using solar energy. In addition to the ease of physical access, access in this case was achieved by knowledge distribution to the community through marketing and skills development.

Currently, the existing theory on social innovation systems by Fontan *et al.* (2008), Verschraegen and Sabato (2016), Zajda (2016), Huddart (2012) and Fulgencio and Fever (2016) did not present accessibility and locality of the social innovation as important factors within the spatial dimension. However, they were emerging factors in the iShack Project case study, as presented in this chapter.

Physical accessibility of the solar panel and the reach (through locality) of the social innovation (iShack Project hub) played an integral part in ensuring prospective users were able to make and sustain physical contact with the iShack Project hub and its agents. In this way, it was easier to execute and educate prospective users through convenience of interaction whenever the need presented itself.

Lastly, local relations were a factor of trust that local actors (Enkanini informal settlement residents) had in the Sustainability Institute of Stellenbosch University and Slum Dwellers International. The interactions built through trust rested on local relations established over time. The trust was built between actors in the local, national, regional and intercontinental dimension. This resulted in the sustainability of interactions created through the foundation of research and development and science and technology infrastructure at local level.

4.5.2 Addressing a social problem through temporary or long-term solutions

When the solar panel installations were rolled out, there was a perception that they were supplied as an interim option while Enkanini informal settlement residents waited for the Stellenbosch Municipality to supply electricity. This was the reason why the pilot implementation of the solar panels did not generate a positive reception from the Enkanini informal settlement community members. Some community members showed positive reactions, while others were sceptical of the solar systems. Those who were sceptical attributed the supply of the solar panels as a delay mechanism to the supply of proper electricity by the Stellenbosch Municipality. Because the solar panels came at a fee, some of the Enkanini informal settlement community members were against the installation thereof. There was a perception that electricity supplied by Stellenbosch Municipality would be installed and used at no cost.

In mid-2015, the roll out of the iShack Project was challenged by sociopolitical interferences influenced by negative perceptions of the solar panels. Social movements erupted within the Enkanini informal settlement community inducing these negative perceptions in certain community members. Social movements resulted in the burning of the iShack Project hub, and damaging some of the iShack property and equipment worth R100 000, including some of the uninstalled solar panels.

The unrest was largely caused by the scepticism of the community, and the idea that the iShack Project stalled the provision of free electricity by Stellenbosch Municipality. Counteracting this scepticism required a great deal of mobilisation by Slum Dwellers International. Getting through this process required the involvement and buy-in of the local leadership. At the time, the Kayamandi Development Forum represented the informal settlement community by building a relationship between the local dwellers and Stellenbosch Municipality. Mobilisation involved general governance matters relating to community organisation and preparation for the introduction of the iShack Project in the form of meetings with the relevant parties, organised and strengthened around certain core values and beliefs, to bring the community's own understanding of development into context.

According to Allen *et al.* (2016), sustainable development-related interventions entailed ensuring long-term solutions. The iShack Project showed that the solar systems could last for five years and more. Therefore, the solar systems certainly lasted longer compared to existing energy sources (candles, paraffin, and liquid petroleum gas) used by the Enkanini informal settlement residents. Owing to the number of years the solar systems lasted, solar systems could safely be regarded as products that provided long-term sustainable usage.

However, the empirical evidence gathered on the iShack Project revealed that the solar systems still did not address all the needs related to the unavailability of electricity connections at Enkanini informal settlement. The empirical data gathered from the iShack Project for this study and literature by Swilling (2014) demonstrates the difficulty of addressing challenges related to social infrastructure in informal settlements. Informal settlements tend to occur in areas not designated for human habitation (Swilling, 2014). Owing to this and other such complexities, informal settlements experience challenges in receiving social services and social infrastructure. Therefore, providing long-term infrastructure for these areas has always been a challenge for their local municipalities. This invariably resulted in conflicts and dissatisfaction from the informal settlement residents.

Users of the solar system in Enkanini informal settlement accepted the availability of the solar systems as a temporary solution, but they perceived electricity connections as a more permanent energy source and solution. Though the Stellenbosch Municipality had not presented any plans to erect electricity infrastructure, the Enkanini informal settlement residents were hopeful that plans would be made available at some point. Users and prospective users of the solar systems were still not content with solar energy in general, but were happy to have it for lighting. Current users further expressed their need for solar systems which could connect more appliances, such as refrigerators and stoves. This was however coupled with the challenge that solar energy was not convenient during rainy and cold seasons. Such perceptions therefore resulted in questions about whether the social problem of non-availability of safe and affordable energy had been addressed in its entirety for the informal settlement or not. This was because residents would still be left in the dark during winter, and would therefore have to go back to using candles and indirect electricity for lighting.

Addressing the social problem remained unresolved, with perceptions of the beneficiary clashing with those of the party executing the social innovation of solar energy. The beneficiaries (Enkanini informal settlement residents) stated that the problem of the electricity connection in the informal settlement was only partly addressed, while the iShack Project aims were based on the view that the provision of solar systems contributed significantly to addressing the challenge of electricity connection and accessing safe and affordable energy in the informal settlement.

Addressing a social problem in an urban informal settlement remained a complex issue, as the beneficiaries insisted on the need for electricity connection. The community could access solar energy in their households regardless of whether some of them perceived it as a long-term or short-term solution. However, even though the iShack Project services were perceived as a temporary and long-term solution, its availability contributed to a sustainable community that achieved access to safe and affordable energy. Users of solar energy further maintained solar energy was a sustainable solution, as it was an affordable and safe service. Users of solar energy stated they would recommend solar energy to non-users owing to its benefits.

4.5.3 Organisational and institutional support offered as intermediary support through top-down involvement

Top-down organisational support was provided by Stellenbosch University, Bill and Melinda Gates Foundation, Development Bank of Southern Africa and Department of Environmental Affairs through funding, research and development, and science and technology infrastructure during the initial establishment phase of the iShack Project. This support for the iShack Project was sourced outside the locality of the Enkanini informal settlement. The top-down nature of the organisational and institutional support of the iShack Project was evident only during the inception of the initiative. This top-down attribute of the support was, however, not consistent with the theoretical observations made by Light (2006) and Novkovic (2006) that social innovation stemmed from bottom-up approaches. The organisational support was also not long-term, unlike support presented in Juego (2009) and Svidroňová *et al.* (2017).

Slum Dwellers International and the Kayamandi Development Forum provided institutional support for the iShack Project. These organisations jointly provided institutional support only at the inception of the iShack Project. Slum Dwellers International provided top-down institutional support, while the Kayamandi Development Forum provided bottom-up institutional support enabling the achievement of their set goals through community engagement in order to set up the iShack Project.

Slum Dwellers International and the Kayamandi Development Forum provided institutional support in their capacity as intermediaries existing between the Enkanini informal settlement community and the international, national and regional level organisations offering support related to funding, research and development, and science and technology. Slum Dwellers and the Kayamandi Development Forum were intermediaries between the Enkanini informal settlement and Stellenbosch University, Bill and Melinda Gates Foundation, Development Bank of Southern Africa and the Department of Environmental Affairs. This observation was consistent with the conclusion by Fontan *et al.* (2008) that social innovation systems belonged to geographical spaces ranging from the global to the local space, and existing through the intermediary spaces that could be continental, national or regional.

The iShack Project urban social innovation system possessed not only top-down characteristics, but also some bottom-up characteristics. The bottom-up approach in the urban informal settlement social innovation system was evident after the initiation, execution and full establishment of the iShack Project. The bottom-up involvement was also evident when the community members were involved in the process of running the iShack Project, through to marketing and installation of the solar systems. However, the bottom-up approach involvement was not achieved through the community's independent activities. The Sustainability Institute needed to oversee all the bottom-up activities provided by the community. The composition of people involved in the facilitation of the daily operation of the iShack Project social innovation system rested on the community and the Sustainability Institute. The collaboration between the iShack Project and the Sustainability Institute was responsible for the bottom-up approach of the social innovation. This partnership or initiative was maintained through local representation, skills development, and executing the service to the community.

4.5.4 Top-down solutions as the most attractive option to informal settlements

A good innovator uses a human-centred approach to engage the beneficiary before starting, as some [beneficiaries] might not think they have a problem. That way you will be able to create value from the outcome. (Social entrepreneur, 2019)

During the pilot and the roll-out phase, there was a bigger need for community engagement. Slum Dwellers International, an international organisation facilitating the intervention of community engagement during the inception of the iShack project, collaborated with the Community Organization Resource Centre (CORC). As a non-governmental organisation supporting the social processes of community-based organisations striving to work for themselves, the Community Organization Resource Centre was one of the organisations that collaborated with Slum Dwellers International to achieve social engagement in the Enkanini informal settlement. Slum Dwellers International was only involved with the iShack Project from 2011 to 2012. It was involved in the enumeration process, community-planning process, mobilisation of the community, and creating a savings plan for the community during the implementation of the solar panels by the iShack Project. The enumeration entailed a community-driven census that focused on the socioeconomic and demographic profiling of the community, tenure status, the level of services, and development aspirations of the community. Slum Dwellers International also assisted in counting available social services such as toilets and running water within a certain group of people as they were the ones able to understand their social interaction within their spaces best. This process entailed working with local leadership to try to access the neighbourhood and households in the settlement through workshops and educational excursions of the iShack Project.

Top-down-initiated solutions seemed to be more attractive to the informal settlement residents. Evidence gathered on the informal settlement hosting the iShack Project showed the top-down nature

of social innovation was more attractive and more acceptable compared to the bottom-up approaches. The Enkanini informal settlement residents ironically demanded and willingly accepted assistance and interventions from outside parties such as the local municipality and any type of organisation willing to lend a hand in addressing their plight of lack of social services. This observation contradicts the perspective of Light (2006) and Novkovic (2006) who emphasised the importance of the bottom-up nature of social innovation.

Enkanini informal settlement residents were very sceptical when presented with the option to open a joint savings scheme to acquire solar systems for their households. The population of the informal settlement was largely one which had migrated from other towns and provinces. Reasons for migration included the need to find employment in the neighbouring urban area. However, the community members were willing to leave Enkanini informal settlement and relocate if an opportunity arose in another area or town. For this reason, the community members stated that there was a great deal of population movement in and out of the informal settlement. Therefore, internal scepticism was attributed to a lack of trust among the community members. The trust issue also extended to a lack of faith in the local councillor at municipal level. This reduced the trust in bottom-up interventions.

One of the main objectives of the iShack Project was to hand the initiative over to the Enkanini informal settlement community. This objective was to have the iShack Project independently run by the community itself without the assistance of the Sustainability Institute. However, the community and the iShack Project agents did not seem to perceive themselves as the owners of the project, but rather as beneficiaries thereof. The Enkanini informal settlement community continued to perceive the iShack Project as belonging to Stellenbosch University and the Sustainability Institute, rather than their own. Therefore, the community strongly demonstrated that residents in an informal settlement were more comfortable with accepting a top-down social innovation. This might be due to the possibility that most residents in the community were not permanently based in the settlement. Data that informed this case study showed that the Enkanini informal settlement community were still open to welcoming any other solutions which would seem to be more attractive in the provision of a better solution to the energy crisis, compared to the solar energy provided by the iShack Project.

4.5.5 Profit making as part of the driver for community involvement

During the training sessions, the iShack Project manager largely encouraged marketing of the solar panels and their gadgets in particular, as that would create a flow of income into the entity. However, the sales of the gadgets were close to non-existent as the iShack agents and the solar system users thought that the gadgets were quite expensive. Other income-generating methods ranged from maintenance visits to agents assisting during installations for a commission. Most of the income-generating activities were largely beneficial for the agents and installers, being some of their main sources of income.

Concerns were raised about the iShack Project agents (employees) constantly attracting clients and conducting maintenance on existing solar systems in order to generate income for the iShack Project. This aspect of generating income through installations and maintenance visits was an important factor in keeping the iShack Project afloat in order to pay agents' salaries. This meant that if the informal settlement community did not provide employees, clients and beneficiaries, the income-generating aspect would be compromised. The objective of the iShack Project was to ensure enough income was generated for salaries and expenses, but not necessarily so much income as to generate profit.

Merging the three actors – namely the informal settlement as beneficiaries, the iShack Project as employees and the Sustainability Institute as contributor to the sustainability of the iShack Project – rendered the iShack Project as a non-profit initiative. Therefore, the perspective of Fulgencio and Fever (2016) on balancing profit making with societal benefit as a vital factor for social innovation systems is not the case for the iShack Project. Generating a profit was not one of the objectives of the iShack Project. Instead, the project primarily required community involvement to keep afloat financially. The iShack Project aimed to supply solar systems to the settlement and to keep afloat in order to meet its monthly financial obligation to pay agents' salaries. Therefore, the iShack Project social innovation system demonstrated that profit making was not necessarily a primary factor, but rather that sustained income generation was needed through top-down involvement.

4.6 The iShack project transformative social innovation system in Enkanini informal settlement

The iShack Project case study demonstrated factors specific to a social innovation system based in an African informal settlement as recognised in the existing framework established with the aid of Chapters 2 and 3. Despite these factors, the iShack Project was characterised by other factors not recognised in the transformative social innovation system in an African urban informal settlement as presented in Section 4.5. This section then incorporated the emerging factors discussed in Section 4.5 with the aid of the transformative social innovation system in an African urban informal settlement. Figure 4.1 demonstrated the incorporation of the iShack Project emerging factors with the iShack Project transformative social innovation system in an African urban informal settlement. The diagram shows the process through which the iShack Project's transformative social innovation system was applied to achieve a sustainable community in Enkanini through accessing renewable energy.

The diagram depicted in Figure 4.1 improved on transformative social innovation systems in African urban informal settlement framework established in Chapter 2 and 3. The framework was improved by incorporating the factors emerging from the iShack Project case study. The transformative social innovation system to access renewable energy was established in Enkanini. The diagram depicts a process centred on accessing affordable, clean and safe energy. From the left of the diagram, it depicts the emerging factors that affected the spatial dimension at the initiation and stability phase. These

factors are accessibility, interaction, local relation and sustainability and they were discussed in Section 4.5.1. The second element shows how the social problem was addressed through a sustainable solution regardless of whether the solution was long-term or temporary and this was discussed in Section 4.5.2.

The initiation phase in the diagram shows that addressing the social problem required interaction between the actors within an innovation system, which is depicted as the third element in the diagram and is discussed in Section 4.5.3 of this case study. The element depicts the approaches applied when actors interacted, namely the top-down approach and the bottom-up approach. The top-down approach was instrumental during all the phases of the initiative: the initiation, mediation and stability phases; whereas the actors involved in the bottom-up approaches were only active during the mediation and the stability phases. This was also consistent with the finding that there was a lack of trust among the informal settlement residents. Residents were not necessarily interested in initiating and overseeing solutions or innovations for themselves. Instead, this informal settlement community preferred to accept and trusted external organisations (above their fellow residents) to initiate and manage social innovation initiatives in their community.

The fourth element depicts how the interactions in the innovation system resulted in the activities and roles played by the beneficiaries, employees and clients. These actors primarily ensured that the iShack Project met its objective of executing the social innovation. The elaboration in Section 4.5.5 elucidated how the social innovation system did not necessarily aim to generate a profit but aimed rather to keep afloat financially to meet its obligations. The fourth element further illustrates that the iShack Project social innovation was a non-profit initiative primarily focused on sustaining the social innovation for the informal settlement. Finally, the last element of the framework shows how the results of the social innovation system initiative resulted in achieving sustainable development goals, and therefore a sustainable community, through accessing affordable, safe and clean energy.

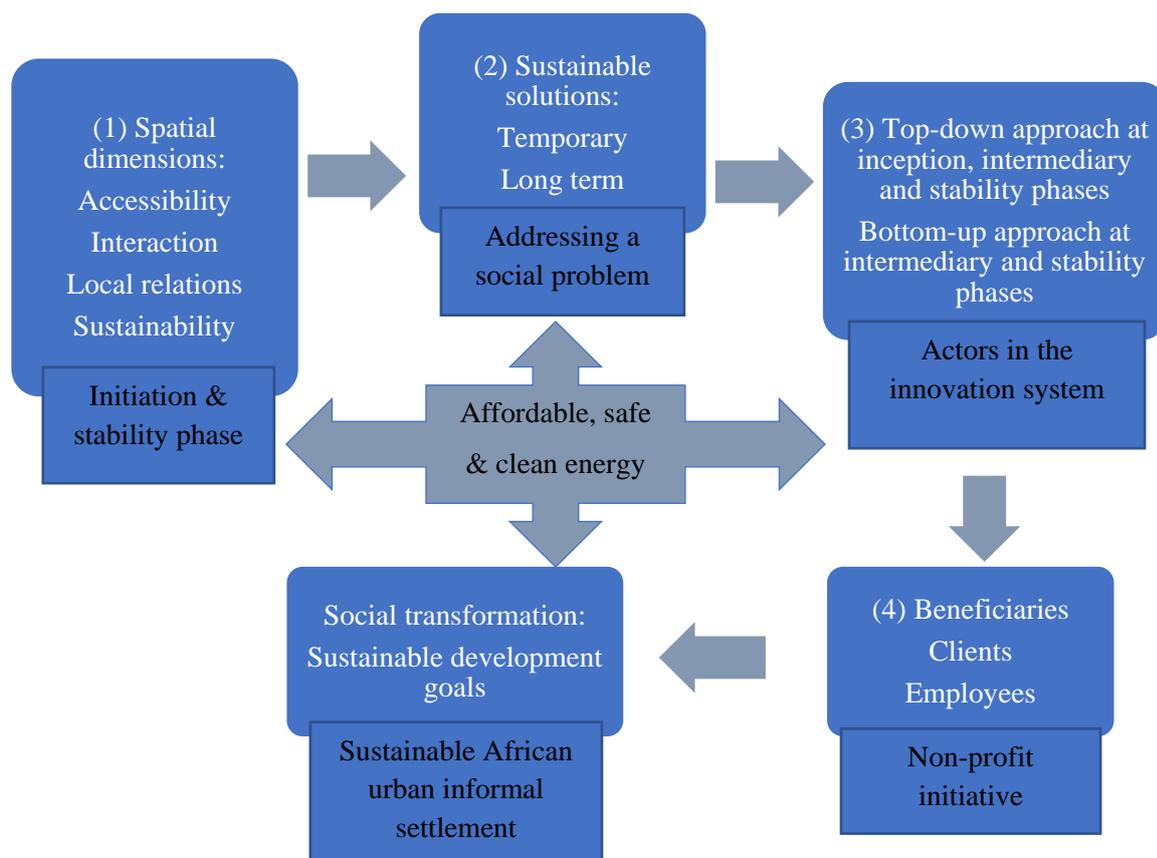


Figure 4.4: Transformative social innovation system in an African urban informal settlement to access renewable energy

4.7 Conclusion

The methodology applied in this study was instrumental in achieving the type of data that would enable a deductive and inductive approach to analyse the empirical section of this research. The data collected for this study responded to the need to acquire an in-depth understanding of the focus of the study. The different forms of data collection that were applied responded absolutely to the need to construct a case study rich with relevant information. The case study presented in the study was instrumental in fulfilling the objective of this chapter, which was to test whether the iShack Project could function as a transformative social innovation to create accessible renewable energy in an African urban informal settlement. The iShack Project proved to reflect most of the characteristics of a transformative social innovation system enabling accessible renewable energy in an African urban informal settlement; however, new traits were evident in the iShack Project. Therefore, in addition to the framework and factors established in Chapters 2 and 3, this chapter applied a case study to suggest viable alternative

social innovation systems approaches, ensuring SDGs were achieved in the Enkanini informal settlement, by ensuring the provision of renewable energy and thus achieving a sustainable community. The chapter was able to achieve this objective through the inductive approach. The analysis of the data was integral to identifying the emerging factors unique to the iShack Project social innovation system based in the urban informal settlement of Enkanini.

A social innovation system can be identified by the various inherent aspects. Firstly, the iShack Project can be identified as a social innovation system because it addresses a social problem or various social problems that are experienced by the residents of Enkanini informal settlement. The social problems addressed are, firstly, a lack of safe and affordable energy, unemployment and a lack of convenient access to energy services. Secondly, one of the main objectives of the iShack Project is to create a self-sustainable initiative that belongs to the community. Therefore, where there is a need for finances to maintain the social innovations, the innovation should be established in such a way that it is financially self-sustainable. This is because social innovations should be focused on solving problems through solutions that can be financially independent in the long run. Thirdly, beneficiaries of the iShack Project, whether consumers (users of solar energy) or employees, have been educated to independently run and maintain the iShack Project. A social innovation system must capacitate its beneficiaries to improve their lives. This must be coupled with instilling a sense of empowerment for the beneficiaries and thereby changing their circumstances and all those involved in the system. This was also achieved in the iShack Project through employment creation, training business management and marketing skills (to run the iShack Project) and disseminating knowledge to the informal settlement community on how to use clean, affordable and safe energy. Fourthly, the social institutions (both formal and informal) involved in the social innovation system seem to be central to the gatekeepers of the system. This is because social capital established through interactions, trust and cultural innovation are the binding factors that govern the sharing of knowledge and execution or uptake of innovation in the network. Lastly, an innovation system qualifies as a social innovation system if the technology introduced has a social impact. The application of technology or socially innovative ideas must be primarily to yield social gain and not private gain.

Chapter 5: Conclusions and recommendations

5.1 Introduction

The main objective of this study was to establish an approach to enable African urban settlements to address socioeconomic problems, such as poor social infrastructure and services. As discussed in Chapter 1 of this study, most African urban areas have been experiencing rapid population growth that has resulted in the development of informal settlements and poor access to social services. Since energy is one of the essential social services in communities, this study aimed to find an innovative approach through which energy could be made available in complex African urban informal communities. Studies show that the acquirement of energy in communities resulted in the ability to achieve more socioeconomic objectives. However, these studies do not go as far as demonstrating the innovative approaches to achieving these socioeconomic objectives in complex communities. This study merges its investigation with the current United Nations development agenda and sustainable development goals, since access to energy is one of the goals. This study therefore proposed an innovation system that would improve the access to energy in a typical African urban informal settlement. The current framework of a social innovation system is more theoretical and has not been put into a practical context. This research has attempted to address this by linking social innovation systems to African urban informal settlements and SDGs. This chapter sets out the contribution (theoretical, methodological and practical) of the study, how each of the research objectives were achieved, the limitations of the study, and recommendations for further research. The study presents the argument that social innovation systems can be used to achieve SDGs in African urban informal settlements. Therefore, the overall objective of this work was to address the mentioned gap by investigating how a social innovation systems approach can facilitate the practical achievement of SDGs in an African urban informal settlement. This overall objective was achieved by addressing the following specific research objectives:

- To examine critically whether a social innovation system existed to deliver SDGs.
- To establish the social innovation systems facilitating sustainable communities in African urban informal settlements, with a specific focus on energy access.
- To determine a social innovation systems approach that could support achieving SDGs through the iShack Project in Enkanini informal settlement.

5.2 Contribution of the study

The three objectives of the study resulted in the main contributions of the study: the theoretical, methodological and practical contributions. The following section elucidates these contributions.

5.2.1 Theoretical contribution

The first and second objectives resulted in the theoretical contribution of the study. The current social innovation systems framework presented in Chapter 1 is theoretical and was not put into context. The first objective essentially coupled the existing social innovation systems framework with SDGs and informal settlement innovations. This section of the study established the overlaps between the two in order to demonstrate how a social innovation systems approach could be a viable approach to achieve SDGs.

However, the development of this framework through achieving the first objective was still not specific as to how access to energy could be achieved in an African urban informal settlement context. It still provided a one-size-fits-all approach that did not account for the fluid and dynamic nature of African urban informal settlements. The complex and dynamic nature of urban informal settlements rendered the framework through which social innovation systems that could achieve SDGs in informal settlements established through the first objective unsuitable. Additionally, the initial social innovation systems framework to access energy had not yet been applied in the context of Africa, let alone in complex areas such as informal settlements. The second objective connected the existing framework and the access to energy, and the literature was therefore reviewed on how social innovation systems in African urban informal settlements accessed energy. By narrowing down the focus of the existing social innovation system framework to African urban informal settlements and SDGs, this study developed the transformative social innovation system for urban informal settlement presented in Figure 5.1. However, the review that informed the second objective did not necessarily source literature on ‘social innovation systems in African urban informal settlements’, as most of the literature available focused on accessing energy in rural areas. Rural areas were not within the scope of this study. However, the literature review explored how disadvantaged areas accessed energy and how this further contributed to the attainment of the SDGs.

Achieving the objective of the social innovation in question involved the availability of a technological product, the solar panel. However, this study mainly focused on the innovative manner in which organisations, institutions and individuals arranged themselves and interacted in order to ensure that the technological product is implemented in practice to address a social problem. The definition of technological innovation systems by Gosens *et al.* (2013) only defines these types of innovation systems as those networks that are based on a dynamic network of agents that interact as part of a particular institutional infrastructure which involves the generation, diffusion and utilisation of technology. This definition refers to the invention or improvement of technological equipment that is intended to contribute to the enhancement of production, communication or sales in a certain industry or firm. The social innovation systems theory developed in this work does not necessarily refer to innovations that are realised from the availability and diffusion of certain technological equipment. Rather, it refers to

the manner in which actors in the innovation systems establish an approach to interact in a way that will address a social problem. This could merely refer to the innovative methods that organisations apply to interact with communities. It could also refer to the type of society-level institutions established to address their society problems.

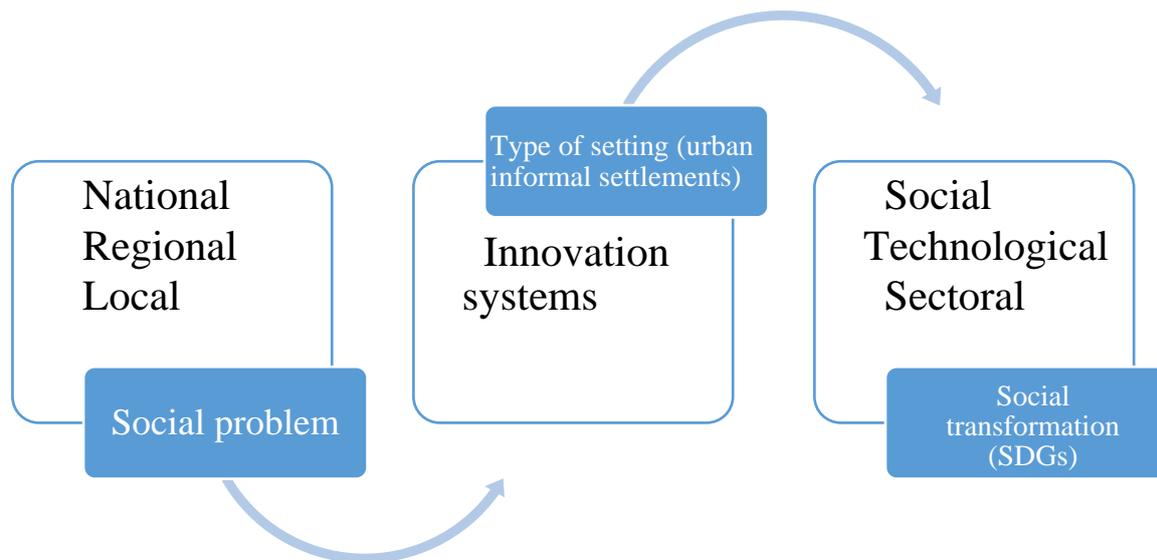


Figure 5.1: Transformative social innovation system for urban informal settlements

5.2.2 Methodological contribution

There are limited case studies on urban informal settlements applied in the social innovation systems framework. Therefore, this study made a methodological contribution by applying the Enkanini case study to the social innovation systems framework. The single-case study method has been criticised as inadequate for making generalisations. However, single-case studies have been used in highly scientific and delicate fields, such as medicine and law, to inform groundbreaking conclusions and decisions that result in theories. Such contributions are achieved by providing an understanding of the specifics of the particular case (Mariotto *et al.*, 2014). Kennedy (1979) and Mariotto *et al.* (2014) further substantiate the use of the single-case study to create opportunity for organisations. Organisations apply single-case studies to advise and lead further adjustments to already perceived understandings of reality and to interpret experience in order to build a shared understanding of the organisation. To the researcher's best knowledge, this application of social innovation systems in the context of African urban informal settlements is the first case study to inform and contribute to theory in the social innovation systems field.

5.2.3 Practical contribution

The literature review revealed that social innovation systems theory had not been applied in practical cases. The application of the Enkanini case study demonstrated that the implementation of renewable energy through a social innovation system in an African urban informal settlement could result in social benefits. Applying the social innovation systems approach has therefore positively facilitated the socioeconomic status of the informal settlement community.

5.3 Key findings

The findings related to the first objective, namely ‘to examine the extent to which social innovation systems can deliver SDGs’, identified the overlaps existing between the social innovation system and SDGs. Some of the overlaps found are as follows:

- Ensuring access to socioeconomic services and resources for all. These goals constitute ending poverty and hunger, and promoting food security, health and well-being, equitable and inclusive education, gender equality for women and girls, improved sanitation, affordable energy, and access to decent work.
- Aiming to promote peaceful and inclusive societies for sustainable development, to provide access to justice for all, and to build effective, accountable and inclusive institutions at all levels.
- Facilitating partnerships through external involvement of actors could contribute to sustainable learning, thereby avoiding lock-in and low innovative capacity in the system.
- Ensuring the benefits of land-based ecosystems, including sustainable livelihoods, would be enjoyed for generations to come (United Nations, 2016). The World Conservation Strategy stressed the following: “We have not inherited the earth from our parents, we have borrowed it from our children”, thus introducing a notion very similar to that of intergenerational equity (Harding, 2006). Social innovation theory essentially focused on the continuity of sustainability and is devoted to prolonged innovativeness.

With the recognition of the overlaps, the second objective was instrumental in the development of the transformative social innovation system framework that accounts for the complexities of an African urban informal settlement. Further, the framework accounted for the spatial and economic aspects of innovation systems, the need to address a social problem, and the bottom-up approach and community-level benefits. Furthermore, the framework showed how the social innovation system could account for the community-level social transformation through spillover effects related to the SDGs.

Firstly, the findings revealed that literature on social innovation systems were still very limited, particularly in the context of African countries and creating sustainable communities in informal settlements through renewable energy. This also illustrated that social innovation systems theory is still

largely associated with business-related and capitalistic interventions in firms at organisational level. Secondly, social innovation systems literature and activities were still perceived to be coupled with and influenced by technological infrastructure.

Thirdly, literature on social innovation systems revealed that social innovation systems activities stemmed from the application of social innovation to address complex social challenges (Huddart, 2012). One of the main attributes of social innovation stemmed from bottom-up approaches (Light, 2006; Novkovic, 2006). The existing work on social innovation systems, though mentioned but briefly, was coupled only with top-down approaches not solely intended for community benefit.

Fourthly, the brief mention of social innovation systems arises from the discussion of Figueroa-Armijos and Valdivia (2017) and Mosimege *et al.* (2016) when addressing the complex social challenges inherent in rural settings. Their studies revealed complex developmental social challenges, which are largely perceived to be in rural areas, requiring innovative solutions.

Finally, the results of the systematic review revealed how accessing renewable energy had positive spillovers for African urban communities. The positive spillovers resulted in the improvement of conditions for communities through social, participatory, communally beneficial and ecologically sound methods and systems. By incorporating the findings of the systematic review and the framework established in Chapter 2, a transformative social innovation system to access renewable energy in an African urban informal settlement framework was established. This way, the transformative social innovation systems in urban informal settlements framework was placed in the context of accessing renewable energy in African urban informal settlements.

The findings on the analysis of the case study presented in Chapter 4 revealed the additional factors required to establish a social innovation system in an African urban informal settlement. The top-down interventions are the backbone of the sustainability of the social innovation systems of informal settlements. The informal settlement community were mostly aware of and affected by their plight of a lack of social infrastructure. However, there were high expectations of assistance from external organisations and institutions. The external assistance that was expected was in the form of funding, resources and infrastructure that would address the lack of social infrastructure and resources.

Furthermore, the external organisations were the main initiators and actors that provided and sustained solutions to the informal settlement's social problems. This included the initiation, start up and establishment of the iShack Project that was achieved through research and development. Such an initiative also required substantial investment of time and resources from the external organisations.

The disadvantage of unemployment and high rates of poverty paralysed the efforts, courage and independence to initiate or make own efforts to source infrastructure that would address their social

challenges. Owing to a lack of faith, the informal settlement community perceived themselves as mere beneficiaries of the initiatives rather than the owners thereof. However, the involvement of the local institutional arrangements such as a local forum was important for buy-in and roll out and sustainability of the initiative. The buy-in of the community was essential as the external organisations had to convince the community through the local forums about the viability of the renewable energy solution. The community had high expectations and trust in the local municipality and local political parties. Therefore, renewable energy infrastructure was only perceived and accepted as a temporary solution to the lack of social services as the community members were still waiting for electricity from the local municipality. Community members' perceptions therefore played an important role in the eventual roll out of the social solution.

A positive factor that contributed to the buy-in of the community was the accessibility, reliability, safety and affordability of the renewable energy solution. The community conceded that renewable energy was a better option compared to other forms of energy, even though it did not meet all their energy needs. It was also accepted as an interim solution in the long-term owing to its durability and lasting reliance. As much as community involvement was crucial in the buy-in phase, it was also important in the sustainability of the project such as during the day-to-day operations. This important type of involvement by the community is largely a bottom-up action that relies on the guidance of top-down interactions.

The literature gathered on social innovation systems revealed the importance of social initiatives breaking even financially and the importance of social benefit. The iShack Project relied on generating just enough income to meet its financial obligations, such as salaries; making a profit was not a priority. Lastly, the findings revealed that the iShack Project innovation system provided safe, affordable and clean energy for the Enkanini informal settlement, resulting in the achievement of some of the SDGs in an African urban informal settlement.

5.4 Limitations and recommendations for future research

This study does not contradict literature on social initiatives in African urban informal settlements, but supplements it. By investigating social innovation systems, this study aimed to understand and establish the different roles and the purpose of the various actors within the system. Furthermore, this study focused only on social innovation systems in the African urban informal settlement context. The case study applied in this research focused only on the available renewable energy in an African urban informal settlement. Indeed, this research examined only one case study – and the relevance of a single-case study was discussed in a preceding chapter. The social innovation systems approach established in this case may not be relevant throughout all informal settlements across the African context. However, the informal settlement used in the study was found to have the main characteristics of the typical urban

informal settlement. Therefore, lessons learnt from the conclusions of this work could be relevant in other African urban informal settlements.

The introduction and execution of a new development agenda requires a different approach and new methods to tackle the complex socioeconomic development challenges in complex areas and regions. Development approaches need to change from the one-size-fits-all approaches. Literature shows that a plethora of social innovation initiatives tend to offer top-down approaches and focus on funding as a method to stimulate growth and development in developed, undeveloped and poor regions worldwide. Rather, the approach suggested in this study prioritises the availability of a combination of resources or infrastructure, coupled with the presence of the relevant actors that can impart and share knowledge, skills and ideas. This combination creates sustainable development outcomes that will address development challenges, both expected and unexpected.

Unlike the one-size-fits-all approaches that were previously implemented, development approaches should apply context-specific measures to address socioeconomic development challenges. For instance, local institutional arrangements organised through public forums, trusts and schemes should be considered as the primary actors for bottom-up development approaches. This ensures institutions that are responsive to local problems and non-discriminatory to gender, and that establish bottom-up methods. Development organisations are still essential in ensuring development products and initiatives in under-resourced areas such as African urban informal settlements. However, local institutional or social arrangements are still the entry point and drivers of bottom-up development initiatives into communities. This means that innovations are not dependent on producers and users, and intermediaries that are internal actors are the most essential in the value chain regardless of the type of social innovation.

Furthermore, high tech infrastructure and ICT are essential for innovative ventures. Social innovation systems should focus on offering an overall perspective to development challenges. Social innovation should not only intend to achieve the demand and supply aspect of the exercise. Policy related to social innovations should not be extensively reliant on diffusing the product (ICT and high-tech infrastructure) that would be supplied by an organisation to a community with social challenges. Instead, social innovations should equally intend to influence or improve the organisational, economic, social, political and other factors vital in the diffusion and use of innovation. Rather, social innovations should include intermediaries that can influence the overall innovation in a way that brings the social, political and organisational aspects of the case on par with each other. This study coupled the social innovation systems approach and SDGs, which was a first. The focus on SDGs is diverse and can be spread to other sectors and other practices. However, literature on social innovation systems is still in its early stages, especially in developing countries. Existing research on social innovation systems are mostly theoretical, with little or no focus on practical applications. Therefore, further research could focus on

the application of social innovation systems in different contexts, such as rural areas, cities, industry and other sectors, as well as the informal sector. The expansion of this research into different contexts, such as education, finance and preservation of resources, would be instrumental in the development of the theory on social innovation systems.

Further research could focus on the application of quantitative data and methods measuring the strength of the network and interaction of the actors in a social innovation system. The transformative social innovation systems approach for an African urban informal settlements framework could also be applied to make comparisons between two or more informal settlements in different African countries. The framework could be extended to focus on other SDGs that have a positive spillover into more SDGs.

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Appendices [not to be edited]

Appendix 1

Search results for systematic review conducted on social innovation systems and energy in African urban informal settlements

Title	Author	Year	Theme	Country	Energy	Spatial	Social problem	Innovation systems
Local and participatory approaches to building resilience in informal settlements in Uganda	Dobson, Nyamweru & Dodman	2015	Informal settlement community manufacturing briquettes from recycled materail for cooking	Kawempe, Kamapala, Uganda	Briquettes	Local	Unaffordable charcoal	Informal settlement community savings group
Social Innovation Creates prosperous Societies	Chika Urama & Acheampong	2013	Grassroots social properity through sustainable methods	Kiberia, Kenya	Solar power	Local		community and wireless information and communication network
Social sustainability: guidelines for urban development and practice in Abuja city, Nigeria	Ogunsola	2016	Achieving sustainable development in Nigerian informal settlements _inadequate and unaffordable housing in urban settlements	Abuja, Nigeria	Electricity			

Strengthening climate resilience in African cities	Taylor and Peter	2014	Conducting 'climate compatible development' within urban system, community level interventions	Accra, Ghana, Addis Ababa, Ethiopia, and Kampala, Uganda	Off-grid, safe, affordable, renewable energy technologies to generate energy for local cooking and lighting, but with a view to getting the network infrastructure in place for local generators to sell excess energy into the citywide grid			
Africa's game changers and the catalysts of social and system innovation	Swilling	2016	game-changing dynamics related to energy, water, soils, food systems, and urbanization	Stellenbosch, South Africa	SDI'S community-based organizing-for-development approach, and iShack's use of solar power technologies to address	National	Poor access to energy sources	Community, donor organisations, University, local municipality

					energy poverty.			
Micro franchising alternative service delivery configurations – creating economic and energy resilience with the iShack	Radmore	2015	off grid energy microfinancing	Stellenbosch, South Africa	Solar power	National	Poor access to energy sources	Community, donor organisations, University, local municipality
The challenges of infrastructure planning in urban slums case study of Kosovo, Mathare 4b, and Gitathuru slums in Mathare valley	Mathenge	2013	infrastructure planning and provision in urban slums	Mathare Valley, Nairobi, Kenya	Electricity, paraffin & candles	Regional	In ability to provide electricity due to lack of land tenure	National power company
Infrastructure in informal settlements: co-production of public services for inclusive governance	Otsuki	2016	Bio-centres as an informal sanitation infrastructure	Kibera, Nairobi, Kenya	Biogas used for cooking	Local	lack of social services	Funding NGO, community based organisation
Inclusive business in Kenya: Perspectives and opportunities for shared value	Kivuitu & Njino	2013	Youth development financing model aimed at supplying cheaper kerosene to	Kenya	Kerosene	National	Unaffordable kerosene	National oil company, National economic empowerment organisation, Youth

			informal settlements					enterprise groups
Designers and artisans solutions for Development: Kibera, life In the slums: Kenya Bamboo Centre	Battiston	2015	The implementation of bamboo planting and trainings activities the project aimed at promoting and increasing the use of bamboo as an environmental-friendly material and renewable source of energy	Kenya	Charcoal	National	Environmentally friendly renewable energy	International NGOs, local authorities and communities
Energy and place making in urban informal settlements: A view from Cape Town	Justo & Mc Cauley	2015	Access to electricity and different forms of energy for cooking	South Africa	Imbuala (wood), illegal electricity connection, kerosene, wood	Local	informal settlements as unsafe, unhygienic and unpleasant places for people to live	International NGOs, local university and community

Slum of hope: Land Tenure Reforms, Local Economic Development and Environmental Improvement in a Kenyan Shanty Town	Toomey	2010	Slum upgrading: electricity provision decreasing the use of kerosene lamps and open fire for cooking	Kambi Moto, Nairobi, Kenya	Electricity	Local	Lack of social services	International NGO, City council, construction, NGOs, community (Social)
eCook: What behavioural challenges await this potentially transformative concept	Brown, Leary, Davies, Batchelor & Scott	2017	Transitioning into different cooking methods	South Africa	Cook stoves, Liquid petroleum gas & solar home systems	Household	unclean and expensive cooking methods	
Challenges and opportunities of new energy schemes for food security in humanitarian contexts: A selective review	Caniato, Carliez & Thulstrup	2017	accessing cooking clean cooking equipment for food security	Various African countries		National	Food security and hunger in humanitarian camps	International humanitarian organisations
Solar power project for informal settlements	IMIESA	2013	Curbing informal settlement fire through solar energy	Umgababa, Benoni, South Africa	Solar energy	Local	curbing shack fires caused by candles	Ekurhuleni metropolitan municipality
Energy poverty, shack fires and childhood burns	Kimemia & van Niekerk	2017	SA Bureau of Standards (SABS) approved cooking stoves	South Africa	Liquid petroleum gas & solar power for off-grid lighting	National	Shack fires and burn injuries	

Energy Use in Durban	Aitken & Jones	1997	Eradicating informal settlement and energy use and preference	Cato Manor, Durban, South Africa	Electricity	Regional & local		Cato Manor Development Association (CMDA)
Paying for power	Horen	1994	Financing safe and affordable energy	South Africa	Electricity & wood	National	affordability and financing electricity infrastructure	DBSA, National Electrification Forum, Reconstruction and Development Fund

Appendix 2

Summary of results from literature, interviews, focus groups and observations

Construction of the iShack Project

The initial stages of the iShack project establishment involved five students including Andreas Keller. These students focused on the improvement and construction of the thermos performance for the iShack Project. Andreas Keller was the project leader. The project entailed the development of a low-cost, environment-friendly minimal solar system that would be used in a shack. The solar system was intended to provide a basic supply of electricity for lighting and connecting home appliances such as television and cell phone charging.

The start-up of the iShack Project was partly influenced by the need to address the National Policy framework, through the Upgrading Informal Settlement Policy, which is part of South Africa's government housing policy. The Upgrading Informal Settlement Policy is part of the measures targeted to address informal settlement evictions. The objective of the iShack Project entailed analysing the Upgrading Informal Settlement Policy in order to improve the informal settlement social infrastructure. One of the challenges that the analysis targeted was the long waiting period for social services such electricity and water, which would extend from eight to 10 years for South African informal settlement dwellers (Swilling *et al.*, 2013).

Construction of the iShack pilot took place between September 2011 and October 2011. The pilot of the iShack Project in the Enkanini informal settlement targeted rebuilding a shack that would enable the installation of the solar system. A shack with a family of four comprising a mother in her mid-40s working as a domestic worker with three children was selected for the pilot. The family's shack was in a very unsatisfactory condition. The shack had a leaking roof with a bare earth floor; it was draughty and had no windows. The shack was situated next to a waste collection area, which brought forth a constant swarm of flies swirling around the shack (Keller, 2012). The family's shack was demolished and the iShack was built for them to live in.

With the help of an informal group of local leaders and with the permission of the local authority, the iShack structure that was 2 square metres in size was constructed. The shack was constructed with insulated walls and roof. The insulation was done with cardboard covered with fire-resistant paint. A thermal mass was installed for passive heating and cooling by using a 1-metre high adobe wall at the back of the shack with a floor made from fired clay bricks from the land fill. The shack was north-south facing with a roof hanging over on the north side for shade in summer and solar penetration during the winter season. The iShack also had appropriately sized windows for ventilation and lighting, including

a gutter for rainwater harvesting. A 25-watt solar panel that powered three LED lights and a cell phone charger was installed on top of the shack with environmental monitoring equipment. The construction of the iShack Project was coupled with two neighbouring shacks. The first neighbouring shack was retrofitted with insulation and a solar system and environmental monitoring equipment. The second shack had no retrofitting or solar system, but only the environmental monitoring equipment to generate comparisons. Results of the experiment revealed positive outcomes that showed four to six hours of extra thermal daily comfort, thereby reducing the risk of fire and providing improved lighting (Swilling, 2014). Figure 1 depicts an iShack Project shack in Enkanini informal settlement in 2017. It was used as the iShack Project hub where the iShack project agents worked.



Figure 1: iShack Project hub based at Enkanini informal settlement

Source: Author.



Figure 2: Installed Specialised Solar System

Source: Author.

Slum Dwellers International further introduced a savings scheme or plan to the community. The idea was to establish a savings scheme that would serve as a cooperative exercise for Enkanini informal settlement households and render the transaction of purchasing solar systems less expensive. The community members were organised to save together in order to assist one another to access the solar systems by taking turns. A group of community members would contribute an equal amount of money per household that would be enough to purchase one solar system per month for one household. This would be done until all members of the scheme had received a solar system in their home. The planning of the savings scheme was intended to assist households and families to learn from and trust one another. This process was facilitated through women, as they were perceived to be the centre of their families. However, the savings plan was not a success in the community, as people did not trust each other with their money.

Capacity-building for the iShack Project

Since the inception of the iShack Project, this initiative has been inclusive of the community. One of the ways that this was achieved was through imparting skills to the Enkanini informal settlement community members. In every phase (pilot and roll-out phase), the project focused on ensuring that the community members were at the centre of the initiative, either by benefiting from outcomes or through the establishment and construction process of the project. Benefits for the participating community members varied from acquiring skills to reaping the benefits of the products. The pilot phase benefited more than the three families selected for the pilot phase. During the erection of the iShack Project, the two neighbouring shacks used for the experiment, and the core group who worked with the researchers gained skills and knowledge through partaking in the construction of the iShack Project by the attending some training sessions related to the project.

Stellenbosch University still houses the main management and administrative offices of the iShack Project at the Sustainability Institute. The Sustainability Institute is based at Lynedoch on the outskirts of Stellenbosch. The iShack Project office based at the Sustainability Institute also serves as a storage facility as most of the solar panels, batteries, appliances and gadgets that come with the solar panels are stored there. The ultimate objective of the Sustainability Institute is eventually to hand over the iShack Project to the community. In order to achieve this the iShack Project office based at the Sustainability Institute also provides weekly training to the iShack Project agents on technical, marketing and customer care-related work of the iShack Project. The objective of this exercise is to create an independent staff running the iShack Project at community level.

The iShack Project agents and the iShack Project manager attend the two- to three-hour weekly training sessions hosted every Friday at the Sustainability Institute. On the agenda of the weekly training sessions attended by the iShack Project agents and the iShack Project manager is progress on the outcomes or activities such as marketing, installations conducted and customer care-related issues.

During the discussions, each agent has an opportunity to share experiences and perceptions on the progress and challenges of the activities related to marketing, installation and customer care in the past week. Agents are also held accountable for drawbacks and poor performance that occurred in the past week. The agents also have an opportunity to defend themselves by coming up with ways in which their drawbacks can be addressed. However, even though all the iShack Project agents received an equal opportunity to express themselves on the week's activities and plans for the week ahead, only two agents seemed to be vocal during the meetings observed during the study.

Rolling out the solar panel

The solar panels were initially rolled out in October 2013. Installation of a solar system required a monthly fee of R130, which came with three light bulbs and a 15-inch television set and free maintenance as required per household. The prepaid vouchers for the solar panel electricity were sold at a local vender called Fish Shop at a commission of 3% (for the vender) along with the use of a tablet. The solar panel was sourced from Specialised Solar Systems and came with a battery life of 5 years. Stellenbosch Municipality provided free basic electricity for every household connected to the solar systems in Enkanini informal settlement. The connected households received 50 kWh. However, the solar panel could only be used for television connection, lighting and cell phone charging, and not for connecting larger household appliances such as refrigerators and stoves. Energy-generation for cooking still depended on wood, gas and paraffin. However, the use of the solar system contributed positively to the users as it decreased the use and cost of energy sources, such as candles and paraffin used for lighting which cost from R100 to R150 per month. In April 2015, 800 solar panels were installed in Enkanini. Users paid only R30 for a call-out fee for maintenance and R100 to change a light bulb of 1 watt when required for both the Specialised Solar System and the B. Box. The battery was changed at a cost of R1 400 and was done once in three to four years, but at the time of data collection battery changes had only been done on the Specialised Solar System. After the introduction of the B. Box, requests for the installation of solar panels increased. A database of solar panel users was kept at the iShack Project office based at Enkanini informal settlement and at the iShack Project office based at the Sustainability Institute. Defaulters were disconnected. However, there were still clients who defaulted on monthly payments and remained connected illegally.

Owing to misuse and poor affordability of the solar panels, the iShack Project business model was revised at the end of 2015 and new solar panels were introduced in 2016. This entailed scouting for alternative options that would ensure smooth and inclusive provision of the electricity connection. Revision of the business model also entailed scouting for a better solar system that would curb the irregularities associated with illegal connection and inclusive supply of the electricity service. One of the iShack Project management members travelled to East Africa and discovered a cheaper and more sophisticated solar panel called the B. Box. The B. Box solar system is a product manufactured in China

and was sourced from a company based in the United Kingdom. The B. Box connects three lights and a cell phone charger. The B. Box is more sophisticated and compact compared to the Specialised Solar System. The B. Box solar system has a charge controller, an anti-tampering device and a smaller battery, and it is cheaper than the Specialised Solar System.

In a case where the shack does not require all three light bulbs installed, only two light bulbs may be installed while the other is kept for back-up in case the two expire or the shack is extended. Each light bulb has a cable that is connected to the B. Box solar system. During the day, the B. Box solar system charges, using the heat generated from the solar panel, with an indicator showing when it is charging or fully charged. The B. Box solar system also has two USB ports that can be used for charging cell phones. For safety precautions, the B. Box solar system is tied or locked with a steal belt around it to prevent anyone from opening it and tampering with it. The B. Box solar system also has a main switch on the device itself and further switches for each light attached in each room where the light bulb is connected.

Installation of the B. Box and maintenance of the Specialised Solar System

On Saturday morning of every week and on some days during the week, the iShack Project agents host a marketing workshop at the iShack Project hub in Enkanini informal settlement. Figure 4 below is a poster advertising the weekly Saturday information workshops hosted by the iShack Project. During the week when the iShack Project agents are not occupied with attending to maintenance calls, they embark on the marketing of the new B. Box solar system (depicted in Figure 4) around the Enkanini informal settlement. Potential users are issued with the B. Box solar system flyer or poster depicted in Figure 3 during information workshops and door-to-door advertising to get all the information they require in the event that they are interested in buying the B. Box solar system. The flyer shows a breakdown of the cost of installation. Interested residents would then express their interest by giving their name, cell phone number and physical address to the iShack agent. Interested residents then indicate when they would be ready financially to purchase the solar panel. Agents would then follow up on the residents who have expressed their interest in the B. Box solar system by calling and arranging a suitable time for the resident to buy the solar system. The iShack agents referred to this process of collecting contact details and the physical address of the residents who are interested in buying the B.Box solar system as “contracting”. Therefore, the application process of the solar panel would begin by contracting. Contracting occurs when the potential users are recorded on a waiting list for B. Box installation. The potential users would be asked to pay a once-off amount of R500, or R300 when the households in close proximity organise themselves into groups of four. The organised group payments are a convenience and a time-saving technique for the installers.



Figure 3: Flyer for the Saturday information workshop

Source: Author.



Figure 4: Installed B. Box solar system box

Source: Author.

Individual vs Group benefits		
	Individual	Group
System Deposit	R400 per client	R300 per client
Installation Fee	R100 per client	FREE!
Installation	Single Clients may have to wait	Groups get installed quicker
Electricity Fee	FREE!	FREE!
iSolar Account	You Save Yourself	You Save Yourself and with Group iSolar Account
Maintenance	More expensive	Cheaper
Cost of TV	Pay upfront	Possible Rent to Own, with Switching Payplan
Panel/Battery Upgrade	Pay upfront	Possible Rent To Own, with Switching Payplan

Figure 5: B. Box flyer indicating solar system options

Source: Author.

Two young men installed the B. Boxes, one of them a qualified electrician and the second an apprentice in training on solar system installation. Once the installation time and address have been confirmed, the

solar panel and the box of the solar system which is installed inside the house are delivered prior to the day of installation. On the day of installation, the installers arrive with only a stepladder and a tool box. The installers can install up to four solar panels per day. Post installation, the iShack Project operations manager inspects whether the solar system was installed according to the required standards. The inspector begins his inspection by climbing on top of the shack to check if the solar panel is placed at the correct angle. The solar panel is usually placed at a 45-degree angle. However, in cold seasons the solar panel is placed at an angle of 50 degrees to ensure that enough heat is sourced from the sun as shown in Figure 6. After that, the inspector goes inside the shack to ascertain whether the B. Box solar system was installed properly. The B. Box should be installed out of reach of children, away from the cooking station, away from direct sunlight, and should not face the doorway.



Figure 6: B. Box solar panel installed at a 50-degrees angle on top of a shack

Source: Author.

In order to track overloading and misuse of the B. Box solar system, the inspector loads the details of the B. Box solar system on a GPS device (depicted in Figure 7) that feeds into a computer based at the iShack Project offices at the Sustainability Institute and at Enkanini informal settlement. The details entail the GPS coordinates of the B. Box solar system, application number of the user and the shack number. All these details are entered onto a database of all the installed B. Box solar systems in the neighborhood. The officer based at the iShack Project office at the Sustainability Institute continuously conducts tracking on all the solar systems in use. The tracking of the B. Box solar system looks out for overusage of the power, tampering, and illegal connection done on the B. Box. When misuse is detected, the B. Box solar system is immediately disconnected.



Figure 7: GPS device used to load newly installed solar systems

Source: Author.

Upon inspection of the B. Box, the inspector provides the user with a contract of agreement, a user manual, emergency precautions and contact details on how to use the B. Box, all written in English and in Xhosa as shown in Figure 8. Figure 9 further shows a new user who has just signed a contract of agreement after installation and inspection. All these documents were signed by the inspector and the user and are kept by the user.



Figure 8: The B. Box solar system user manual and contact details provided to the new owner

Source: Author.



Figure 9: A resident having just received a solar system holds her signed contract after inspection was been conducted

Source: Author.

Maintenance visits were conducted when a Specialised Solar Systems user logged a call and paid a call-out fee of R30 to the agent doing the maintenance. The Specialised Solar Systems were the first type of solar panels that were used before the B. Box solar systems were introduced. However, owing to high rates of payment defaults and tampering with the systems, the new B.Box solar systems were introduced and the Specialised Solar Systems were no longer provided. Currently, only maintenance checks are conducted on the Specialised Solar Systems panels. Maintenance checks range from battery replacement to technical work conducted on the inside of the Specialised Solar Systems box. The breakdown of the call-out fee and other services provided by the iShack Project are depicted in Figure 10, while Figure 11 shows an iShack Project agent conducting maintenance on a Specialised Solar System.

	'FREE BASIC' PAY AS YOU GO	CONTRACT
Maintenance w/Callout	R30 per Maintenance Callout Requires positive iSolar Account balance before visit	FREE Maintenance Callout
Faulty Items	Remove, Quote, Pay, then Repair Deduct from iSolar Account – no switching	Remove, Quote, Repair, then Pay Sign Equipment Repayment Agreement – switched OFF if miss Repayment
Battery Replacement	Paid by client Client can choose which battery size to take next	FREE Unless battery overused and dies early
Switching	Without Switching Unless getting upgrade financing (PayPlan), Only to remind client to pay	With Switching Only to remind client to pay
Service Fees	None Only voluntary savings in iSolar Account	With TV: R130 per month Lights Only: R80 per month
Default on payments	Possible If missed PayPlan payment – will be switched OFF and possible Repossession of financed item.	Possible Moved to PAYG after 14 days and switched ON (after PAYG induction), if on contract. More than 24 months – TV not Repossessed Less than 24 months – TV Repossessed (encourage clients to complete payments)
iSolar Account	YES, Voluntary Payments	NONE Clients doesn't have one, only System Deposit

Figure10: Contract types for the Specialised Solar System

Source: Author.



Figure 11: An iShack agent conducting maintenance checks on the Specialised Solar System

Source: Author.

Though the Specialised Solar Systems are no longer installed, these devices still have their challenges. Users still default on their payments, tamper with the devices, and overload their systems. Agents complain that users of the Specialised Solar Systems would default on their payment until they needed maintenance. Once they discovered that their solar panel was faulty, they would make two monthly

payments of R130 for the solar panel and then log a call for maintenance. At times a call would be logged without paying a call-out fee. One agent attributed the high rate of defaulting and non-payment of call-out fees to poor administration habits at the iShack Project office based at the Enkanini informal settlement. Most of the Specialised Solar Systems users were defaulting on their payments, but were not disconnected. At times, they would default on payments as they also relied on their free basic connection that they received monthly from the municipality.

Perceptions about the availability of solar energy in the informal settlement

It has been close to five years since the Enkanini informal settlement residents have been exposed to the solar system. Therefore, the aim was to devote part of this study to gathering the views and experiences of users of both solar panels (Specialised Solar System and the B. Box) and different combinations of energy sources through focus group interviews. The focus group workshops were conducted over three days. The first group consisted of 10 solar users and they participated on the first day. The second group consisted of 10 residents who were illegally connected to electricity and they participated on the second day. The third group consisted of 10 residents who were not solar users and were not connected to any form of electricity (legally or illegally) and they participated on the third day. Figure 12 shows one of the groups of participants who participated in one of the focus group workshops.

The facilitator of the focus group interview opened each session by asking if energy access was a problem in Enkanini informal settlement. Figure 13 showed a session that was facilitated by one of the School of Public Leadership postgraduate researchers. There was a very confident response namely, “Yes, and it is dangerous”. During the focus group sessions, the following three main questions were asked by the respondents: Why is energy access a problem in Enkanini informal settlement? What influenced your access to energy? What are the possible solutions to challenges that hinder your access to energy?

Various responses from all the three groups raised similar responses related to communication, power and representation. Responses to the first question ranged from concerns related to poor communication between the council and the municipality, cost of erecting electricity infrastructure and the terrain of the settlement. Respondents stated that the municipality said it would be difficult to erect or build infrastructure in this area owing to its terrain. They mentioned that the informal settlement was not represented at the municipal chamber because of internal politics, interparty politics and power dynamics at community level. The opposition political party (representing Enkanini informal settlement) could not deliver on their promises to the community, as the ruling party had told the informal settlement residents that they were on their (the ruling party’s) priority list to receive social services.

The focus group participants (residents) also stated that what influenced their inability to access energy was the lack of communication between stakeholders such as street committees and ward councillors in the municipal chamber. The group asserted that this was because people who were aware of the local challenges were local residents. However, residents expressed that residents were not the decision makers participating and representing them at council level. The lack of communication with the councillor therefore raised the need to vote for a councillor who was a community member so that there would be accountability and face-to-face representation.

Solutions to addressing the council-level misrepresentation ranged from the need for the community to elect someone who was not politically involved to represent them at council level. The group also stated that it would be imperative to establish a locally based and formed structure instead of having the Khayamandi Development Forum representing them instead of Kayamandi Township which had different infrastructure and facilities to Enkanini informal settlement. Khayamandi Development Forum could not properly represent Enkanini informal settlement as it (Khayamandi) already had proper infrastructure such as roads, lights and toilets, and hence Enkanini informal settlement should have its own organisation.

It was therefore suggested that creating a forum that would represent Enkanini informal settlement would be achieved if the municipality could establish the number of organisations that existed in Enkanini informal settlement. The solar users suggested that the municipality could build a database that showed which community-level organisations or forums had an impact on the community through a record of accomplishment. The “inhumane treatment” by political parties was also identified in the way the municipality viewed the community of Enkanini informal settlement. The “inhumane treatment” by the municipality was attributed to the rubbish dump that was “uncontrolled” in the informal settlement. Therefore, to improve participation with the community, the group suggested that the municipality have community-level representation. Residents further suggested that in order to address these challenges of misrepresentation, the municipality could improve its engagement with the Enkanini community by providing a listening procedure. They suggested that this could be achieved by reaching out to people with the potential to uplift the community by speaking on behalf of the community and that the focus should not only be on the street committee.

Geography also came up as a hindrance to accessing energy in the informal settlement. The focus groups attributed the energy access problem in the informal settlement to the steep slope of the area and the closeness of the dwellings to each other. Another point contributing to the problems in accessing energy in the settlement was the fact that people came to live in the settlement by force.

Residents had mixed views on the cost and affordability of the solar system. Non-solar users stated that they were aware that the price of a standard solar panel was R300, or R500 including lighting and

installation. However, unemployment was a major hindrance to accessing solar energy for those who were not yet connected to solar energy. Furthermore, from their side, the obstacle to obtaining the cheapest option of the solar installation was attributed to the problem of finding neighbours living in close proximity with whom they could organise themselves in a group. Respondents complained that such an arrangement was not convenient for some of them as most of their neighbours were already connected to solar energy. Also, a few residents stated that the availability of solar energy had negative effects on the supply of electricity connections in the future.

Residents also mentioned that solar energy was affordable compared to electricity connection. Users of indirect electricity connection however complained that this source of energy was expensive and unreliable. This group stated that indirect electricity was expensive as it cost R350 or R400 and more per month, but it did not last them until the end of the month. Indirect users had to pay more towards electricity connection before the month ended. The availability of solar energy was a solution to their problem of access to electricity. This group further said that “government” was slow to provide services and that there were street committees, but there were no services, as they had a dumpsite crisis and no water.

The factors that affected the attractiveness of the solar systems were the safety and affordability of solar energy. The respondents mentioned that using solar energy was a safe option for their children and families as it did not cause fire. However, there were quite a few challenges related to using solar energy. The first disadvantage of solar energy was its unreliable nature as a source of energy, especially during the cold and rainy seasons. Secondly, solar energy was perceived as a source of energy that is not good enough for household use, as it could not cover all the basic needs required for energy. Thirdly, solar energy could not connect most essential household appliances such as refrigerators, stoves and irons. Lastly, solar energy was not a reliable source of energy as it would not be beneficial for entrepreneurial ventures such as a “shebeen”, which would require a refrigerator. Fourthly, users of solar energy expressed their dissatisfaction about the unreliable service provided by iShack Project agents, as they took too long to respond to complaints and maintenance calls.



Figure 12: One of the groups that participated during the focus group workshops

Source: Author.



Figure 13: Focus group workshop facilitated by a School of Public Leadership researcher

Source: Author.

The objective of this section was to provide an elaborate demonstration of the establishment, the daily running, the perceptions and the impact of the iShack Project at the Enkanini informal settlement. The

case study provided an overview of the reasons and drivers of the iShack establishment. The case study aimed to present various aspects of the iShack Project based on observations and perceptions of the different parties that were involved and interviewed. The objective of applying the case study was to sift out the specific elements that resonated with a social innovation system in an urban informal settlement. The following section therefore elaborates and presents those factors inherent in the iShack Project social innovation system according to the framework established in Chapter 2 of this work.

Appendix 3

QUESTIONNAIRE: SOCIAL INNOVATION SYSTEMS FOR SUSTAINABLE DEVELOPMENT IN SOUTH AFRICAN URBAN INFORMAL SETTLEMENTS

My name is Hlokoma Mangqalaza, I am a research student at Stellenbosch University. I am conducting a study on social innovation systems as suitable catalysts for sustainable development in urban informal settlements. The main focus of the research is to establish whether social innovation systems can aid the achievement of Sustainable Development Goals in urban informal settlements. This study will focus on questions related to how, what and why social innovation systems participate in development initiatives in ensuring stable and peaceful societies in order to achieve sustainable development in urban informal settlements.

I would like to request your participation in the research as a respondent. Your participation in the interview is completely voluntary. The name of the participants and everything said in the interview will be kept confidential. As the participant, you are allowed to withdraw from the interview or refrain from answering any questions you are not comfortable with.

Your support will be highly appreciated.

ADMINISTRATIVE INFORMATION

Name of the participant / organisation/ institution	
Name of settlement / physical address of the organisation/ institution	
When was the organisation/entity established?(Year)	
Date of interview	
Duration of interview	
Interview number	

1. About the organisation/ institution & the initiative

1.1. What are the objectives of using or using/ introducing the solar panels?
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1.2. Are the objectives related to economic, social or environmental objectives?	
1.3. Do you prefer the solar panels to the previous methods of sourcing energy?	
YES	NO
1.3.1. Please give reasons for your answer	

2. Equity & equality (Roles: initiatives, production, development, diffuse, utilise new technologies, economise, inclusion)

2.1. What are your main reasons for taking part in this project/ initiative?	
2.2. Who initiated the idea of this project/ how did you learn about the initiative?	
2.3. Are all participant's members of this community?	
YES	NO
2.4. Who benefits from this initiative?	
2.5. Are you able to apply your own ideas (as a community/enterprise/organisation) in the usage and implementation of the solar panel? (Adapt)	
YES	NO

2.5.1. If yes, how do you apply your own ideas in the enterprise	
2.5.2. If no, why not?	
2.6. Does the project make use of the (community's) resources in the initiative?	
2.7. Are community members that are not members of this community allowed to contribute or participate in the usage or implementation of the device?	
YES	NO
2.7.1. How do they contribute/benefit?	
Contributions/benefit	How?

3. Participation & inclusion (Activities: learning, interactions, access/ use)

3.1 Has the solar panel solved the problems/challenges it was intended for?	
YES	NO

a. If yes, how did it solve your problems/challenges?	
b. If no, what is still need to solve/overcome your problems/challenges?	
c. Who helps you solve/overcome your problems/challenges?	
d. Are you able to maintain interactions?	
YES	NO
e. If yes, how do you maintain your interactions?	

d. If no, what kind of challenges do you encounter to maintain interactions?	
3.2 Have you encountered any challenges in using the solar panel?	
3.3 What challenges do you encounter in using the solar panel?	
3.4 What could be the cause of the challenges?	
3.5 How do you think they could be addressed?	
3.6 Who are better able to use this device?	
Who	Why
Females	
Males	
Children	

Adults	
Professionals	
Skilled/ Unskilled	
Others	
3.7 What resources are required in order to use the device? (select the examples below if applicable and elaborate)	
a. Skills	
b. Knowledge / information	
c. Financial ability	
d. Distance a factor	
e. Infrastructure	
f. Other resources you have	

4. Governance and Regulations (A representative of the University, provincial department, community association or forum is to answer this section)

GOVERNANCE
4.1 Are you or the enterprise part of a union, association or forum? (Please provide a list of their names)
4.2 Why are you part of a union, association or forum? (please provide reasons/contribution or advantages)

4.7 Does the enterprise/ organisation take part in programs or interventions that are introduced or promoted by the union/association or forum?	
YES	NO
3.2.8. What are these interventions/ programmes?	
4.8 Do you ever experience challenges in taking part in these interventions?	
YES	NO
4.9 What are these challenges?	
4.10 How do you overcome these challenges?	
4.11 Are you able to apply or adhere to local rules and practices of the community in your enterprise, union, association or forum?	

YES	NO
4.12 If yes, could you please give an example of an incident?	
4.13 If no, what are these challenges? (Please provide an example of an incident)	
4.14 If there were challenges; how did you overcome the challenges?	

4.15 Who did you involve?		
	Formal	Informal
Regulations		
4.16 Do you adhere to any regulations related to renewable energy		
4.17 What are these regulations?		
4.18 How did you learn about these regulations?		
4.19 Who introduced these regulations to you?		

4.20. Are there any obstacles in adhering to the necessary regulations
4.21 What type of skills, resources and infrastructure are required in order to adhere to these regulations?
4.22 Do you have the required skills, resources and infrastructure that are required to adhere to the regulations?
4.23 Do the regulations have a positive or negative impact on your work?
4.14 Have you adapted any skills/knowledge/ infrastructure or technologies to suit your needs?

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5. Networks/ collaboration (organisations, institutions & society)

5.1. Are you in collaboration with other enterprises/communities?	
YES	NO
5.1. If yes (to the previous question), who are you in collaboration with?	Reasons for collaborating
5.2. Are all these enterprises/ organisations in the same sector that you operate in and where are they based? (in your community, nearest town, other province, country)	
5.3. In which year did you begin collaborating with other enterprises/ organisation?	
5.4. What are the reasons for collaborating?	How often do you interact? (Daily/ Weekly/ Monthly/Yearly/ other)

5.5. How does collaborating with these enterprises/organisations add value to your enterprise?	
5.6. Which collaborations are mostly important for your enterprise or organisation	
Formal	Informal

6. Bottom up & Collective activity (Interactions, relationships, cooperation, interdependence)

6.1. Which organisations/enterprises/communities/ households contribute to your work?		
6.1.1. Organisations/enterprises/communities (Client/in your value chain)	Formally	Informally
6.2. Who do you interact with (regularly)?	Reasons for partnership	

6.6. Are all your partners in your sector?	
YES	NO
6.6.1. If no, which sectors do your partners fall under?	
6.7. How do you contact/ communicate with each other?	Why do you choose this way of contact?
a. Telephone	
b. Face-to-face meetings	
c. Fax	
d. Post	
other	