



Exploring the Quadruple Helix Model for Strengthening Community Engagement in Innovation

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Abstract

This research investigated the potential for increased community engagement in both the triple and quadruple helix models of industrial development as a tool to achieve better innovation results, using the East London Industrial Development Zone and Science and Technology Park case study. The study was qualitative in nature and employed the non-probability sampling technique. In-depth semi-structured interviews were conducted with 13 key informants, which included five industrialists, four business executives, four ex-factory workers, and 40 residents living close to and around the three industrial parks. This was augmented by an in-depth analysis of literature as part of desktop data. The study found that greater community involvement would result in innovations that are tailored to local requirements and circumstances, maximising their potential for adoption and dissemination. Partnerships with communities could also act as a feedback mechanism. The study concludes that the quadruple-helix model offers a sounder community engagement dimension for harnessing the socio-economic potential of innovations and recommends more innovative partnerships with local communities that can see more meaningful implementation and adoption of innovations.

Introduction

Innovation can be a critical anchor for stimulating local economic growth, creating employment, and rolling back poverty. Innovative economies are more productive, more resilient, more adaptable

to change, and better able to support higher living standards (OECD 2015). Innovation has become an imperative for effectively addressing inequality. Yet, innovation ecosystems are complex and comprise

numerous stakeholders with multiple interlinking, and sometimes competing, interests. However, the breakthroughs that development practitioners seek require new approaches, and the urgently needed results cannot be found by simply making incremental changes to current approaches. Working harder alone is not enough; therefore, it is important to strengthen community involvement in innovation (Cheuy 2019).

Economic stagnation, joblessness, and inequality continue to be a reality for the previously marginalised groups after 22 years of the East London Industrial Development Zone (ELIDZ) and the growth of innovative start-up companies at the Science and Technology Park (STP) (Masiwa 2021). Massive unemployment, poverty, and economic stagnation followed the collapse of the old industrial parks at the beginning of the democratic dispensation in 1994.

The IDZ strategy came as a response to the need for a robust catalyst for sustainable regional economic development and industrial diversification to create meaningful employment opportunities in the country, especially in economically lagging regions such as the Eastern Cape and as a response to the demise of the old parks. It was meant to become the main vehicle for job creation, local innovation, and global competitiveness and was supposed to provide customised solutions for various industries, including automotive, agro-processing, and aquaculture. To date, the organisation has secured 42 investors with an investment value of over R8 billion. Of these investors, 36% are foreign-owned, 28% are locally owned, 23% are 100% black-owned, and 49% are BBBEE-compliant.

The entity creates most of its jobs through infrastructure delivery projects that created about 510 direct construction employment opportunities in 2020 (ELIDZ 2020), and the ELIDZ is generally acknowledged as an employer in the community. It has been on a drive to forge collaboration and partnerships with various stakeholders, yet ordinary people had a negative perception of the innovations the entity housed and felt alienated from its programmes.

This paper is a contribution to the literature on advancing the role of the fourth helix in the quadruple helix model in South Africa. The fourth helix is relevant to stakeholder engagement, a

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modification that is absent in the triple helix model in a step towards looking outside proven systems to explore new, solutions that are meaningful to intended beneficiaries. More community engagement would mean that innovations are adapted to local needs and circumstances, which would optimise the potential for their adoption and diffusion.

The Industrial Development Zone was supposed to promote innovation and entrepreneurship to stimulate economic growth and global competitiveness. The STP component of the ELIDZ was thus established to contribute to increasing the competitive and comparative advantages of the zone as an investment destination, through effective innovation (ELIDZ 2018).

According to Livingstone (2000), one of the main attributes of innovation is that it is applicable to the public good, not-for-profit, and commercial ventures that are supposed to provide ‘novel solutions that respond to the local situation and the interests and values of the local communities’ (Smith 2016). Since their inception in 2014, however,

the ELIDZ innovations have not significantly improved the situation of the people of East London or met their needs.

Despite the many interactions between the ELIDZ STP and its partners, including several Memorandums of Understanding (MoUs), there appeared to be neither convincing partnerships with communities nor acknowledgement of their important role in the local innovation ecosystem. This inherent failure to acknowledge the criticalness of the cultures that are built around very well-defined ideas about “who we are,” “where we come from,” and “how things are done around here” points to a missed opportunity to further innovation-led socio-economic impact. (Antorini and Muñiz 2015).

The implication is that the ELIDZ STP strategy could be mapped onto the triple helix model. In this model, the main actors (University-Industry-Government relations) in the triple helix model (and most of the literature of its proponents) regard local communities essentially as labour pools in the innovation ecosystem and not bona fide stakeholders in the ecosystem. The quadruple helix model of industrial development that emphasises participatory engagement has not been fully explored as a tool for achieving better innovation outcomes and local economic development.

The aim of the study was to investigate the potential for increased community engagement in both the triple and quadruple helix models of industrial development as a tool for achieving better innovation results using the ELIDZ and STP case study. This article starts with a review of the literature that explores the triple helix model before discussing a place-based approach to innovation. It then discusses the quadruple helix model, how it deals with the community and the place and how it integrates with the other three helices. The second half of the paper deliberates the outcomes and analysis of the outcomes and contribution to knowledge.

Literature review

1. The triple helix model

At the turn of the century, Etzkowitz and Leydesdorff consolidated the triple helix concept through collaborative works (e.g., Etzkowitz and Leydesdorff 1995, 2000) to explain the dynamic interactions

between the three strands of the model: academia, industry, and government in fostering entrepreneurship, innovation, and economic growth in a knowledge-based economy (Etzkowitz and Leydesdorff 2000). The triple helix model is conceptually different from the National Systems of Innovation (NSI) approach (Lundvall 1988), which considers the firm as having the leading role in innovation. Most literature on the triple helix model has tended to neglect the importance of community, civil society, and political actors in the innovation ecosystem. As much as there has been new literature that acknowledges ordinary communities as key stakeholders in the innovation ecosystem, this school of thought is only emerging with literature that mainly focuses on Europe.

The ethos behind the triple helix model is that in exploring the potential for innovation and economic development in a knowledge-based economy, the university, the private sector, and the government play significant roles in generating new institutional and social formats for the production, transfer, and application of knowledge (Etzkowitz et al. 2007; Champenois and Etzkowitz 2018). The triple helix model contains the idea of multi-centeredness: in addition to firms, universities and national and regional governments can take on leading roles in innovation ecosystems.

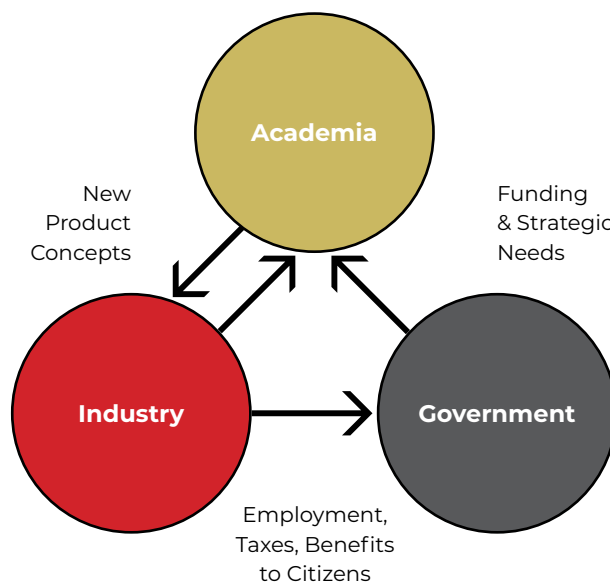


Figure 1. The Triple Helix Model

Source: CNR (2023)

The “Triple Helix” thesis suggests that the university can play an enhanced role in innovation in increasingly knowledge-based societies. Some of the literature looks at how the university interacts with the state and industry within the triple helix model of interaction. Barber et al. (2013) promotes a return to the idea that universities play a crucial developmental role in society and the economy and must be repositioned in society so that they have a role to play in city and regional development. The main part of the literature, so far, agrees that it is important to extend the triple helix model to a fourth helix that extends beyond University-Industry-Government relations, but there is some confusion regarding what this fourth helix could consist of (Carayannis and Rakhmatullin 2014; Nordberg 2015).

What is clear, however, is that the triple helix model has not been effective as a tool for deepening local economic development as it does not put local communities at the heart of economic development, and hence the outcomes are often far removed from the immediate needs of the local community. More attention, therefore, needs to be paid to the role of communities in innovation through strengthening the fourth helix in the quadruple helix model to enhance innovation outcomes.

2. The role of the community in innovation outcomes

Community innovation is about bringing people together to improve community services and support to enable better lives for community members (Horan 2024). In exploring the quadruple helix as a useful model for strengthening community engagement in innovation, it is critical to reflect on the concept of community innovation. Community innovation is a particular form of social innovation that is place-based, within the specific geography of a community. Canada has been a pioneer in the field of social innovation, defined as “both a destination – the resolution of complex social and environmental challenges – and a journey – devising new approaches that engage all stakeholders, leveraging their competencies and creativity to design novel solutions” (Cheuy 2019). As dynamic ‘living labs’, communities offer the perfect container for innovation. To be effective, innovation requires an appreciation of both the issue one is

hoping to address and a deep understanding of the unique characteristics of the community, the place and the people within it, where the innovation will be implemented. Innovations that have proven successful in one community can, at best, serve as a source of inspiration for another, but they must be adapted and modified if they are to maximise the strengths and assets of the community where they hope to be replicated (Cheuy 2019).

When working with community innovation, it is more meaningful to respond pragmatically to contexts: specific situations call for specific measures and include local grassroots organisations whenever possible. This will ease implementation plans and the mining of data for future reflection and innovation. Some contexts may require more independent organisations or direct involvement, as there is need to understand which contexts call for incremental improvements and which contexts are out with the old and in with the new.

Local ownership and partnership are important conditions for the long-term sustainability of an innovation (Cheuy 2019). For example, the uncommercialised STP Twerly prototype innovation (an innovative streetlight powered by green energy (ELIDZ 2017)) is a renewable energy source that is powered by a vertical axis wind turbine and PVA panel that generates electricity ‘off the grid’. The Twerly can be used as a streetlight, a WI-FI hotspot or to house a surveillance camera for use in the security industry. This unimplemented innovation could have been rolled out by the STP in partnership with communities and the Buffalo City Municipal Metro (BCMM) in different settings to assess its potential impact. Grassroots organisations have the advantage of knowing the people, culture, and political environment to take the innovation and better implement it on the ground (Cheuy 2019). Working with responsible grassroots organisations can be a major asset to innovators and their innovations to get the best raw and accurate data on how to pilot a project from the user communities.

According to Cheuy (2019), the design of promising innovations to solve vexing community problems begins by shifting the relationship between those experiencing the problem and those who see it as their role to try and fix it. Investing time to build an evidence-informed view of the system that reflects

a diversity of perspectives ensures that the issue – and not the proposed intervention – remains at the centre of thinking and action. Projects backed by local organisations can quickly gain momentum on the local level because they are generally enacted by local actors. Moreover, larger organisations could benefit from local grassroots initiatives that are directly connected to the issues and the people living in need (Bettencourt 2017). One respondent in a study in the literature noted:

I am worried that technologies developed by a small number of people will affect us all. It's all about a dialogue between the scientific community and the public. When they let us know what they're doing it won't be a secret anymore and will be unregulated. That's how people see it sometimes. Or they think something dangerous is being developed while they are supposed to just stand there without a say. (Schulz et al 2019)

This suggests that increased attention to public preferences should lead to more welcome innovations and thus benefit the scientific community as well. First to introduce the terms “context” and “content” experts, Zimmerman (2015) described the two essential actors in the community change process “content experts” are the professionals, staff in the organisation, service providers, and leaders with formal power who have knowledge, tools, and resources to address the issue; and “context experts” are the people with lived experience of the situation. Also, most sustainable improvements in communities occur when citizens discover their own power to act, stop waiting for professionals or elected leadership to do something and decide they can reclaim what they have delegated to others (Block 2009).

Public sector involvement of context experts is an essential element of effective community change because of the unique “knowledge based on personal experience of situations of poverty and social exclusion” they have and which those embracing this approach have found accelerates the collective ability of the group to “identify the problems and needs of people in situations of poverty.” (Cheuy 2019). Partnerships can prove to be fruitful when people and context experts come together to address a need and context since people understand the multifaceted contexts and

issues that could deter progress or stall innovative solutions while also creating a sense of trust in a community by authenticating the potential benefits of an innovation as well as identifying flaws, and iterations required (Bettencourt 2017).

However, Schütz et al (2019) identify two major challenges to incorporating laypersons into the innovation process:

Firstly, the methodological challenge of individuals can effectively introduce their (public) perspective? And how can actors from academia, business, and government benefit from society's knowledge? Second, what is the functional role of the community as the fourth actor in collaborative innovation processes, and what should they contribute?

A study by Antorini and Muñiz (2015) demonstrated the benefits gained by LEGO when they accessed their innovation user community found that the firm could utilise the deep knowledge that users had accumulated and use the feedback to improve their innovations to create more relevant products after listening to complaints. This community involvement is for both the innovator and the intended beneficiary. Therefore, the multi-stakeholder approach is also crucial in determining how Local Economic Development projects end up and how they impact communities at the grass roots level. Every setting, however, has attributes that are specific to that context and place, and communities add very place specific value to the interactions at play in the innovation-mix. The ‘place,’ therefore, is a crucial element of this ‘mix’ in which stakeholder interactions in the fourth helix are key to enhancing innovation participatory outcomes.

3. Place-based innovation

Place-based development has been defined as “a holistic approach” that utilises and enhances the natural and human assets of a particular place to strengthen local capacity to adapt (Avis 2019). The South African New Growth Path Framework (2011) places great emphasis on developing an innovation-led service and knowledge economy in cities (Bank, 2018). Industrial growth and development are understood in a much more place-specific context and the National Development Plan (NDP) 2030 (2012) proposes driving growth in new industrial sectors and in manufacturing, decreasing the

dependence on primary products, while at the same time creating incentives for new industrial hubs to emerge through place-based planning. The NDP (2012) visualises special industrial development zones established in places such as East London, where the state felt that place-based incentives could spark industrial economic growth (Harrison et al. 2007).

While the state has operated with an understanding of the place-based opportunities for industrial growth, there has been little discussion or analysis of the role of local communities in innovation-led, industrialisation and knowledge economy in which IDZs are located while the triple helix model was not taking advantage of the place-based embeddedness of the webs of relations in which people existed. However, the role of community involvement in innovation must be recognised as city-building and an agent for regional development and redress (equity). Roman et al. (2020) note that the regional innovation systems (RIS) approach emphasises the importance of regions as key drivers of innovation (Asheim et al. 2011) and that innovation is viewed as the outcome of interaction between a multitude of actors distributed over many different institutions and locations (Doloreux 2002).

4. The quadruple helix model

The quadruple helix model can be seen as an enhancement of the triple helix perspective that not only focuses on the actors from academia, government, and industry, but also recognises the increased role played by civil society (Leydesdorff 2012). Roman et al (2020) note that despite the strong emphasis on the quadruple helix model in European regional innovation policy, civil society participation in regions' design and implementation of research and innovation strategies for smart specialisation (RIS3) through the participatory entrepreneurial discovery process (EDP) remains low, which means that the potential for quadruple helix innovation has remained largely untapped in RIS3. Carayannis and Campbell (2012) in Hasche et al (2019), conceptualise the fourth helix as media, culture, and civil society and integrate the importance of place and community, arguing that the fourth helix is human-centered, focuses on democratic knowledge, and in favour of arts, artistic research, and arts-based innovation (Carayannis

and Campbell 2014). Similarly, Kriz, Bankins, and Molloy (2018) take an end user perspective of the fourth helix including, for example, public members embedded in the artistic and cultural fabric of a community. Höglund and Linton (2018) argue that the fourth helix should not only be viewed as a separate helix but also as a context of society as a whole and civil societal goals.

However, Carayannis and Campbell (2009), open up the possible sources of innovation and argue that in an emerging glocalising, globalising and localising world (Carayannis and von Zedwitz 2005; Carayannis and Alexander 2006), the frontier of converging systems, networks, and sectors of innovation that is driven by increasingly complex, non-linear, and dynamic processes of knowledge creation, diffusion, and use, confronts us with the need to re-conceptualise, if not to re-invent, the ways and means that knowledge production, utilisation and renewal take place in the context of the knowledge economy and society. This effectively means that innovation and sources of knowledge creation are unlimited. Therefore, Carayannis (2009) developed what he called Mode 3 Innovation Ecosystem which allows and emphasises the co-existence and co-evolution of different knowledge and innovation paradigms: The competitiveness and superiority of a knowledge system is highly determined by its adaptive capacity to combine and integrate different knowledge and innovation modes via co-evolution, co-specialisation and co-competition knowledge stock and flow dynamics. The 'quadruple helix' emphasises the importance of also integrating the perspectives of the media-based and culture-based public.

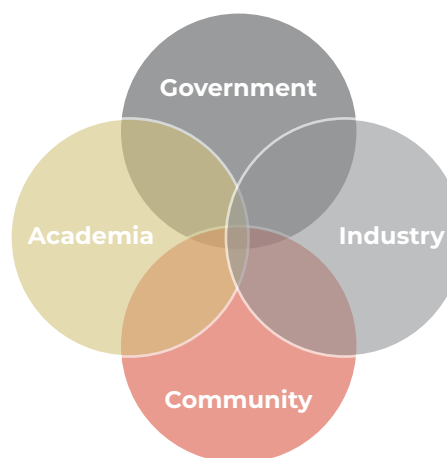


Figure 2. The Quadruple Helix Model
Source: GRRIP (2020)

Therefore, the quadruple helix model is seen as playing an important role in fostering the shift from technical to social innovations (Carayannis and Rakhmatullin 2014; Foray et al. 2012) and strengthening democracy in the decision making of regional research and innovation strategies (Cavallini et al. 2016). Innovation networks: are real and virtual infra-structures and technologies that serve to nurture creativity, trigger invention, and catalyse innovation in a public and/or private domain context (for instance, Government-University-Industry public-private research and technology development competitive partnerships (Carayannis and Alexander 2004; Carayannis and Alexander 1999). Crucial is the idea that an advanced knowledge system may integrate different knowledge modes. Florida's (2004) ideas of the 'creative class' find true resonance in the idea of the quadruple helix, as the 'fourth helix'. A new society must be able to 'tap the full creative capabilities of every human being' to answer the question as to what makes economic communities tick (Florida 2002).

Many studies have focused on the actors, often from a triple helix perspective, that make a distinction between actors from (1) academia/universities, (2) government, and (3) industry (Etzkowitz and Leydesdorff 2000; Leydesdorff 2016) or from a quadruple helix perspective that also includes a fourth helix of the users and civil society (McAdam et al. 2012). When it comes to the quadruple helix model, the inclusion of users and civil society has been highlighted as critical for the development of a RIS (Kriz et al. 2018).

Theodokopoulos and Harabayimye (2019) focus on innovation co-creation and how transformative change can be achieved through co-learning between living lab researchers and user communities. They argue that the amount of knowledge available in each society plays an essential role in its economic development and its importance is now widely considered critical for growth and competitiveness (Chen and Dahlman 2004; Hanushek and Kimko 2000).

Furthermore, Schumpeter (1949) rejected the extreme reduction of the economy to abstract mathematical models, with total disregard for institutional analysis, empirical studies, and history. There are other phenomena of nature

that are not necessarily quantitative but impact economic development. To Schumpeter, economic development was endogenous and driven by the creation of 'new combinations' including new products, new production methods or processes, new organisational forms, new markets, and new sources of raw materials and inputs.

It is therefore important to explore the interactions of these actors in the innovation ecosystem. This study therefore aims to address the gap in literature that explores the development of the role of more community engagement as part of the fourth helix in the quadruple helix model, which would mean that innovations would be adapted to local needs and circumstances, which would optimise the potential for their adoption and diffusion.

Methodology

This research investigated the potential for increased community engagement via the quadruple helix model's stakeholder engagement focus as a tool for achieving better innovation results than traditional systems of community engagement (e.g., triple helix model). The study was qualitative in nature, and it relied on in-depth, semi-structured key Informant interviews and participant observation to collect the data. The study employed the non-probability sampling technique. A total of 40 community respondents and 13 key informants (KI) were interviewed using the purposive sampling technique.

Ex-factory workers and residents living close to and around the industrial parks were targeted. These helped understand the demise of the old industrial parks and the extent to which the ELIDZ had played a role in innovation and local economic development. Most of the in-depth interviews with community members were carried out in the townships of Dimbaza and Mdantsane, with mostly female participants (who formed most ex-textile workers) on site or at their homes. The researcher snowballed using details emerging from the interviews conducted i.e., names of people or places and common themes, which helped the interviewer decide who to interview next. Respondents also suggested other relevant people to talk to. The interviewees remained anonymous, and interviews were coded.

This group of respondents was chosen because of their knowledge of and association with the ELIDZ,

STP, and the old industrial parks to provide a richer collection of data that would make it possible to deepen the analysis. The interviewees remained anonymous, and interviews were coded as KI 1 to KI 13 after the signing of a consent form.

All respondents' identities were protected using codes. For example, key informant interviews were coded KI 1 to KI 13 and community respondents from the different sites were systematically coded with site identifiable codes such as, for example, DMB, 1-25 for interviews conducted at Dimbaza (a place that desperately needs investment after serious de-industrialisation) and EL 1 – 13 for interviews conducted in the East London area. The semi-structured in-depth interviews allowed the researcher to be flexible in the approach to different interviews and allowed the interviewer to probe more into unforeseen but valuable data that emerged during the interviews.

The key informant interviews provided very rich data on industrialisation and confirmed some data that had been collected from secondary sources or from community members. The background case studies of collapsed industrial zones in the cases of Dimbaza, Wilsonia and Fort Jackson were valuable in providing a comparative perspective for the study. They provided the researcher with a solid foundation and a firm understanding of the evolution of industrialisation in the city of East London and painted a clear 'from then to now' picture. The researcher snowballed from there using interview guides at the 3 sites.

Key informants (KIs) included ELIDZ Industrialists and Business Executives that were tenants at the ELIDZ, BCMM and Department of Economic Development and Environmental Affairs (DEDEA) Officials and ELIDZ STP Executives. Semi structured interview-guides were developed for each designated group of interviewees and all interviews were conducted face to face recorded and transcribed.

Findings

There was conceptual confusion about innovation in the community and among stakeholders that participated in the study. Many of the respondents from the grassroots were not very familiar with the word innovation and were not aware of the innovation flagships at the ELIDZ and the role

they could play in stimulating the economy and raising the standards of living in their locality. They however, regarded the ELIDZ more as a potential employer in the locality and were therefore more concerned with labour issues in their responses as evidenced by Respondent EL, 35 who stated, 'People are not employed permanently and there is the involvement of agents, and the labour broker gets a certain percentage from your salary.' When asked about her knowledge of the innovation flagships at the ELIDZ and the community participation in them, another community leader (KI 11) added:

No comrade, the community is not part of that, even for recruitment the community is not involved. It's not clear how the IDZ recruits and the procedure they are using is not clear to the community. We have never seen a single post advertised in the *Daily Despatch*.

Respondent EL, 9 added, 'The poor have no access to the IDZ.' Respondent EL, 23 didn't see the role of his community in innovation in partnership with the IDZ retorted:

The blue collar on the ground does not even have time to focus on economic growth, you see. They are just exploited. There is no economic growth for them. Economic growth is only shared by the elite, those that are connected to those that have ownership and control (In-depth interview, EL, 9).

Quite interesting and most relevant was the response of Respondent KI, 2 EL, a Ward Councillor at BCMM who stated:

Innovation applies to ways that seek to achieve a certain objective through certain strategies and tactics. The innovation at the (EL) IDZ is focussed on exports. How many people can afford a Mercedes Benz? I don't think it translates into pro poor. It is far removed from the day to day needs of the communities at large and does not find expression to us as a poor community. Furthermore, we import food, and my view is that the Eastern Cape is an agricultural province so you would want to start with the things that you consume in terms of

making sure that you have innovative ways of creating jobs. We must start by making sure that what we consume, we produce.

(In-depth interview KI, 2 EL).

The idea that the ELIDZ was an enclave that was elitist was shared by a significant number of community respondents who did not see it as a catalyst for local sustainable development. However, Respondent KI, 14, ELIDZ, a member of a business network responded by saying, 'From my own understanding it is about creative destruction, but I do not see much creative destruction taking place there (at the ELIDZ).'

Respondent EL 1, a Wilsonia ex-factory worker, noted that the ELIDZ was not innovative because they did not have easy access to it and that most of its employees were not from the locality, interestingly associating innovation with accessibility. Respondent EL 18 stated; How can we talk about innovation at the IDZ, yet we struggle to even gain access to it? Yet a Business Executive Respondent (KI 3) noted that innovation sustains a company and is driven by the market:

Innovation sustains a company. The market drives it (innovation). Don't sell what you make but make what you sell. Go to the marketplace and find out first if they will buy the product. You must respond to the market needs and produce them. For example, ILB Helios is remodelling their business completely in response to the market. They brought in new machinery and are going to make new generation PV panels. *(In-depth interview KI, 3 ELIDZ).*

The understandings of innovation and its role in local economic development among interviewees were diverging and varying. Some Respondents suggested that innovation must always be accompanied by a strong component of research and development (R&D), and Respondent KI, 6 ELIDZ highlighted the aspect of project delivery under stringent global competition in a rapidly changing and IT driven world. Some participants understood the need for innovation as going beyond just the creation of jobs and growing the economy but as also being about finding solutions to society's problems as observed by Respondent KI, 4 EL:

I am an innovator for social and economic change, so whatever I come up with in terms of

innovation must address a particular problem which means already when you innovate that thing you have a consumer at the end of that value chain because that product or service needs to be used by someone and address a particular need. It's pointless to come up with a nice rocket of spaceship or whatever it is if it's not going to contribute to any change in society or in the economy so that's where the entrepreneurship part comes in.

(In-depth interview 2018).

There were significant interactions between the three elements in the triple helix model (University-Industry-Government relations) that explored and forged partnerships with the ELIDZ and STP. These interactions were generally captured in MoUs with local and regional government agencies, authorities, and business chambers aimed at harnessing local knowledge from local academic institutions and the extent to which these MoUs were utilised to advance innovation at the ELIDZ and STP. The ELIDZ STP had MoUs with institutions such as the University of Fort Hare (UFH), Walter Sisulu University (WSU), and BCMM. The ELIDZ STP dealt with the technology stations that are located at all institutions of higher learning. Respondent KI, 11 ELIDZ from the STP:

Institutions of higher learning have technology transfer offices with a team that looks at the research and development that comes out of the university with the purpose of turning it into commercialised products. So, they work with Technology and Innovation Agency and the National Research Foundation to take these post-grad research and see if they have commercial value and turn them into actual enterprises *(In-depth interview, KI, 13 ELIDZ).*

The ELIDZ STP has MoUs with institutions such as the UFH, WSU and BCMM via its Design Centre. The STP also collaborated with CAMDI Lab, the Rapid Product Development Association of South Africa (RABDASA), the Engineering Council of South Africa (ECSA), the Office of the Premier and the Small Enterprise Development Agency (SEDA). The ELIDZ's MoU with the BCMM partly read 'The forum will serve as a mechanism to further extend and enhance relations and communication between both organisations on matters of common interest.'

Respondent KI, 13 ELIDZ an ELIDZ official added:

The STP partners with the ELIDZ and its investors to develop solutions for their innovative needs. It also partners with academic institutions like WSU whose engineering department feeds into the work that the STP does.

The University of Fort Hare (UFH) had partnered with the ELIDZ STP and AET Africa (a start-up company that was incubated at the STP) on running quality tests of the company's Hotspot innovation (referred to below) while the government through the STP provided the funding through the Eastern Cape Development Corporation (ECDC) and TIA for the prototype from concept to commercialisation. A Key Informant, an innovator with successful start-up story to tell after commercialising their innovation, had this to say as a demonstration of how partnerships were being utilised to impact positively:

We appointed the UFH to do research on the energy performance of the device (Hotspot) because we wanted to get an independent researcher, so the Institute of Technology appointed the UFH to do the energy verification and the pilot lab test at their site in Alice and they assisted me in residential testing. I have been working with the UFH since October 2016. (In-depth interview, KI, 4 ELIDZ).

Furthermore, AET Africa had partnered with the Institute of Plumbing South Africa (IOPSA) through which they would not only market their Hotspot innovation but also utilise the plumbers' networks to install and maintain the Hotspot device in geysers in both residential and industrial areas. This was a clear example of how partnerships between the various stakeholders, such as academic institutions and professional bodies, impacted innovation and entrepreneurship positively. However, some respondents felt there were insufficient collaborations between the relevant stakeholders in the city of East London's innovation ecosystem in a way that would dent poverty and inequality, as Respondent KI, 2 EL noted:

Locally the guys do share knowledge, but it's limited. They say I can get everything also, so I don't need to collaborate...A lack of experience is evident as is

a lack of fresh thinking. We are not yet using virtual collaboration platforms hence there is a gap with converting from research to commercialisation. (In-depth interview, KI, 2 EL).

Partnerships in prototype testing

The ELIDZ also partnered with other industrialists such as the Master Artisans Association of South Africa (MAASA) in prototype testing. "There are currently various renewable energy prototypes that have or are in the process of being developed within the ELIDZ STP and our students are involved in the monitoring and data collection process for some of the residential testing of prototypes. This, according to Gresse the CEO of MAASA, also allows for collaboration with other players within the park. The study also found that other local players such as the Border Kei Chamber of Business (BKCB) were involved in prototype testing at their office which was said to be the only '100% green driven office in the country. They use us as their 'guinea pigs' if you like. The gel battery and the lights that use sensors all come from other manufacturers and they come to check on them from time to time' (Respondent KI 2 ELIDZ).

Yet collaborations and partnerships must be centred around particular social, economic, and/or environmental issues, and driven by the imperative to provide benefits to the wider community (such as infrastructure, health, and education) rather than solely advance individual interests (Hazlewood 2016). The ELIDZ's technology-and-innovation-related collaborations can go beyond partnerships for the funding, testing, and marketing of innovations but can be effective in addressing socio-economic challenges.

Inasmuch as the involvement of the three actors in a triple helix approach can impact sustainability in communities positively, the effective rolling out of the innovations from the ELIDZ STP will change the lives of the poor for the better i.e., partnerships employing new technologies for job creation and social good.

Nonetheless, despite the MoUs, the stakeholders were not speaking the same language. The BCMC complained that the local universities were not producing the required skills to further stimulate innovation and economic growth and the UFH did not have an Engineering faculty whose skills and

research output would have contributed through partnerships, to the work being done at the ELIDZ and STP.

Also, the BCMM's MoUs with the city's key economic development stakeholders were just negotiated, signed, and filed but never implemented. Business, on the other hand, is generally driven by profits first and the rest of the social or economic justice issues or concerns are secondary unless commercial firms stand to benefit profitably from the interactions (Masiwa, 2021).

This could make it seem like business is concerned less about reducing inequality in the country, the model suggests that they seem to put profits first and community engagement would become essential if it offered direct benefits for actors in the triple helix. Working with context experts can improve the quality of people's lives by helping shape and adopt impactful innovations.

Missing in these important interactions, however, was the crucial voice of local communities. Respondent KI 12 EL had their take on the same subject stating:

There is need to be innovative and flexible in terms of how they (participants in the innovation ecosystem) do their business—we can't sit there and think I am the sheriff – I am the chief and I call the shots! It's about coalitions – it's about joint ventures so that is why I am saying we need to work together yes. (In-depth interview, KI 10 ELIDZ).

Respondent KI 7 a community leader weighed in:

If the IDZ can embark on the relevant industrial manner, if they can openly understand good governance within their own industrial space, they could form a very good industrial chain where the locals have access to training...it all starts from leadership, management.

Discussion

This study acknowledges the most recent level of engagement and conceptualisation of sustainable development (SD) in which countries and agencies have recognised the degree of global interconnectedness of today's economies, industries, and societies, as well as the natural environment. The study therefore also accepts

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Yet, innovation is not achieved until ideas have been transformed into tangible outcomes applicable to public good, not-for-profit, and commercial ventures and emphasis on the indivisible, mutual importance of good science and good business practices (Livingstone 2000).

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the interconnectedness of the industries and the communities, and that industry-led growth must bring about shared prosperity and partnerships with communities. Ironically the broader East London community did not feel connected to the ELIDZ. Yet, innovation is not achieved until ideas have been transformed into tangible outcomes applicable to public good, not-for-profit, and commercial ventures and emphasis on the indivisible, mutual importance of good science and good business practices (Livingstone 2000). Sadly, most of the prototypes at the ELIDZ STP were not adopted in a meaningful way hence their failure to realise the tangible good of far-reaching socio-economic impact.

The way big business perceives and relates to the ELIDZ is different from the way communities would like to perceive the ELIDZ. For example, business' understanding of the role of ordinary citizens at the ELIDZ was that of providing labour so that industries at the Zone could boost exports as captured in the following quotation by Respondent KI 1, a Businessman in East London: 'If you used to work in the old industrial parks but have no technical skills, you are of no use to us.' The community, on the other hand, saw the ELIDZ as an opportunity to address socio-economic challenges like feeding and employing people from the surrounding poor communities.

This paper, however, argues that for meaningful innovation to occur, there ought to be more cooperation than competition among all the stakeholders, including communities, with the state facilitating these interactions, including the enactment of the relevant policies that will allow for further embedding innovation in the 'place' (context). This paper therefore advances the quadruple model as a more useful approach to harnessing the socio-economic potential of the innovations through the participation of the target communities. However, the ELIDZ seemed to ignore the relevance of the place and was not taking advantage of the place-based embeddedness of the webs of relations in which people existed. Respondent EL, 8 from Duncan Village expressed:

Black people cannot do nothing. Our black space is only the union – especially at the industrial space like the IDZ, and then when you join a union you become a member of the management ...that is the black home on the industrial landscape, the union. The coloured people are the only ones that have a home at the industrial space...So you must understand Afrikaans – that will make it easier for you to rise to the other levels. (In-depth interview 2018).

The ELIDZ STP innovations' socio-economic impact potential had not gone far in solving the challenges the local community was facing. For example, socio-economic benefit potential had been lost by the failure to roll out the Twerly prototype which came with a fitted camera, a solar powered streetlight, and an in-built camera (that uses solar and wind energy to provide electricity and a Wi-Fi

hotspot (off grid)). Not only was the Twerly needed in the city of East London, but it would have had far reaching socio-economic impact had it been rolled out in rural schools in the broader Eastern Cape Province, where there continued to be a lack of basic infrastructure like electricity for lighting the streets and for powering cell phone networks.

Also, if commercialised and rolled out the 'Safe Pass' (an ICT based innovation aimed at reducing road fatalities due to motor vehicle accidents especially collisions with oncoming vehicles. The prototype consists of a small device installed on a vehicle that uses an app that has been developed to allow the driver of a car that intends to overtake another vehicle to see what lies ahead of that vehicle so that they can pass safely) would assist in saving lives at the grassroots levels as it will make it safer for drivers to overtake in a province where road accidents continued to claim many lives. What lacked was the engagement of the communities who would have been instrumental in meaningful adoption of the innovation through the utilisation of the fourth helix of the quadruple helix model, which recognises four major actors in the innovation system: science, policy, industry, and community (Schütz 2019).

Harnessing the developmental potential of innovation requires more than MoUs between formal stakeholders but involves consulting all actors in the innovation ecosystem including the knowledge of target user communities. The amount of knowledge available in each society plays an essential role in its economic development, and its importance is now widely considered critical for growth and competitiveness (Chen and Dahlman 2004). If innovations are supposed to generate solutions for sustainable development and improve livelihoods, they cannot be implemented successfully without involvement of the locals.

Embracing a 'place-based' rather than 'issue-based' approach enables the work of innovation to unfold within the boundaries of a particular geography and generates results that are context specific. Locals are a valuable resource in the innovation ecosystem as 'context experts' not just potential employees. There seemed to be an inherent failure to acknowledge the importance of the cultures that are built around very well-defined ideas about "who we are," "where we come from," and "how

things are done around here” which spells out a missed opportunity to further innovation-led socio-economic impact. (Antorini and Muñiz 2015).

The partnerships that were forged by the relevant actors under the triple helix model of industrial development (i.e., industrialists, academic institutions, and the state), who together were effectively leveraging to promote industrialisation, localisation and job creation as demonstrated by the multitudes of trainings targeting students from poor and marginalised communities have however not produced the rolling out of the innovations from the STP.

They have not positively impacted the lives of the poor by using the innovations to stimulate job creation and social good. That is because opportunities were missed to involve the communities in the rollout of innovations as the triple helix model does not create sufficient room to bring communities on board. However, the quadruple helix model offers increased opportunities for participatory engagement. The involvement of communities would make innovation more effective as they would bring better appreciation of the issue being addressed and a deeper understanding of the unique characteristics of the community and participatory engagement would inform further R&D that would improve innovation outcomes.

However, under this triple helix model, a key aspect of innovation, the community, is excluded. Yet, according to the ELIDZ, the Zone is specially developed for innovation and efficiency for growth-oriented manufacturers in search of ultimate global competitiveness focusing on streamlining business operations and engineering operational efficiencies for located industries (ELIDZ 2015). There was room to push for putting innovation at the heart of local economic development at ELIDZ.

Contribution to knowledge

The study has contributed literature on the evolution of the role of the fourth helix in the quadruple helix model in South Africa. It has demonstrated how the triple helix model has not unlocked the full innovation potential and contribution of user communities as community engagement has not been at the heart of innovation during the interactions between – academia, industry, and government in the case of the ELIDZ STP.

The quadruple helix model offers opportunity for more effective community engagement in innovation instead as failure to engage context experts by content experts can impact innovation negatively as the socio-economic potential of innovation is lost when innovations are not piloted in the relevant communities and adopted more broadly.

‘New combinations’ (including new methods or processes, new organisational forms are essential for innovation. These ‘new combinations’ evidenced by the multitudes of interactions at the ELIDZ STP must go further to include more communities in stimulating innovation and highlight the importance of the ‘place’ when it comes to strengthening innovation outcomes. Greater community involvement would result in innovations that are tailored to local requirements and circumstances, maximising their potential for adoption and dissemination.

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Conclusion

The triple helix model has not been effective as a tool for deepening local economic development, as it does not put local communities at the heart of economic development and hence the outcomes are often far removed from the immediate needs of local communities. Developing what Schumpeter termed 'new combinations' means looking beyond traditional systems such as the triple helix model to evolve new innovative solutions that are meaningful to the community. This should be at the heart of the innovation agenda. This would necessitate innovative thinking about how to strengthen the fourth helix of the quadruple helix model of innovation engagement.

The interactions of the three elements of the triple helix model, in this study identified adequate and meaningful community involvement as the missing element in the innovation mix for the socio-economic impact of innovations at ELIDZ STP. The quadruple-helix model offers a better alternative with a stronger community engagement dimension and opportunity for a more locally embedded innovation landscape.

That would mean that innovations are adapted to local needs and circumstances (context), which would optimise the potential for their adoption and diffusion. Communities are still being regarded as a source of labour and not yet as context experts, and partnerships are mostly viewed as a highly technical process that does not involve user communities within the triple helix model. Therefore, prototype innovations (Twerly, and 'Safe Pass') with great potential for addressing socio-economic challenges affecting the poor were yet to launch. Local communities were supposed to act as feedback mechanisms in the identification of a need and market for the innovation bringing a better appreciation of both the issue one is hoping to address, and a deep understanding of the exceptional characteristics of the community – the place and the people within it – where the innovation will be implemented.

The literature has demonstrated that the deep knowledge that users have accumulated and embedded in their innovations to create more relevant products by engaging communities under the fourth helix of the quadruple helix approach as a sustainable solution.

Implications and recommendations for policy

Even though actors under the triple helix model might have competing interests in innovation, more meaningful consultations within the fourth helix of the quadruple helix model would bring better appreciation of both the issues one is hoping to address as well as a deep understanding of the unique characteristics of the place (context) – the place and the people within it – where the innovation will be implemented. The missing link, however, was inadequate partnerships with communities that could have seen the meaningful piloting or implementation of innovations.

As a step in the right direction, and to overcome the difficulties of the top-down approach, the South African government has promoted the user-centred approach to innovation inherent in the Living Lab (LL) methodology as a more robust policy model that can be applied to stimulate inclusive rural innovation aimed at achieving a structural transformation that promotes co-learning as part of its strategic approach to foster inclusive development (Habiyaremye 2019).

As much as the current policy framework acknowledges the importance of the multitudes of interactions of the various actors (including the communities), roles, responsibilities and an implementation strategy are still not spelled out clearly in the White Paper of Science, Technology, and Innovation (2021) that must foster and promote the embeddedness of innovation systems.

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