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Bottom of Pyramid 4.0: Modularising and Assimilating Industrial Revolution Cognition into a 4-Tiered Social Entrepreneurship Upliftment Model for Previously Disconnected Communities

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Abstract. Developing a sociopreneurial (social-entrepreneurship) ecosystem is a substantial long-term investment. Much like natural ecosystems, there are a multitude of support systems needed to maintain balance and diversity in sociopreneurial ecosystems and their interactions are complex in nature. Yet, the various benefits that arise from such ecosystems make them a worthwhile investment. Examples of this come from global universities and private companies who have succeeded in creating hubs of innovation and creativity in different cities around the world. These hubs have achieved commendable results and produced quality initiatives. Yet, there is little success beyond the walls of cities, especially in low income communities. Typically, Bottom of Pyramid (BoP) Entrepreneurs must either move to cities to make their entrepreneurial ambitions come true or settle for small business status. This is especially troubling given that their communities are often the ones that need their skills most. The article begins by discussing the concept of Bottom of the Pyramid (BoP) society. It argues that in the context of the knowledge era and the rise of the network society, the BoP is better named "the outer network society". Using Industrial Engineering principles and systems thinking, the researcher designed a product range and upliftment model (collectively known as the ModulaRISE) that helps resolve most of the structural issues with developing a sustainable sociopreneurial ecosystem. The ModulaRISE model provides three core support structures that can assist in reversing this unfortunate brain drain: Education, Operation and Finance. Moreover, an overarching concern resolved with the model is the tiered system that helps bridge cognitive challenges of being exposed to Industry 4.0 futuristic technologies without the proper incentivized build up. The model has already been launched on a small scale with preliminary case studies showing significant promise. The vision is to develop a fully turnkey upliftment in a box model for BoP communities which connects them to the world and allows them to collaborate to mutually enrich their society and the global society. In concluding, it is discussed that since the majority of society (80%) lives in the outer network, it is fundamental for Industrial Engineers to help design new systems that connect these societies to resources (in the broadest sense) that can help them develop socio-economically and cognitively to be able integrate to the global network society.

Keywords: Social entrepreneurship; upliftment model; industry development; learnership; micro franchise; bottom of pyramid; industrial engineering; industrial revolution.

1. From Bottom of Pyramid (BoP) to the Outer Network

When one imagines a thriving entrepreneurial ecosystem, the setting is rarely in a rural African village or a disconnected farming community in central Asia. Typically, a picture of a thriving metropolis is envisaged in a first world country with big investors backing the next "big thing" with substantial finances and connections. This is not necessarily in itself a negative thing. Yet it shows an inherent bias towards expecting radical and large-scale innovation from locations which are better connected or have better support networks — the silicon valleys of the world.

To a certain extent, the definition of entrepreneurial ecosystems plays a role in this since they can be defined as "communities of agents, social structures, institutions, and cultural values that produce entrepreneurial activity" (Roundy *et al.*, 2017, p. 99). These important foundations and features are often missing in Bottom of Pyramid (BoP) ecosystems, which often leads well-meaning entrepreneurs to search for other ecosystems to grow their entrepreneurial nature. Otherwise, their ambitions tend to fade as they are unable to realize success in the overarching conditions of their current ecosystem.

The economic effects of migration of entrepreneurs from BoP ecosystems to mainstream entrepreneurial ecosystems is part of the larger "brain drain" which has "cost the African continent over $4 billion in the employment of 150,000 expatriate professionals annually... Ethiopia had lost 75 percent of its skilled workforce between 1980 and 1991, affecting the ability of such nations to get out of poverty... [Whilst countries accepting immigrants give] preferences for people who arrive with sufficient capital [Financial and Human] to start new businesses" (Mba and Ekeopara, 2012, p. 42).

This paper explores whether the status quo can be challenged using the disruptive developments of the knowledge era and the concept of the sharing economy. In the knowledge era, the economic base has shifted towards viewing intellect as a resource (Gorey and Dobat, 1996; Lima, 2016). Additionally "entrepreneurship is present in all societies, but it manifests itself differently depending on the context." — Philip E. Auerswald. This presents a golden opportunity to use highly skilled economic migrants (within a country, region and internationally) to help establish low-income entrepreneurial ecosystems which can lead to a "brain circulation" phenomena in those regions (Lima, 2016). Saxenian (2005) explains that "brain recirculation" is the effect of highly skilled individuals who originally left their country for a better life returning to their home countries to establish companies whilst maintaining ties with the country they migrated to.

The case study for this paper is the sub-continent of Southern Africa with specific focus on regional economic migrants. It is assumed in the above context (to be successful) that the home location "are politically and economically stable enough that immigrants will consider returning home" (Saxenian, 2005, p. 56). As mentioned in Saxenian (2005, p. 35), this model has worked well for India and China which have reaped the benefits of "these engineers and entrepreneurs, aided by the lowered transaction costs associated with digitization, are transferring technical and institutional know-how between distant regional economies faster and more flexibly than most large corporations".

The scenario described above might work for some countries and regions but as explained in Saxenian (2005, p. 56) not "all developing economies are positioned to reap the benefits of brain circulation and peripheral entrepreneurship". The South African scenario creates special considerations which need to be catered for. For example, one of the problems is the existence of a dual economic and social system. Another is the history of apartheid which purposefully created poverty traps (through policies) in township and homeland areas where economic migrants came from. These policies still hinder the growth of entrepreneurial ecosystems until today. Yet, some of these challenges to the development of sustainable entrepreneurial ecosystems can be alleviated by utilizing modern developments in the field of Industrial Engineering. The developed conceptual model is known as ModulaRISE.

1.1. *BoP*

The BoP can be defined as the segment of the global population (almost 4 billion people) living on less than $2 a day (Prahalad, 2006). The concept was introduced by C.K. Prahalad in his argument that companies should focus significant effort on trying to reach and grow in these underserved markets (Prahalad, 2006). Notably, the idea was that the 4 billion individuals in the BoP formed the world's largest untapped market of potential consumers. Moreover, it is important to note that "BOP problems cannot be solved with old technologies" — C.K. Prahalad.

Faria and Hemais (2017) point out that, unfortunately, even though some scholars and initiatives studying the BoP may mean well; it is very much possible that their approach led to more negative than positive impact. Faria and Hemais (2017, p. 271) explain that "rather than a future-oriented cosmopolitan business design aimed to overcome poverty challenges in the developing world ... the [current] BoP approach rearticulates the rhetoric of salvation and progress which was inaugurated by the darker side of modernity over five centuries ago with the discovery/conquest of America".

Some of the dark sides of the traditional BoP approach were overcome by a newer iteration, namely BoP 3.0. What BoP 3.0 proposed amongst other things was open innovation, innovative ecosystems, sustainable development and innovation for the last mile which can help rectify some of the negative connotations and applications of the previous paradigm (Cañeque and Hart, 2015). Yet, modern developments surrounding Industry 4.0 and the rise of network society suggests even further room for improvement to form BoP 4.0.

1.2. *Value, entrepreneurship and entrepreneurial ecosystems*

Building on the above, it is important to shed light on entrepreneurship and entrepreneurial ecosystems from a BoP lens. Using a case study from Asia, Peng *et al.* (2016, p. 1) conclude that "for hub-based entrepreneurial ecosystems [Which the ModulaRISE model aims to be] ... antecedents of symbiotic relationship are resource needs and opportunity perception" and the "dimensions consist of mutual recognition, strategy fit, common goal and governance mechanism". Recognizing and pre-developing these antecedents and dimensions is vital for sustainable ecosystem development (Peng *et al.*, 2016).

On a parallel note entrepreneurial research (including ecosystem) in Africa, similar to that of Asia, "should focus not only on boundary conditions to the research from the West but scholars should also seek to begin to develop unique streams of insight that begin to utilize existing theory to develop unique Asian [in this case African] insights to entrepreneurship" (Bruton and Chen, 2016, p. 1).

Moreover, it is important to acknowledge that a different type of value is being created through this process. Although the term has been the subject of discussion since ancient times, its meaning is constantly evolving and developing (Furtado *et al.*, 2017). In the same way that the traditional mechanisms could not accurately account for value created by Big Data, as shown in Furtado *et al.* (2017), this paper aims to argue that immense value can be created by properly understanding, engaging and designing BoP entrepreneurial ecosystems. Specifically, the social stability generated by creating relevant economic opportunity.

1.3. *Network society*

Sociologists typically distinguish between three types of societies: Pre-industrial, industrial, and post-industrial. Each era of human development had a unique organizational structure worth exploring. Staron *et al.* (2006, p. 23) states that "an era is a particular period of historical time having distinctive characteristics. Every era has a signature (or preferred) style of organization". Figure 1 summarizes the insights in Staron *et al.* (2006). It is notable that in the knowledge era, all previous structures are present simultaneously (in the form of an ecology) which adds to the complexity of designing solutions for the knowledge era.

Some modern accounts cite a 4th type of developing society: the network society (Castells and Cardoso, 2005). The biggest concern with regards to the network society is that only a small percent of global society exhibits its expected behavior and benefit from the ability to extract value from being connected, collaborating and

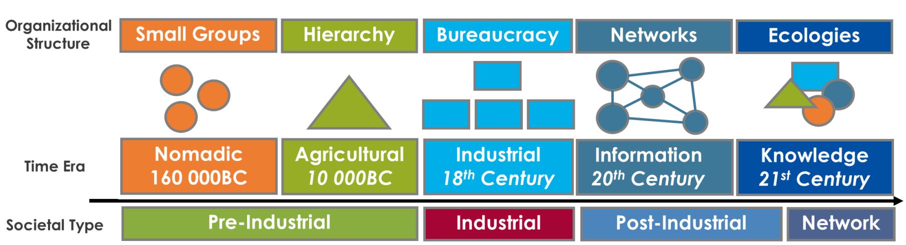

Fig. 1. Evolution of human organization — adapted from Staron *et al.* (2006, p. 23).

leveraging networks (Castells and Cardoso, 2005). This has led to unequal and unjust access to the benefits of being connected, collaborating and leveraging networks. Thus, "the future is already here... it's just not very evenly distributed" — William Gibson.

1.4. *Opportunity for an sociopreneurial ecosystem for outer network society (BoP 4.0)*

Although we live in the 21st century, starting a business is still very costly and personal initiative driven. Expanding markets into underserved markets is challenging. Additionally, ensuring social and environmental sustainability requires special consideration. This is further complicated in the outer network due to a lack of appropriate systems in place to connect entrepreneurs in these areas to resources and support (Darwish, 2017a).

In order to successfully start business or social initiatives in the 21st century, appropriate payment, power and support infrastructure is vital (Darwish, 2014, 2017a). Thus, potential solutions require a truly turn key offering that includes the necessary groundwork and training content. Moreover, the rise of electronic management platforms and dashboards (in the form of enterprise resource planning software) can help visualize business operations and establish key performance indicators for business owners (Xu, 2007).

More importantly, given the history of the Southern African region, a special focus is needed on skills development and resolving the entitlement mentality (in South Africa specifically) (Darwish, 2017a). Thus, to develop skills and encourage autonomy, a structured learnership-type model which follows a tiered approach to growth based on accountability is suggested (Darwish, 2017a).

Additionally, the strategic sequence of building business models for the BoP must follow to ensure that the correct value proposition is generated (ver Loren van Themaat *et al.*, 2013). ver Loren van Themaat *et al.* (2013, p. 199) highlights how Capitec, in the South African context, successfully disproved various assumptions regarding the BoP namely that they "[1] have no purchasing power; [2] They are not brand conscious; [3] Are hard to reach and are unable to use technology". The sequence of elements used in the case study that helped overcome the barriers is shown in Fig. 2.

Identified Opportunity: By considering the BoP communities as merely a segment of the network society that lies in the outer network (disconnected from resources), it became apparent for the Southern African context that a sociopreneurial solution can be designed to suit the needs of the BoP communities. The suggested solution takes the form of a tiered turn-key sociopreneurial solution (social upliftment business in a box) which houses the necessary hardware, software and educational content (leveraging Industry 4.0 innovations) to successfully sustain the business. The initiative holds promise in resolving many of the challenges facing charity and social investment-based initiatives of the sort in BoP communities.

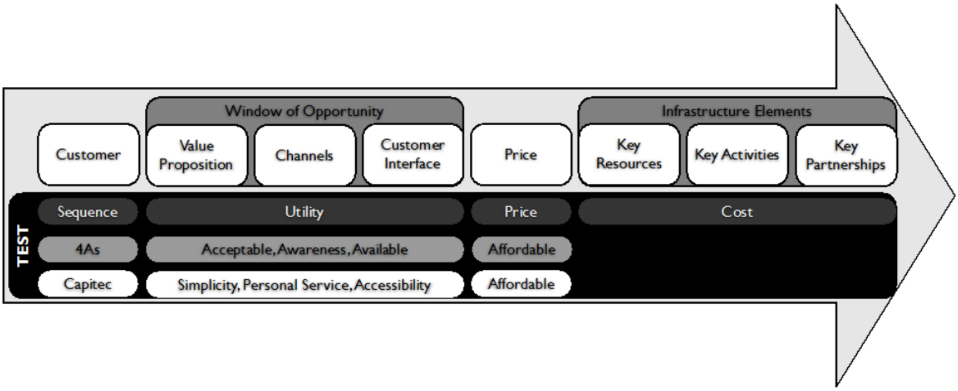

Fig. 2. Framework for BoP [Capitec Case Study] (ver Loren van Themaat *et al.*, 2013, p. 198).

The solution would need to be designed using industrial and cognitive engineering principles to help these communities develop socio-economically with the necessary industrial revolution cognition.

2. Industrial Revolutions and Industrial Engineering

A brief historical exploration of Industrial Engineering activity uncovers that an imbalance exists in its benefactors (Bowen, 2009). For the most part, Industrial Engineering activity appears to contribute a majority of solutions to the top of the pyramid of most industries. In the colonial era, engineering (in the broadest sense of the term) was recorded as being overly concentrated on creating weapons and organizing army logistics (Sperotto, 1994). The industrial era saw most engineers being caught up with the problems of mass manufacturing (Sperotto, 1994). Even a more recent account of history shows that an imbalance still exists between engineers servicing the "top of the pyramid" as opposed to those servicing the many layers that allow that top to be supported (Lister and Donaldson, 2011). This is a major problem with immeasurable impact. The state of many bottom of pyramid communities, industries and sectors is living proof that there is a need for a more equal distribution. Only in the knowledge era are engineers opening their prospects to previously overlooked industries with needs for the solutions only engineering expertise can provide.

Although every field of the sciences and humanities contributes to human knowledge, engineering is tasked with using scientific knowledge to solve human problems in innovative ways (Kotkin, 2013). This is perhaps why there is a strong connection between engineering activity and human development (Sperotto, 1994). Joel Kotkin (2013) explains that "engineering advances drove America's quest for industrial supremacy in the 19th century . . . By the early 19th century, the U.S. was producing its own major inventions, including the steamboat and cotton gin. By the end of that century, the U.S. was clearly on the way to industrial preeminence". In fact, the sheer importance of engineering graduates has led to institutes such as the UNESCO evaluating economic development in countries by their number of graduates in science, engineering and technology. It is concluded that there is some correlation between the number individuals with high problem-solving capability and economic development.

As discussed in an Interesting Engineering (2015) article "normally, it is expected that countries such as the United States and Japan would make the cut. But what is even more interesting is that some of the developing countries are also starting to make the top 10 as well... According to the World Economic Forum, 'talent will be the key factor linking innovation, competitiveness and growth in the 21st century'". However, many institutions, such as the OCED (2016), decouple the number of graduates from potential growth and focus more on the % of graduates in natural sciences and engineering as an indicator. Evaluating the data reveals a more accurate perspective. Countries such as Germany and South Korea graduate 30% of their students in fields of science and engineering and display extremely high economic prosperity whilst several countries with widespread social and economic problems rank below 10%.

It is important to note that several countries with natural science and engineering graduates falling below 10% might still have excellent programmes in engineering and technical fields (such as South Africa). Yet, the problem seems to lie in where those graduates work. In South Africa, for example, a majority of qualified graduates work for the private sector and resolve problems relating to improving the profitability of the private sector in some way or another. This happens in city centres and economic hubs such as Gauteng where up to 40% of the country's GDP is generated. Yet, the outer network communities (BoP, rural, low income, township and informal) do not get their fair share of qualified graduates assessing their problems and developing relevant low-cost solutions. This is perhaps why even 20 years after becoming a democracy in 1994 which promised to resolve many of these problems, South Africa maintains elevated levels of inequality, high reliance on subsidy income, low levels of education and elevated levels of unemployment in BoP and outer network areas.

2.1. *Field of industrial engineering*

The Institute for Industrial and System Engineers (IISE) defines "Industrial and Systems Engineering [as the field] concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of Engineering analysis and design, to specify, predict, and evaluate the results to be obtained from such systems". Furthermore, the field is fuelled "by the challenges and demands of manufacturing, government and service organizations throughout the twentieth century. It is also a profession whose future depends not only on the ability of its practitioners to react and facilitate operational change but, more important, on their ability to anticipate, and therefore lead through the change process itself" (Maynard and Zandin, 2001, pp. 13–14). "Modern Industrial Engineering is concerned with the integration of resources and processes into cohesive strategies, structures and systems for the effective and efficient production of quality goods and services" (Sperotto, 1994).

Many professionals have noted a lack of Industrial Engineers in the public sector or participating in public service in the Southern African context. A study done by Van Dyk (2014) showed that although many Industrial Engineers work for parastatal or state-owned companies, they do not directly deal with issues of inequality or social justice. Moreover, Schutte *et al.* (2016, p. 18) highlighted Black Coloured and Indian (BCI) Industrial Engineers "end up in positions where they are less influential and earn less, and are therefore not clear enablers of the drive to attract more young people from disadvantaged backgrounds to become IEs. This is likely hampering the growth of the discipline in significant industry sectors such as general government services, where the IE discipline needs to have more BCI IEs of the appropriate stature to grow in this sector".

Lister and Donaldson (2011, p. 48) explain that "current Industrial Engineering paradigms aim to improve quality and profits, and emphasise labor-reduction, specialisation, analysis and optimisation. This can be at odds with the needs in a developing country... [In addition to this] relatively few Industrial Engineers are employed in South Africa and Kenya, and not many are produced by the educational systems in these countries. Those who are available, work in organisations such as manufacturing industries, government, parastatals and the services sector". Namibia, for example, "aspires to be an industrialized nation by 2030 facing significant challenges like poverty. (Only about 47% of households have a main source of income) ... The Namibian, like the South African, economy is diversified ... [Which is why there is a] ... need for Industrial Engineering tertiary education. Of course, real wealth comes from people with ingenious ideas and tenacity to make them work to the benefit of all. In the process, they change themselves, change those who work with them and will industrialize Namibia. While designing and running superior systems are at the heart of Industrial Engineering, it is the people in them who matter to both consumers and producers... [And] Ethical behavior is paramount in producing a good society" (Snaddon, 2011, pp. 1–2).

One of the things that hinders the development of more IE based initiatives in the BoP is a preconception that an Industrial Engineer's technical skill has no value in this setting. Yet, a good example of an Industrial Engineering application (without necessarily defining it as such) is the unique food delivery business endeavor Dabbawala in India. Every day, 2 million home-cooked food deliveries take place in a range of 60 to 70 km. The speed, precision and cost of doing these transactions through traditional structures would have probably been impossible (Thomke and Sinha, 2010). However, this industry has been running for more than a hundred years in India with proper structures, offices, delivery people and virtually no theft (Thomke and Sinha, 2010). Moreover, it is considered a six-sigma process

(Thomke and Sinha, 2010). This success would not have been possible without excellent supply chain design and the use of quality management and process engineering principles (which form part of Industrial Engineering).

Another example in India is the production of the Indian bread Lijjat Papad where thousands of Indian women earn extra income for the family by producing as many of these breads as possible (Ramanathan, 2004). The supply chain, cash handling and international sales pipelines that those ladies have achieved are remarkable. The organization also ensures that money is given only where value is created and the workers are motivated to produce as much as they can because the organization has the capacity to buy all the bread produced (Ramanathan, 2004).

It is possible to successfully implement similar solutions in South Africa and other developing countries. However, that would require Industrial Engineers to take initiative and apply their minds to help solve problems faced by the largest part of the world's population. Yet, the context being entered has not undergone an industrial revolution in the traditional sense. Thus, some inspiration for designing the initiative can be drawn from the four industrial revolutions to design micro-versions based on similar principles.

2.2. *The four industrial revolutions*

Major developments or disruptions in the underpinning technologies that enable manufacturing and services are typically referred to as industrial revolutions. "Historically, the world has experienced three major growth periods where disruptive technology has brought about huge productivity improvements in manufacturing. More specifically, the invention and implementation of the steam engine in the 1800s,

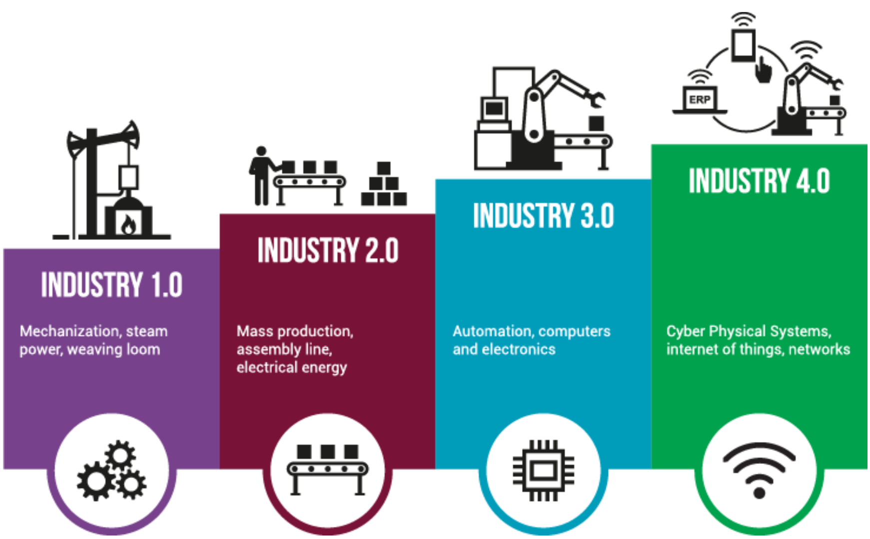

Fig. 3. Four industrial revolutions (Simio, 2017).

Ford's mass production model of the early 1900s and the first wave of automation with the birth of Information Technology (IT) in the 1970s" (Simio, 2017). Currently, the modern world (network society) is experiencing the fourth industrial revolution which is described "a trend towards a fully connected and automated manufacturing system, or Smart Factory [Where] all production decisions are optimized based on real time information from a fully integrated and linked set of equipment and people." This is summarized above in Fig. 3 (Simio, 2017).

One of the problems facing the African continent, as a whole, is the lag in industrial revolution cognition. Rural regions of Africa remain disconnected and virtually unexposed to developments around the world (even in places with high mobile penetration). Any solutions developed need to cater for the historical situation facing South Africa. Thus, to avoid technological shock and ensure integration, a clear structure integrating the beneficial developments of these revolutions is required.

3. The Modularise Model

The Problem Context: In the South African context, the lack of participation of Industrial Engineers (and other disciplines) in bringing about major technological disruptions to outer network areas has left them economically and socially underdeveloped. This has led to most initiatives in those regions to require significant post-implementation investment, leaving them unsustainable because of their non-adherence to basic business design principles that accommodate their market. Moreover, education forms one of the biggest stumbling blocks to implementing a successful ecosystem. Insufficient education inhibits the ability of the community to communicate with external entities (which may be able to provide support in a variety of ways) and risks the potential of success to socio-economic development (due to improper education on how to manage and sustain the developmental projects).

The Opportunity: Many workers in mainstream economic sectors come from the outer network and in fact can be classified as migrant economic labor. These are hardworking, skilled and resilient human beings whose only option to gain a better life lies in entering employment, mostly, of large organizations and franchise businesses. They are well exposed to developments of the knowledge era but generally have not considered it possible to integrate these developments into their home communities. Moreover, these individuals earn minimum wages in South Africa (R3 000-R8 000) and most of their wage is spent on transport and renting accommodation which leaves very little as "savings". Yet, many communities have internal savings funds known as stockvels (which were initially setup as a survival fund), get Corporate Social Investment (CSI) from nearby businesses and can potentially access government development funds.

The ModulaRISE Model: By carefully examining the context, a socio-economic upliftment learnership model was designed. Modular represents the design philosophy used in the product design and RISE stands for the 4 tiers: **R**ookie

Toolkit, **I**ntermediate Home Business, **S**ervitization Center and **E**conomic Hub. The idea was to design a simple business case that would leverage existing funding systems to help plant sociopreneurial initiatives which can integrate and grow within communities. The model uses developments in the sharing economy and the financial structure of franchise restaurants to create turn key upliftment opportunities in a box. The units and their business cases (repayment plans) are designed using Industrial Engineer principles (from supply chain, business engineering, operations management, facilities management and others). Everything from the standard processes, costing and service offering is already designed into the four-tiered system. These kits also come with an ERP system, educational content and operational manuals to assist in bridging the gap for entrepreneurs. Moreover, the model provides three continuous support relationships with the outside world network society (Operational, Education and Financial).

The Process: An entrepreneur, to become a participant, simply has to go the local ModulaRISE **Showroom** and they will be exposed to a variety of turn key opportunities that run out of shipping containers. Once the entrepreneur has made a selection of available businesses in their area (that are determined by studying the community's integrated development plan, studying the competitive landscape and analysing the community's fundamental human needs), they will participate in training courses at the local **Incubator** (available in their community). The entrepreneur, after developing some basic accounting and technical skills, will then get funding from the **Financing Centre** which bases the decision for providing a starting toolkit on their performance rather than their ability to fill in paperwork. Moreover, this challenges the traditional learnership model which provides certificates to graduants instead of opportunity. With ModulaRISE the entrepreneur graduates with an entry level business which they must grow themselves. The entrepreneur thereafter provides services to their community and repays their "capital". An operator is available continuously to help advise them on how to develop their skills, repay their unit better. Once they are ready, they "RISE" to the next tier of their selected business stream. A visual representation of the model is presented in Fig. 4.

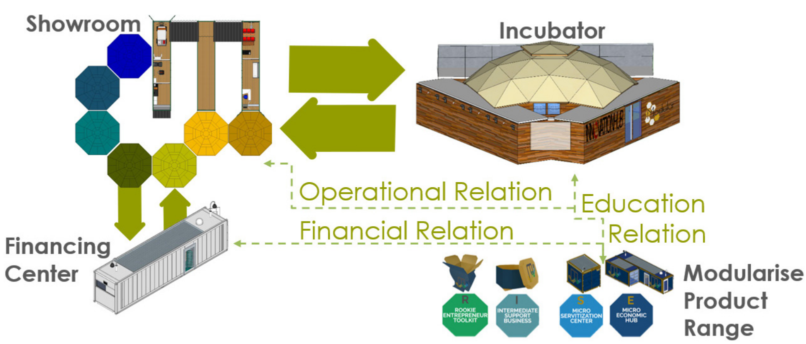

Fig. 4. ModulaRISE model [own work].

3.1. *Operational relationship*

The first point of contact is the Showroom. This element of the model can better be understood if one conceptualizes it like a car showroom. An entrepreneur enters and sees various turn key business model opportunities available to their region. Much like a car, these turn-key container businesses (Modular Innoboxes) come with a warranty plan which is administered centrally. The Modular Innoboxes are fully solar powered, insulated, internet connected, include an Enterprise Resource Planning (ERP) system, are movable and come with business and operations manual (Darwish, 2017a). Unlike cars, however, the Modular Innoboxes come with their own repayment plan (given that the entrepreneur can use them to generate an income and repay their capital). However, in order to ensure successful transition and build accountability, the entrepreneur starts at the R level which is the entry level of that business stream. For example, if the Modular Innobox houses a clothing design and production workshop (as an E level), then the R level will be a sewing machine (Darwish, 2017a). A description of the level, the necessary Key Performance Indicators (KPI) that must be monitored and the ERP apps that are provided are discussed in Table 1.

A key element of the operational relationship is the design of these packages. Given that some community members may not have access to the bigger picture and cannot distill the Integrated Development Plan (IDP) for their given community, a Modular employee will conduct these analyses using Industrial Engineering tools and design a unit which [1] satisfies a fundamental human need in the community, [2] can be funded by grants or corporate social investment (which the employee will obtain

Table 1. Operational relationship of ModulaRISE model (Darwish and Engineering, 2017b).

Level	Description	Main key performance indicators	ERP Apps needed
[R] **Rookie Entrepreneur**	Single Tool — Multi Service Range — Single Person	**KPI:** Customer satisfaction **KPI:** Response time	- Customer Relationship Management - Quality Control - Accounting, Invoicing, - Purchase - Expenses - Sales - Timesheet
[I] **Intermediate Support Business**	Multi Tool — Multi Product Range — Partnership of Rookies	**KPI:** Customer retention **KPI:** Number of orders met on time	**R Apps &** - Manufacturing - Maintenance - Equipment - Appraisal
[S] **Servitization Center**	Single Facility — Service and Product Offerings — Manager+Employees	**KPI:** Number of business goals completed on time	**I Apps &** - Inventory – Events - Marketing - Leave (Vacation) - Employee Appraisal
[E] **Economic Hub**	Multi Facility — Complimentary Offerings — Multiple Owners	**KPI:** Return on capital	**S Apps &** - Projects - Website

as well) and [3] caters for the local business ecosystem and ensures that the market is not flooded with toolkits that would compete with each other and therefore hinder all of the individuals' ability to earn an income.

3.2. *Educational relationship*

The educational relationship is the cognitive development mechanism of the model. This element was introduced to truly integrate the accountability aspect and ensure that incentive and rewards are based on success. An example of an entrepreneur's journey is: the rookie entrepreneur receives a single tool (sewing machine, camera, handyman equipment, etc.) and begins with a 1-month program focused on tool specific training as well as supportive financial and marketing training. After a six month on-the-job practical element, the recorded data obtained from the entrepreneur qualifies them to go into the next level or remain in their current level. If the individual makes it to an intermediate, they are grouped with similar minded individuals and trained for two to three months to run a support business offering multiple compatible services as part of a value offering. Their educational program grows to include human resource, inventory, advanced financial and other complimentary training. After one year on the practical element of the job, the individuals can qualify to receive a permanent containerized Modular Innobox site and offer formal services in the form of a Servitization center. The training component of the S tier is on the job and includes several interventions based on the collected data from the micro facility. After running the business for one further year, the micro facility and its owner/operators can graduate to the highest tier E where they become part of an economic hub offering various other services to compliment and cross-pollinate with their services.

The aim is to create a knowledge sharing platform that allows owners of similar business units to share their insights and continuously improve the operational model. Individuals who contribute new service or product designs would be rewarded by deducting from their capital repayments and employing them as educators in the incubator. Summary shown in Table 2.

3.3. *Financial relationship*

One of the key elements that is often disregarded in sociopreneurial initiatives (and can ultimately be a cause of failure) is finances. The ModulaRISE project took note of this element and ensured that the financial model was well designed. Each tier was designed to correlated with a business type that could be registered formally. Additionally, the packages were costed reasonably to allow for suitable repayment cycles. Grant funding is the main form of funding that is used. Yet, since all entrepreneurs are expected to repay their capital, a cyclical fund was setup to ensure that grant "repayments" help in starting new RISE initiatives and therefore contribute to ecosystem development. Summary shown in Table 3.

Table 2. Educational relationship of ModulaRISE model [own work].

Level	Education timeframe	Industrial revolution cognition
[R] Rookie Entrepreneur	One Month Course Followed by Six Months in Continuous Rookie Level Monitoring and Training	Links to the cognitive elements of the first industrial revolution of replacing human activity with machines. Toolkits are simply made up of single tool that must be used by entrepreneur to generate an income.
[I] Intermediate Support Business	Two to Three Months Course Followed by One Year in Continuous Intermediate Level Monitoring and Training	Links to the second industrial revolution of dividing labor amongst skilled workers and creating production lines. Several toolkits need to work together to make product offerings and value propositions.
[S] Servitization Center	Four Months Course Followed by Two Years on Site Assessment and Peer to Peer Training	Links to the third industrial revolution of using data and information to make smarter business decisions.
[E] Economic Hub	Teambuilding Activity Followed by Continuous Progress Reporting	Links to the fourth industrial revolution of automating various processes and producing technical workers.

Table 3. Financial relationship of ModulaRISE model [own work].

Level	Capital requirement	Repayment timeframe	Business registration type
[R] Rookie Entrepreneur	R10 000–50 000	8 Months–1 Year	Sole Proprietor
[I] Intermediate Support Business	R50 000–150 000	1–1.5 Year	Partnership
[S] Servitization Center	R150 000–450 000	+/−2 Years	Private Company
[E] Economic Hub	R450 000–2 000 000	+/−4 Years	Public Company

4. Piloting, Prototyping and Future

4.1. *Prototype*

The first attempt at testing the concept of the Modular Innobox was undertaken in early 2013. The concept was known at time as the Busy Box. This business concept dealt with designing a movie theatre in a shipping container for low income communities that is flexible enough to provide a multitude of services through the existing service infrastructure (Darwish, 2014). Thus, the concept was designed to perform a dual functionality as a business and educational initiative. By day, the unit serves as a virtual, self-sustaining classroom providing learners with support and educational services that they would otherwise not have had access to. By night, the unit transforms into a simple, sustainable business managed by an owner-operator with the support and partnership of an external party. The Busy Box implementation site was located in Soshanguve, South Africa. The Busy Box went live on Aug. 2013 until end of 2014. Various lessons were learnt from the process of designing, testing, and implementing the Busy Box concept. It was found that incentivized models are the most effective way to ensure good buy-in from potential owners or managers. In addition, it is important that product and services in low income communities be redesigned to give only what the community members are willing to pay for. The final, and perhaps the most important, lesson was that excess capacity in low income communities can be used to create a social and business revolution (Darwish, 2014).

4.2. *Pilot*

One year later (in 2015), the first official Modular Innobox product was launched as a pilot in partnership with the South African branch of a well-known German company. This product was known as the Log Lab. The Log Lab was designed to be hi-tech multipurpose venues that fits inside a container. The unit features 15 comfortable multimedia room seats and 12 computer desk workstations (Darwish, 2015). The unit was fully solar powered, internet enabled, with CCTV and security sensors. Furthermore, fingerprint entry and exit was installed. The unit was sponsored to a school and the income generated would subsidize the school's existing programs (Darwish, 2015). More importantly, the Log Lab provided local and world class content for education and skills development. It also helped educate communities about crime, health and other important aspects of community life. A comprehensive review of the unit was done in mid-2016 with encouraging results. The school had experienced only a few days of downtime in the entire year and generated a sizable income from sponsorships and micro-transactions (Darwish, 2016). Moreover, the community started designing their own initiatives using the tools provided to meet some of their needs (Darwish, 2016).

4.3. *Future*

Modular Innobox (Pty) Ltd launched its first ModularRISE showroom to the public on the 2nd of June 2017. The aim was to market fully functional and real-life models of most of its product range. The showcase was displayed at the Innovation Hub in Pretoria until late-2017 and was moved to the North West University after developing a strategic relationship with the institute (Darwish, 2017a). To lower conceptualization costs, the showroom was designed to use VR and AR technology to facilitate conceptualizing new turn-key business designs. Currently, the project has filed various proposals (with government and private entities) to help develop comprehensive ERP software packages that can enhance the product offering. Additionally, this can assist outer network micro-economies in formalizing existing community services and developing innovative servitization value offerings for their community (Darwish, 2017a).

5. Concluding Remarks

5.1. *Results*

These pilots and launches were shown on SABC, Etv, Joburg Today, Business Day live and several other media outlets and had a feature on the University of Pretoria website. The researcher also received an award from Young People in International Affairs as being one of the top 35 projects impacting Africa. Moreover, the forming of the strategic relationship with the NWU and a major South African bank will help strengthen the educational and financial aspects of the model and allow Modular Innobox to focus on the operational aspects.

The model truly presents a new take on developing sustainable entrepreneurial ecosystems by integrating industrial revolution cognition in the design and providing support in key areas. Additionally, an interesting finding was that the ModulaRISE product range is less expensive than purchasing the elements, necessary to start a business, separately (given that it makes use of economies of scales and leverages partnerships). This further adds to the appeal since many financial institutions loan out money to start small businesses but cannot necessarily guarantee that the entrepreneur will know what to purchase to start their business and manage their cashflow. This model allows financial institutions to loan a business instead of money and to continuously provide financial support to the entrepreneur by facilitating rapid repayments and financing future growth. Ideally, stockvels can participate in this, given that they are community-centered investments, and this would see wealth being captured within the community. Stockvels could become the finance house for initiatives within the community.

Currently, four project students have completed their final year Industrial Engineering projects in designing supporting systems that will further the success of the model. Darwish and Engineering (2017b) determined the requirements for the performance management system for monitoring and graduating entrepreneurs. De Beer (2017) is analyzing how some units can impact food security and improve availability and quality of fresh produce by designing sustainable supply chains (using one of the Modular Innobox units). Erasmus (2017) conducted a preliminary investigation on how funding can be captured in these communities by selling some of their art products in overseas market and bringing back hard currency to the micro community. Lastly, Ferreira (2017) created a tool that assists in integrating the ModulaRISE offering to the community's IDP and fundamental human needs.

5.2. *Future research*

The current focus is on building a financial model to help scaling up on a national scale. Additionally, an appropriate ERP and performance management system is in development. Yet, an ambitious goal to see whether the ERP system cannot become an Entire Resource Planning solution for the entrepreneurial ecosystem (Xu, 2011). This could, in principle, strengthen the accountability and traceability of the model.

The project team is currently working with existing partners to roll out a full-scale test in a community in North West province. The idea is to start with 80–100 rookie toolkits and see how many economic hubs can be extracted at the end of the project lifecycle. Naturally, some entrepreneurs will fall away during the process, but the aim is to assess the overall impact of planting these seeds of initiative in the community.

5.3. *Conclusion*

ModulaRISE is a four-tiered entrepreneurial learnership model designed to uplift outer network micro economies. The ModulaRISE model is branded as a learnership model because it offers the educational content required for individuals with little to no formal education to RISE to business levels by owning and running their own Modular Innobox. It is entrepreneurial because a ModulaRISE participant does not graduate with a degree; they graduate with a business. It is not a perfect model as yet, but it holds significant potential to be the way initiatives are started in the Southern African area, hopefully leading to sustainable sociopreneurial ecosystems.

The overarching goal of the project going forward is to propose a scientific approach to capture and record value in these communities by formalizing and modernizing their economic activity. Moreover, it is to give the communities assets not liabilities since "charity is no solution to poverty. Charity only perpetuates poverty by taking the initiative away from the poor" — Muhammad Yunus.

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