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MAKING THE INVISIBLE VISIBLE

INFORMAL INNOVATION IN SOUTH AFRICA

JULY 2023



Co-building the Accelerator Labs as a joint venture with:



UNDP
Core
Partners

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Cover

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Foreword



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UNDP Africa's Strategic Offer (2022 – 2025) anchors its vision on a promise: to build on the power and ingenuity of Africa's communities to innovate toward their own futures. A step toward tapping home-grown ingenuity is to explore how informal innovation and entrepreneurship really work in Africa. We need to understand what motivates innovators, how their innovations emerge and spread, how an ecosystem for innovation and entrepreneurship is structured, and what policies can be designed to support them.

This research is the first of its kind. In it, the UNDP Accelerator Labs, in partnership with Utrecht University, the University of Johannesburg, and the MIT Sloan School of Management, have conducted the first-ever survey on informal innovation and entrepreneurship in South Africa. This work found that 2.5% of South Africans aged 18 and over —1 million people— have innovated. This percentage is higher than those previously observed in China (2.1%) and South Korea (1.5%). This suggests that informal innovation is not only widespread in South Africa, but that its innovation capacity is underestimated.

When informal innovators develop solutions to serve themselves and their communities, and those innovations don't spread, we lose massive opportunities for solving problems and income generation. But we can only intervene to support these innovators if we understand why and how they innovate, what types of innovations they create, how they spread, what resources they need, and the policies needed to enable informal innovation to thrive.

This report will help UNDP Africa advise African governments on untapped innovation opportunities. It will also help policymakers at the African Union and other supporters of innovation to understand what makes informal innovation ecosystems distinct and use this knowledge to support informal innovation to uplift and transform communities.

Key insights from this study

This research is the first statistical representation of informal innovation in South Africa. It uses methodology comparable to that used in high-income countries such as the US, UK, Russia, China and South Korea. While data collection methods are comparable, the higher rate of informal businesses in South Africa make this research both novel in that it helps us understand informal economy innovation, and cautions direct comparisons, especially related to the rate of commercialization among innovations.

Informal innovation

One million informal innovators. In the South African economy, many citizens spend their leisure time developing new products. Amongst citizens aged 18 and older, we estimate that 2.5% have innovated in the past three years, representing around 1 million innovators. The fraction of 2.5% is in sync with other countries (usual range is 1.5% to 6.2%), and higher than percentages previously observed in South Korea and China. Informal innovation is embedded in general do-it-yourself (DIY) behavior in which citizens use their leisure time to build existing products for themselves (DIY applies to an estimated 13% of South Africa's citizens).

Many innovations are children- and education-related. We found that 36% of all reported informal innovations were meant to help children. This exceeds what has been observed in other countries. South Africans develop complementary study materials, games and applications to acquire basic skills including reading and arithmetic, but also to familiarize the younger generation with engineering principles, to mention only a few examples. This finding probably reflects the demographic makeup of the country, with a substantial younger generation and relatively few elderly people.

Innovation frequency is higher in affluent groups. As in other comparable studies, people are more likely to innovate when they have completed more formal education, have higher incomes, and live in prosperous areas. These people are also more likely to share their innovations freely. In contrast, in lower income/education groups (including township residents) innovators are more likely to innovate out of necessity and seek to generate income from disseminating their innovations.

Dissemination of informal innovations is relatively high. 33% of the informal innovations in South Africa are developed in collaboration with other people, which exceeds all other countries. Innovations also disseminate better: over 50% of the informal innovations are directly shared with peers, and over 10% are commercialized (in other countries this is usually 25% and 5%). While diffusion appears higher in South Africa than elsewhere, it remains a frontier where investments are needed.

There are four types of informal innovators: users, participators, helpers and vendors. Their innovations are driven by, respectively: personal need to use their innovation, enjoyment of the innovation process and learning new skills, altruism to help others

and commercial intentions. South Africa has many innovators that are the 'helper' and 'vendor' type, explaining the aforementioned favorable dissemination rates.

Informal business ownership

Informal business is more widespread than formal business ownership. We estimate that in South Africa, 2.5 million citizens (6.2%) run a business that is completely informal: unregistered, not paying taxes, without keeping financial records, and without a bank account. Another 5.9% runs a business that is only partially formalized. The number of (partially) informal businesses exceeds the formal business ownership rate, which is estimated at 5.3%. This study illuminates business activity that is not visible in international statistics.

People in low-income groups tend to run informal businesses. Informal business ownership is more frequent among women, those with lower levels of formal education and township residents. If informal business ownership in the official statistics is included, the typically higher frequencies of business ownership amongst well-educated and high-income groups would diminish.

Informal innovation and business ownership are strongly related. Business owners are more likely to be informal innovators, and vice versa. Especially in low-income communities (including townships), informal innovators start informal businesses to generate income with their innovations. In contrast, for formal business owners, it is shown that more informal innovations are unrelated to their business and that they share for free.

Policy implications

Policy intervention is merited to address lack of dissemination incentives and commercial barriers. As in other countries, many informal innovators in South Africa lack incentives to disseminate their innovations. This 'diffusion failure' merits policy attention: it means that innovations are not reaching their full potential. Next, the (mostly informal) businesses that are starting to commercialize informal innovations face challenges related to down-to-earth growth barriers like finance and infrastructure.

Different innovation policies are merited, to address basic problems. The emergence of informal innovations and businesses differs from the formal business sector. In the informal sector, it is everyday problems that matter, such as access to simple innovation tools, vending places and microfinance – not the more sophisticated innovation challenges that formal businesses face, such as access to scientific knowledge, a highly-educated workforce and advanced appropriation schemes. Examples of policy interventions in the informal sector arena are: public support for makerspaces to provide access to innovation tools, securing internet access for all and maintaining a sound physical infrastructure (including access to electricity).

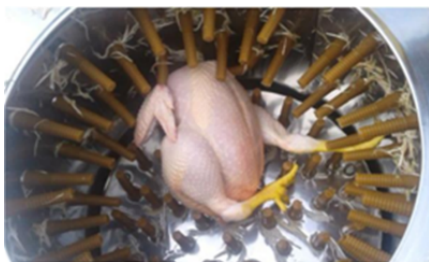
1. Introduction

1.1. Motivation

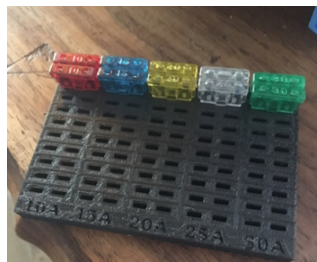
In contrast to common wisdom, a lot of innovation and business development in society happens informally: outside the business sector. Individuals in the household sector innovate at a private cost during their unpaid discretionary time – no one pays them to do it, and they often do not protect their design with patents. Consequently, their designs are potentially acquirable by anyone for free. Citizens may innovate for several reasons: personal need, enjoyment, learning and self-development, helping others, and commercial reasons (von Hippel, 2017).

Household sector innovation is ‘informal’ as it is unrecorded in official statistics. Nevertheless, it has been found in many countries, and is clearly present in any economy (de Jong & von Hippel, 2022). Box 1 gives some examples we encountered while doing interviews in South Africa.

Box 1. Examples of informal innovations in the South African household sector



Chicken plucker
(manually operated device to efficiently remove feathers)



Automotive fuse holder
(to organize fuses and easily see when to order new stock)



Cross-shoulder bags
(fit to purpose from recycled materials)

Notes: examples of informal innovations encountered in 26 interviews with South African citizens.

Informal innovation contributes to economic development in multiple ways. First, informal innovation is a source of products with new functionality (Riggs & von Hippel, 1994; Ogawa, 1998) and new industries emerge out of informal innovation activities (e.g. Shah & Tripsas, 2007). Second, informal innovations sometimes compete with existing commercial products, when individuals build cheaper versions of existing products. This reduces overall prices and enhances consumer welfare (Gambardella et al., 2017). Third, informal innovations sometimes complement existing products (e.g., a car and a trailer), and hence expand their use value.

Informal innovations are often also useful to other people, but these broader societal benefits are only reaped when informal innovations diffuse to other people. Most citizens lack incentives to diffuse what they have built (de Jong et al., 2015). Without diffusion, each adopter who might benefit from a solution has to make the same innovation effort – a poor use of resources from a social welfare perspective. In

general, informal innovations may be shared directly with peers, or be commercialized. In the case that innovations spread via commercial pathways, this can happen through formal, existing businesses, but also via startups that only become visible after a lot of work has been done (Shah & Tripsas, 2007).

There is a lack of studies in developing countries with huge informal sectors

This report delivers the first findings on informal innovation in the household sector on the African continent. So far, studies of informal innovation have only been done in highly developed countries (e.g., UK, Netherlands, Japan, Finland, Canada) and economies that have made significant development progress (e.g., Emirates, China), but not yet in developing countries. We collected data in South Africa, to explore the nature of informal innovation, and benchmark with other countries. Additionally, we investigated how informal innovation is related to new business development and identified implications for policy making.

The informal sector is dominant in all African countries, and South Africa is no exception. The share of the informal economy in non-agricultural employment is estimated to be 74.5% for sub-Saharan countries (Kraemer-Mbula & Wunsch-Vincent, 2016). The informal sector is typically associated with poverty and social exclusion, as it includes activities performed by people that are marginalized, such as people living in townships. (In the South African context, the term ‘township’ refers to settlements that were planned by the apartheid government for black workers to achieve racial segregation within cities. In post-apartheid South Africa, townships remain characterized by socio-economic deprivation.)

Innovation in the informal sector clearly deviates from the formal sector: it is non-R&D-based, very collaborative, revolves around technology adaptation more than invention, adheres to circular economy principles (minimize resources, reuse, repurpose) and is heavily constrained (Kraemer-Mbula & Wunsch-Vincent, 2016; Kaplinsky and Kraemer-Mbula, 2022). Also, informal businesses are widely present in developing countries, as it is quite normal to encounter companies that are unregistered, are not known to the tax authorities, do not keep financial records, and do not have a bank account (Williams et al., 2016). For example, the cross-shoulder bags in Box 1 are commercialized in businesses that are impossible to detect in public sources.

A related and important issue is that national innovation and business/entrepreneurship strategies are often still informed by insights from developed countries, disregarding how much economic activity happens in the informal sector. To inform policymaking, it is important to integrally study the factors that enable the development, diffusion and commercialization of informal innovations that are developed by citizens in the household sector, and we deploy an ecosystems approach for this purpose.

1.2. Purpose

We investigated innovation and business development in the informal sector of South Africa to achieve the following three goals:

1. Explore the nature, processes and diffusion of informal innovation;
2. Explore the nature and characteristics of informal business ownership. In doing so, we also investigated to what extent informal innovations are related to informal business development as a pathway towards diffusion;
3. Map the ecosystem for informal innovation and business development and identify policy implications.

This report summarizes our most important findings: the results of the explorations described above are given in chapter 2 (informal innovation), 3 (informal business ownership) and 4 (ecosystem and policy implications). In chapter 5 we conclude. Our research project included a survey of South African citizens, dozens of in-depth interviews, and extensive literature and desk-research (including consultations with experts). For a description of our research methods, we refer to Appendix 1, while our references list is in Appendix 2.

2. Informal innovation

2.1. General principles

Informal innovations (usually referred to as household innovations) are functionally novel products, processes, or other applications that consumers develop in their leisure time without being paid to do so (de Jong & von Hippel, 2022).

Why do individuals in the household sector develop products in their leisure time? Their motives clearly deviate from businesses. Table 2 provides an overview of how informal innovation in the household sector differs from the business sector.

Table 1. Differences between household and business innovation

	<i>Household innovation</i>	<i>Business innovation</i>
Dominant motives	Personal need, hedonic, helping	Commercial, sales, efficiency
Examples	Consumer innovation, open-source, Makers, hackers	New product development, R&D, technology licensing
Look and feel	Amateurish, but sometimes very novel	Professional, better designed and engineered
Embedded in	Consumer creative behaviors like DIY, tinkering	Business strategy, willingness to survive and/or grow
Dissemination	Free sharing, startups, business adoption	Sales, licensing, involuntary spillovers

Notes: overview based on de Jong & von Hippel (2022).

Citizens mostly innovate for non-commercial reasons

In the business sector, innovations are primarily developed for commercial reasons: to be sold as a product, to operate more efficiently (process innovations) or to facilitate the production of products (technological innovations). They eventually benefit from their innovation efforts when other organizations or people (customers) adopt their products or services (von Hippel, 2005). For this purpose, businesses develop products to bring to the market, perform R&D and sometimes license their technologies to other organizations.

In contrast, individuals in the household sector are usually not commercially motivated. They develop solutions to personal problems or challenges that otherwise remain unsolved, or that they cannot afford to buy. Alternatively, citizens may derive benefits from the innovation process itself, such as enjoyment, learning, or to help others fixing particular problems (Raasch and von Hippel, 2013). Hence, their innovation behavior can be self-rewarding and in many cases, does not require (any or broad) adoption by other people to be deemed successful (von Hippel, 2017). These different motives are not exclusive, however. As we will report later, some citizens innovate with commercial purposes in mind.

Informal innovations may look amateurish, but are sometimes very novel

To objective standards, the innovations that citizens develop in their leisure time are not as professional as business innovations. They typically look amateurish. Citizens develop rough prototypes that are good enough to solve a personal problem, to practice with learning new skills, to enjoy the art of tinkering, or to fix a challenge for a family member. In this context, there is no need for a perfectly designed product. Examples are cases A and B in Box 2.

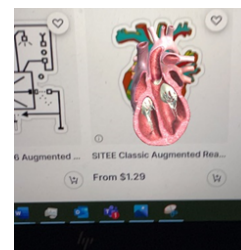
Box 2. Informal innovations enabling a novel function (A), cost-saving (B), or direct societal contribution (C)



A. Drone stand
(helps to show people that a drone's camera does not make intrusive images)



B. Bird feeder
(platform fits with plastic bottle, cheaper version of existing product)



C. Sisanda App universe
(employs VR in teaching when physical classroom models are inaccessible)

Notes: examples of informal innovations encountered in 26 interviews with South African citizens.

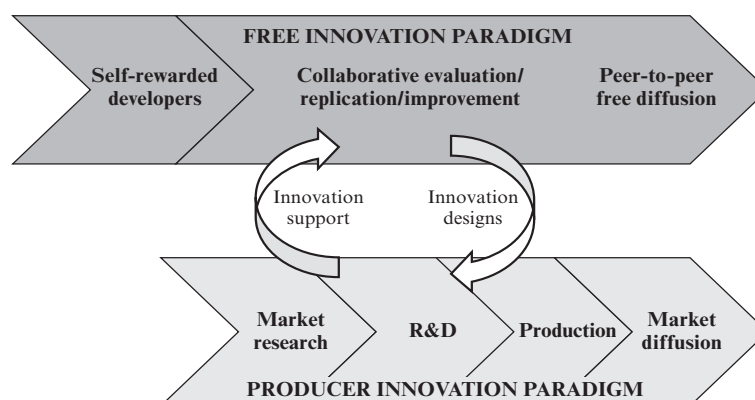
In contrast, business innovations should be reliable, safe to use, properly designed and operated smoothly – or no one would buy them. Business innovations demand more design and engineering: the overall development effort exceeds that of informal innovations. Businesses have advanced design and engineering skills and are more capable of developing innovations that meet professional standards (Riggs & von Hippel, 1994).

What makes informal innovations worthwhile is that citizens sometimes introduce novel functions that people could not do before (functional novelty, see case A in Box 2), or they enable performing a function at significantly lower cost (case B). Also, informal innovations sometimes contribute directly to UNDP's sustainable development goals (SDGs). For example, case C in Box 2 is an app developed by a citizen collective to deal with the shortage of teaching materials in many South African classrooms. The app employs virtual reality (VR) to demonstrate scientific and biological principles to students who lack access to physical models. Novel functions are the reason that informal innovations are often found at the edge of completely new product types and mark the birth of new industries (Shah & Tripsas, 2007). Informal innovations leverage citizens' perfect understanding of their personal needs (Riggs & von Hippel, 1994).

Informal innovation complements business innovation

Von Hippel (2017) explains that informal household innovation and business innovation complement each other (Figure 1). Informal innovations in the household sector are in principle freely available to anyone, as citizens barely protect their innovations. Commercial producers can take advantage by adopting informal innovations (to be marketed as commercial products) and by helping citizens to prototype innovations for themselves.

Figure 1. Informal household innovation and business innovation as complementary paradigms



Source: von Hippel (2017).

2.2. Informal innovation in South Africa

Informal innovation is common in basically any country

Applying the same survey procedure as we did in South Africa, researchers have observed that innovation in the household sector is an everyday phenomenon. At first glance the percentages reported in Table 2 seem modest, but each percentage represents hundreds of thousands to tens of millions of citizens innovating in their leisure time.

Table 2. Frequency of informal innovation by citizens, across ten countries

Country	Year of study	Frequency of informal innovation
Netherlands	2010	6.2%
United Kingdom	2009	6.1%
Canada	2013	5.6%
Finland	2012	5.4%
United States of America	2010	5.2%
United Arab Emirates	2017	4.9%
Japan	2011	3.7%
South Africa	2022	2.5%
China	2017	2.1%
South Korea	2014	1.5%

Notes: benchmark data are reported in de Jong & von Hippel (2022). Reported frequencies represent citizens aged 18 to 65 (Finland) or aged 18 and older (other countries).

In South Africa we find around one million informal innovators

Based on our representative sample of 1,096 citizens in South Africa (see appendix A for details), we estimate that 2.5% of the citizens aged 18+ developed an informal innovation in the past three years. Compared to the high income countries that have

been surveyed before, this percentage may be relatively low, but it is still within the common range. The explanation is that South Africa has a less educated, and less prosperous workforce. Education and income usually increase the frequency of informal innovation, because these are enablers of citizens' engagement in do-it-yourself activities for self-expression and in making creative use of their time (Mulhuijzen & de Jong, 2023). It is noteworthy that South Africa has a higher percentage compared to high-income countries like China and South Korea.

Nevertheless, 2.5% implies that *one million citizens* in South Africa are innovators. We feel that this is a substantial number. It has never been visible before this survey, because innovation in the household sector is not recorded in official surveys in any form. We can safely conclude that informal innovation is widespread in South Africa.

Informal innovation is embedded in home production and do-it-yourself behavior

Innovation by citizens is embedded in a broad range of creative behaviors: related to do-it-yourself (DIY), tinkering and the generation of online content (de Jong et al., 2021; Mulhuijzen & de Jong, 2023). In the past two decades, citizens in developed countries became increasingly empowered to do things themselves, based on the emergence of the Internet where instructions and tools are shared (e.g., YouTube videos explaining how things are built, CAD files on Thingiverse ready to be printed), and facilities such as Fab Labs (Fox, 2014). It is in this context that informal innovations are embedded (Table 3).

Table 3. Informal innovation by South African citizens embedded in other creative behaviors

Variable	Explanation: In the past three years, South African citizens used their leisure time to...	Percentage	Citizens
Modification	...copy, modify or improve an existing product	30.2%	12.1 mln
Creation	...create their own product	13.4%	5.4 mln
Innovation	...create their own product from scratch, while the product enabled a new function or significant cost-saving	2.5%	1.0 mln

Notes: percentages based on a survey of 1,096 South African citizens aged 18 and older.

We found that around 30% of South Africans modify or improve existing products – think of activities like home refurbishing and building adds-on to a car. This is generally known as ‘home production’ (Mulhuijzen & de Jong, 2023). Next, over 13% engaged in the self-creation of existing products, like building a chair from an online model – generally known as do-it-yourself behavior. Finally, 2.5% created an application with a novel function or that was a significant cost-saver; these we consider informal innovators.

2.3. A closer look at informal innovations

Many innovations are for children and education purposes

As in other countries, informal innovations relate to a range of objects (Table 4). In South Africa, we observe that many innovations are meant for children (e.g., toys, games) and in particular, are related to their education. We suspect this is due to the demographic composition of the country, with many younger citizens. Also, many parents are eager to have their offspring become as educated as possible, to be able to cope with (future) economic circumstances. Regardless of whether parents can afford private schooling, they seem eager to innovate in teaching materials and methods to support their children.

Table 4. Objects of informal innovation, and examples

Object	Frequency	Example responses
Household items	22%	<i>A much bigger sink outside the house for ceremonial events. I created it from an old iron tank, then put a hole for the pipe to transfer dirty water from it to the drain. At home we usually have ceremonies and the sink inside the house is too small.</i>
Transport/vehicle	5%	<i>A part to assist me with the realignment of my vehicle door, to get it perfectly straight.</i>
Tools/equipment	7%	<i>A tool to clean hard to reach places within the house. I was having difficulties getting to those places to clean so I needed a solution.</i>
Sports/hobby/entertainment	12%	<i>A device to assist with the hand and eye coordination of cricket players. I wanted to improve my own game and assist as a coach.</i>
children/education	36%	<i>A model to understand mathematics, so that my son could understand the concepts he was struggling with.</i>
Help/care/medical	10%	<i>I combined different oils and creams for a much better moisturizing lotion. I have sensitive skin and all products I have tried were unable to help me.</i>
Computer software	6%	<i>A program that stores our family pictures so that users can view the pictures by typing the date on which the picture was taken, to make it easier for family elders to access them.</i>
Other	2%	<i>A website that helps people get started in Bitcoin investing and trading. I felt many people did not know how to go about it, as it is confusing, and experts use big words.</i>
	100%	

Notes: percentages based on 210 South African informal innovation cases.

Innovations can also be service-related

Not all innovations are products or physical objects. Citizens collectively set up systems to avoid the cost of a commercial service, e.g., rotating childcare by working mothers in a neighborhood. Another example is innovative *stokvels*: societies to which members regularly contribute an agreed amount of money for some pre-defined purpose. In our interviews, we detected examples where citizens collectively saved on groceries by buying in bulk, or enabled future investments to set up businesses (Box 3)¹. Such innovations were especially found in low-income areas like townships.

Box 3. Behavioral innovations: related to collective saving schemes

¹ These kind of self-services are not reflected in the estimated 2.5% innovators in section 2.2. To date, researchers have not been able to develop suitable survey instruments for citizens' self-services.



Grocery stokvel
(saving scheme to buy groceries in bulk, executed annually in the expensive December period)



Business investment stokvel
(collective saving for future investments in business, e.g., buy land, equipment, transport vehicles)

Notes: examples of informal innovations encountered in 26 interviews with South African citizens.

Innovators are more often educated, prosperous, young, and business owners

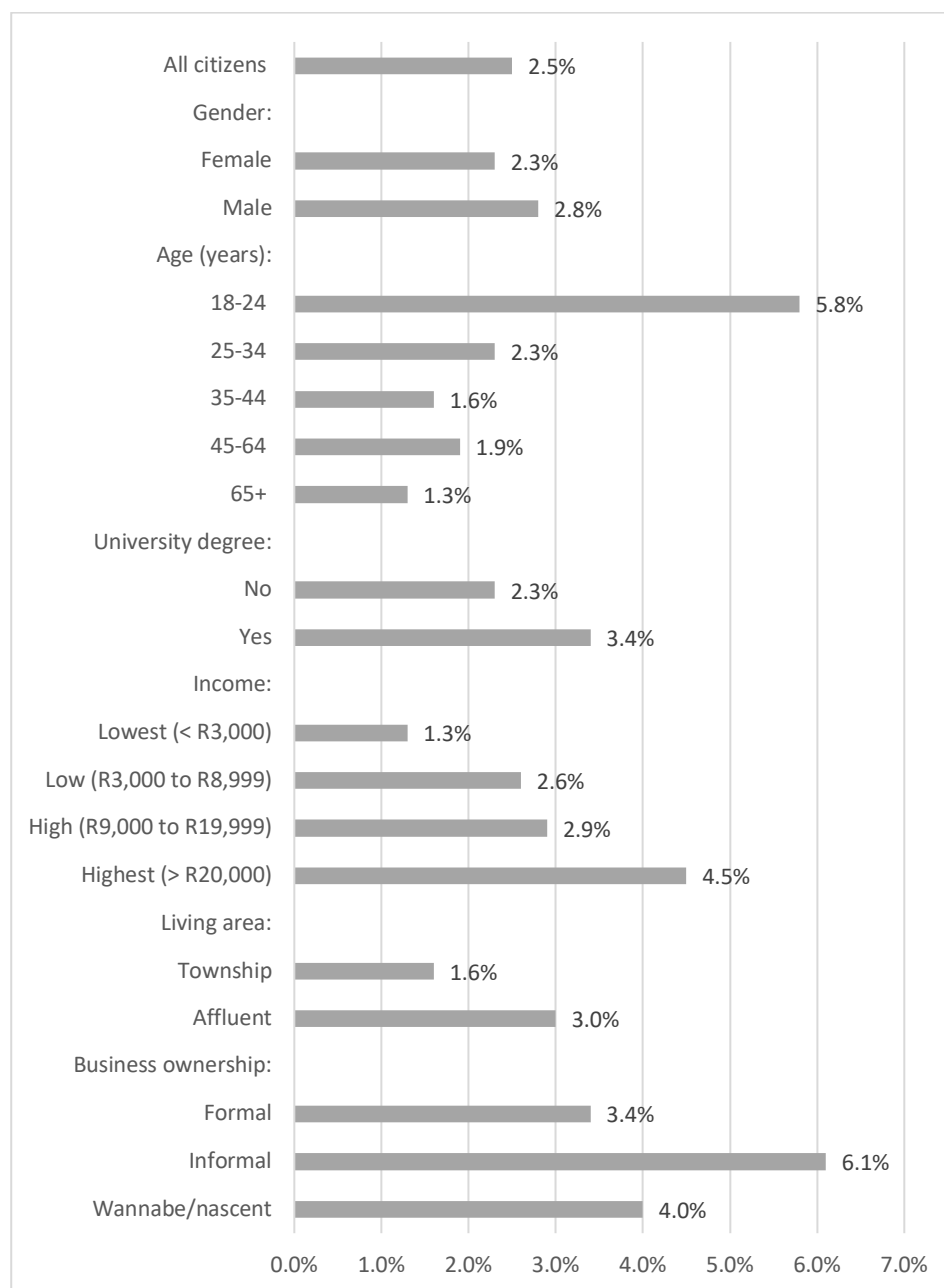
From surveys in other countries, we know that informal innovators have particular demographic characteristics. For example, in an absolute sense innovators are generally better educated and have higher incomes (Chen et al., 2020; Mulhuijzen & de Jong, 2023). Higher levels of education indicate better skills (e.g., design, engineering, tinkering), while income proxies' access to innovation resources (e.g., tools, materials) and eagerness for self-expression and personal development – to which innovation is instrumental. In South Africa, we find that these differences are confirmed (Figure 2). Given the role of education and income, it is also no surprise that in affluent regions, the percentage of innovators exceeds the frequency of innovation observed in townships (3.0% vs 1.6%).

Also, younger citizens (18 to 24 years) are more likely to be innovators (5.8% vs 2.5% on average), probably reflecting high eagerness to learn and to develop opportunities in this age category, while buying power is low (increasing the need to build products for themselves). We also assume that many younger citizens are still students, able to tap into their school's tools and infrastructure to develop innovations.

Next, business ownership is related to informal innovation emergence. Especially informal business owners (those making money with an unregistered business) are much more likely to have developed a household innovation in the past three years. Likewise, nascent business owners (those who are starting a business) are more likely innovators. As we will see later, some innovators start or use informal businesses to generate income. The reverse is also true: being a business owner indicates proactivity and taking charge, so business owners are more likely to innovate.

Finally, gender is barely related to informal innovation. Where in high income countries males were found to be more likely innovators (von Hippel et al., 2011), in more recent studies the gender difference was not significant. This also applies to South Africa: 2.3% of all females are estimated to be innovators, while 2.8% of males are innovators. In our survey this distinction was not significant; females were as likely to innovate in their leisure time.

Figure 2. Informal innovation across demographic variables



Notes: percentages based on survey of 1,096 South African citizens aged 18 and older.

Informal innovations are often developed with others

In all countries surveyed to date, the great majority of informal innovators develop their projects on their own, without the help of others. Perhaps surprisingly, in South Africa the frequency of collaboration exceeds other countries: around one out of three innovations is developed with the help of others (Table 5).

Table 5. Share of informal innovations developed with other people, across eight countries

Country	Year	Sample	Frequency
South Africa	2022	210 innovations	32.9%
Finland	2012	176 innovations	28.3%
United Arab Emirates	2017	125 innovations	26.4%
Canada	2013	539 innovations	16.7%
China	2017	185 innovations	11.9%
USA	2010	114 innovations	11.0%
United Kingdom	2009	104 innovations	10.3%
Japan	2011	83 innovations	8.0%

Notes: benchmark data are from de Jong & von Hippel (2022).

Depending on the context, the nature of innovation collaboration differs. In townships, collaborators are local members of the community, e.g., neighbors, family members and friends. We learned from our interviews that collaboration at the township level mostly arises due to lack of access to necessary tools or know-how to make their creations.

In affluent areas, collaboration is more often with strangers sharing a common interest. We observed that affluent innovators collaborate through Facebook groups, or online knowledge-sharing platforms like Thingiverse. Collaboration is not restricted to solving problems at hand, but also for the joint hedonic experience of exchanging thoughts with like-minded others.

In affluent areas, innovation tools are more advanced

The tools used by innovators in affluent and township areas are different and illustrate the difference in spaces of innovation. In affluent areas, where innovators are highly educated and prosperous, advanced technologies like 3D printing and CAD software are used. Innovators also consult online sources like global knowledge-sharing platforms like Thingiverse. In townships, it is more often basic tools like welding and sewing kits, or even household appliances like scissors and pliers. If there is any online sourcing for solution ideas, township innovators limit themselves to YouTube videos, or just ask around in their direct environment. For examples, see Box 4.

Box 4. Innovations developed with advanced (A) and basic tools (B)



Custom skeletal keyboard



Wire weeding tool

(3D printed keyboard base with electronics and keycaps all attached by the innovator. Completely modifiable, ergonomic)

(removes weeds from small, fragile plants. Unlike a hoe, it avoids damage to the plant. Built from stiff wire and rope)

Notes: examples of informal innovations encountered in 26 interviews with South African citizens.

2.4. Typology of informal innovators

Innovators can be users, participators, helpers, or vendors

As mentioned in section 2.1, informal innovators can be driven by personal need, hedonic reasons (enjoyment, learning), and a desire to help others. Beyond this, there are also innovators with commercial intentions. In other higher income countries, research indicates that commercially oriented innovators are rare: in Finland for example it was only 9% (von Hippel, 2017).

Based on cluster analysis, four types of informal innovators can be distinguished in South Africa, though usually a mix of motives applies: users (around 20% of all informal innovators), participators (35%), helpers (32%) and vendors (13%). See Table 6.

Table 6. Typology of informal innovators according to primary motive

	<i>User</i>	<i>Participator</i>	<i>Helper</i>	<i>Vendor</i>
Key motive:	necessity	enjoyment, learning	altruism, help others	sell, generate income
Fraction of innovators	~1/5	~1/3	~1/3	~1/7
<i>Motive:</i>				
Personal need	100%	63%	27%	52%
Enjoyment	0%	87%	66%	52%
Learn/develop skills	20%	77%	66%	59%
Help others	20%	0%	100%	59%
Commercial	0%	0%	0%	100%

Notes: percentage based on sample of 210 innovations by South African citizens aged 18 and over.

User innovators are driven by necessity

Users innovate to solve a problem that they face. Users are mostly concerned with innovations in household items, sports, hobby and entertainment products, and help, care and medical applications. Examples are shown in Box 5. In interviews in townships we encountered a female innovator who developed a cooking bag to preserve heat and save on her energy bill. It was also tailored to carry food across distances. Another example is a device to quickly remove feathers from a chicken – a time-saver. The device was manually operated and much cheaper compared to similar electronic devices.

Box 5. Innovations born out of necessity



Fireless cooking bag
(preserves heat, enables cooking, saves on energy bill)



Chicken plucker
(manually operated device to efficiently remove feathers)

Notes: examples of informal innovations encountered in 26 interviews with South African citizens.

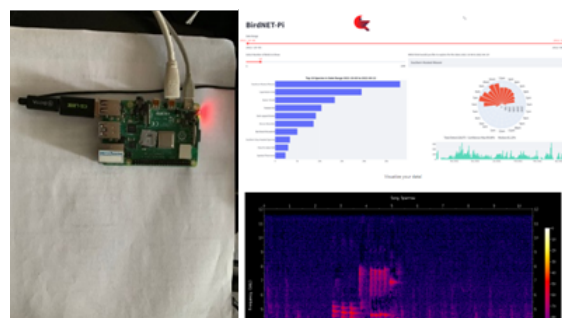
Participators enjoy the process of innovation and/or learn new skills

This type of innovator enjoys the benefits that come from developing innovations as such; they just consider innovation a good use of their time, or are eager to have some practice in order to develop their skills (e.g., furniture construction, Computer Aided Design (CAD) skills). Participators most often innovate on household items, and children/education-related products. While there is no strict requirement for them to personally use the innovation that they are developing, 63% of the participator innovators end up applying their creation in their personal life. Examples are in Box 6. In our interviews in affluent areas, one innovator created a device that enabled him to separate coffee grounds from their container, as he thought it was nice to reduce pollution. Another created an impressive device to record and process avian patterns – primarily a hobby and to learn.

Box 6. Innovations driven by process benefits



Dolce Gusto pod drainer
(separates coffee grounds from container, for environmentally friendly waste processing)



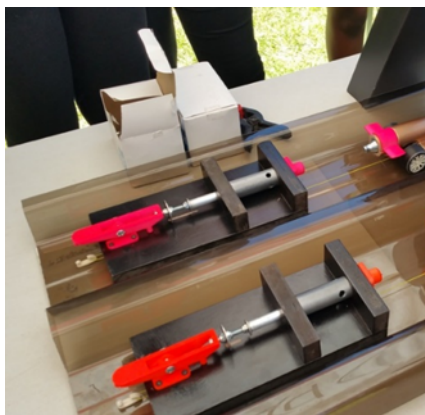
Bird Brain
(identification device that plots different avian patterns within a certain area)

Notes: examples of informal innovations encountered in 26 interviews with South African citizens.

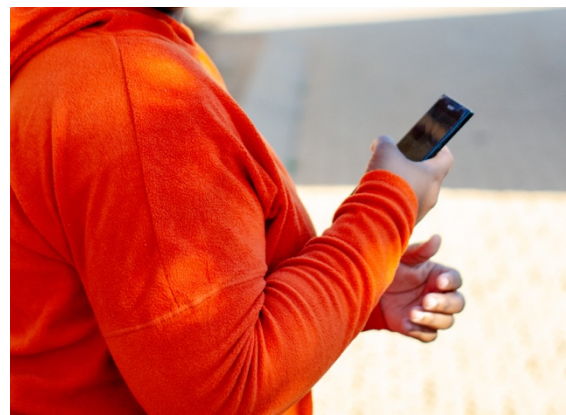
Helpers are obviously concerned with others

These innovators volunteer to solve challenges for people in their environment. Table 6 shows that many helpers also enjoy the innovation process, or developing new skills. Not surprisingly, helpers are dominantly concerned with things related to children and education. Sometimes they contribute to their community or address a societal problem. For example, we interviewed a father who volunteered for a project at his community's school. He designed a CO²-powered launcher for toy cars, to teach students about engineering. Another example was the app *Safe Home for Everyone*. It was developed by two female students to share knowledge and tools with women and girls facing gender-based violence (Box 7).

Box 7. Innovations to help other people



Dragster Launcher
(makeshift launcher for CO²-powered mini dragster cars)



Safe Home for Everyone
(mobile knowledge platform to cope with gender-based violence)

Notes: examples of informal innovations encountered in 26 interviews with South African citizens.

Vendors are commercially oriented, in parallel with other motives

The final type of innovator includes those who seek to generate income with their innovation. Vendors often innovate transport- and vehicle-related products, and – again – children- and education-related applications. Yet, their range of innovation objects is broad. In our township interviews, we encountered residents who developed a stoop and floor polish from leftover candle wax, enabling easy cleaning in dusty areas. Another example is a woman developing cross-shoulder bags, initially meant for small-scale traders in her environment who could use a light bag to carry their money (Box 8).

Commercial motivation is almost never the sole reason to innovate. Most vendors have other motives in parallel (Table 6). In the case of the stoop polish, the initial motivation was personal use, but the innovators soon learned that other people in their community wanted their polish too, so they started producing and selling it.



Stoop and floor polish
(easier to clean, tailored to dusty areas)



Cross-shoulder bags
(recycled materials, tailored to any purpose)

Notes: examples of informal innovations encountered in 26 interviews with South African citizens.

South Africa has many helpers and vendors

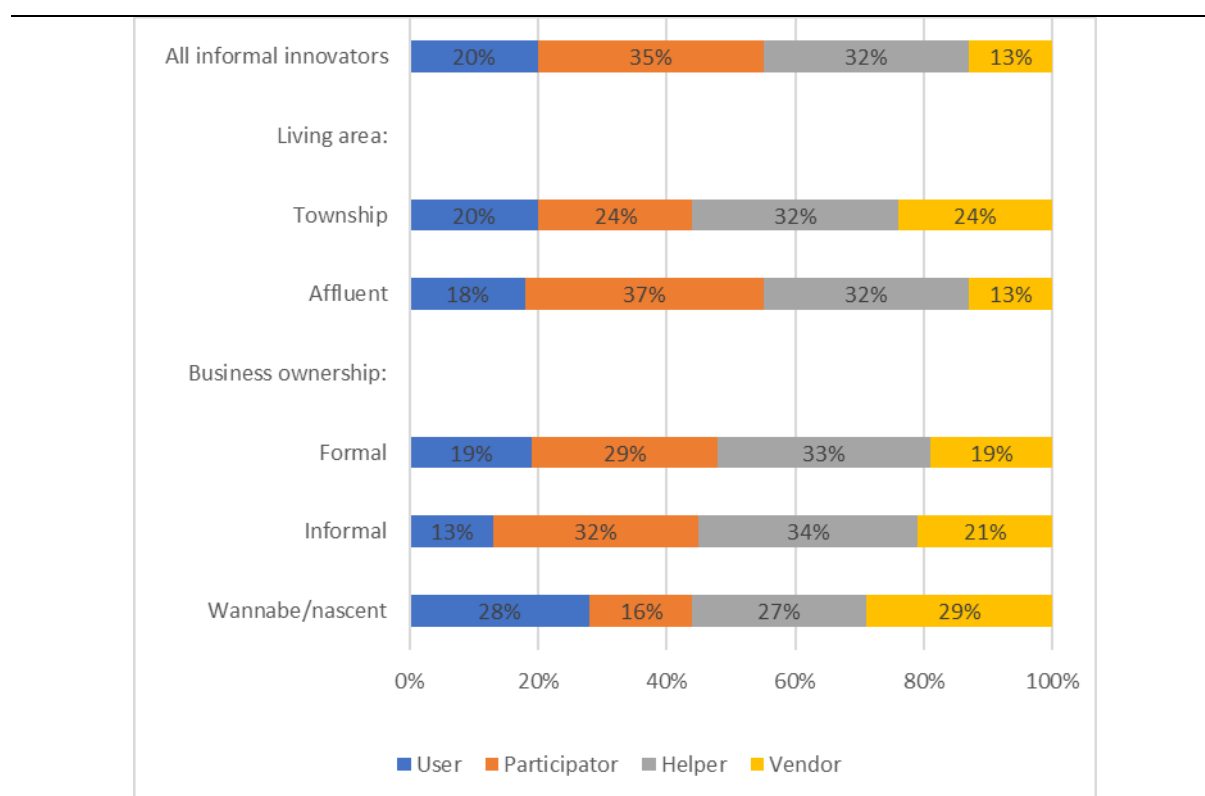
Compared to other countries, the fraction of helpers and vendors is high. For example, in Finland 11% of the innovators were helpers, and 9% were vendors (von Hippel, 2017) while in South Africa it is 32% and 13% (Table 6). In contrast, the fraction of users (20%) and participators (35%) is less than elsewhere (e.g., in Finland it was 37% and 43%).

We can conclude that in South Africa, informal innovators are more concerned with other people, either to help directly, or indirectly by selling their innovations as products. Likely, this is an implication of a stronger community culture (*ubuntu*), demographic composition (younger population, eager to impact others), and lack of economic opportunities in the business sector.

Township residents are more often vendors, compared to all South Africans

Looking at demographic variables, we found two characteristics that matter for the frequency of the four innovator types (Figure 3). In township areas we find a higher fraction of innovators with commercial intentions, seeking opportunities to generate (extra) income: 24% vs 13% for all South Africans. Township citizens are more directly concerned with solutions to problems they experience, or opportunities to make a living and generate extra income. Innovation linked to income opportunities can provide fundamental solutions to many challenges facing the poor, including creation of entrepreneurial avenues, employment and upliftment of standards of living. Amongst township residents, the fraction of participators is less (24%, vs 35% for all South Africans). This is reasonable given their difficult economic circumstances.

Figure 3. Distribution of innovative types across living areas and business ownership



Notes: percentages based on 210 informal innovators in South Africa

Another difference we observed is that business owners are more often of the vendor type. For formal and informal business owners the percentage of vendors is 19% and 21%, respectively. This is explainable, as it makes sense that entrepreneurs have more commercialization experience and focus. In our interviews we observed that business owners develop innovations that are unrelated to their existing business, but still, they may use their business as a vehicle to sell their emergent innovations. Amongst nascent entrepreneurs with informal innovations the vendor type is even more present: 29%. Here, we learned from our interviews that some informal innovators are in the process of starting new businesses to reap benefits from their innovation.

2.5. Dissemination to the benefit of others

Informal innovation has only limited impact if innovations do not become available to others. Without dissemination, every citizen facing the same problem has to undertake similar upfront efforts – a poor use of resources from a societal welfare perspective (von Hippel, 2005; 2017).

In other higher income countries it was repeatedly observed that diffusion of informal innovation ‘fails’ (de Jong et al., 2015). This is because innovators generally lack incentives to disseminate what they have done, especially when they are motivated by personal need or hedonic reasons (while in contrast for helpers and vendors, diffusion prospects are clearly better).

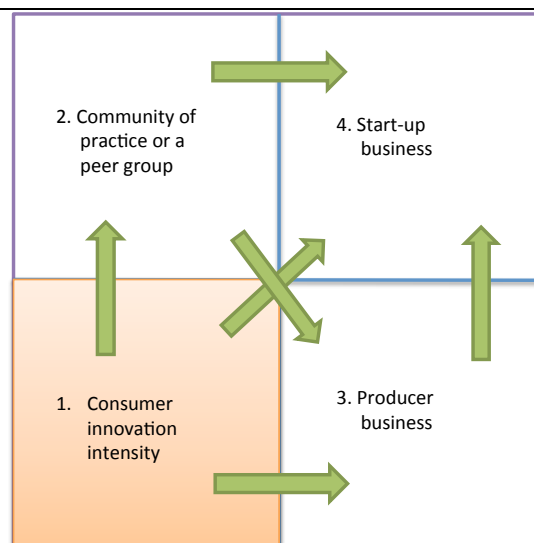
Shielding off innovations is rare in South Africa

Most informal innovators worldwide have no commercial interests, and as such, no reason to shield their innovations from other people. In South Africa, we found a similar pattern, as only one of the 26 people we interviewed had tried to protect his innovation with a patent. Even when innovators had commercial intentions, they did not engage in any modalities of knowledge appropriation (e.g., patent, copyright, trademark). In townships, lack of protection can be partly attributed to cultural proximity and shared cultural values, which the literature has suggested plays a part in shaping knowledge-sharing practices (Belete, 2018; Sheikh, 2014). For example, South Africans have cultural beliefs of 'ubuntu' where any idea or item of value is shared with family and members of a community. We also observed a lack of knowledge on how to protect innovations, and general beliefs that the created items were not so valuable that protection would be merited, or simply impossible to protect. In the absence of intellectual property rights, informal innovations are potentially available for anyone to adopt (von Hippel, 2017).

South African innovations disseminate relatively well

Lack of patent protection does NOT imply that innovations become broadly available. Dissemination requires an additional effort from the innovator. Researchers have identified three pathways to disseminate informal innovations (Figure 4).

Figure 4. Dissemination routes of informal innovations



Notes: Kuusisto et al. (2013).

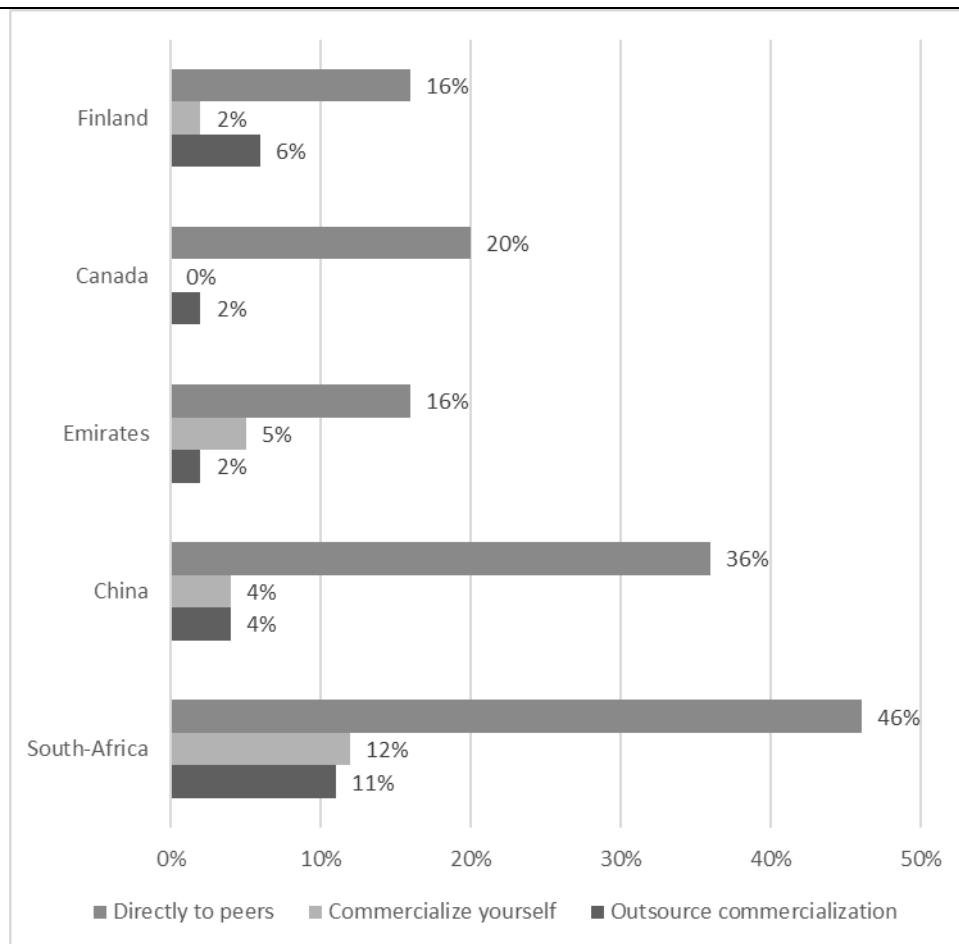
Innovations may disseminate:

- Directly to peers: the innovation is revealed to people to copy and use, without charge.
- Commercialize yourself: an innovator may start a new business to commercialize the product.
- Outsource commercialization: a producer adopts the innovation to sell as a product.

In South Africa, the dissemination of informal innovations is relatively good. In previous comparable surveys in higher income countries, the share of freely revealed

innovations was usually around 20% (slightly higher in China, with a culture revolving around strong family ties), while commercial diffusion by existing producers or in startups was rare. In South Africa, however, 46% of the informal innovations were reported to be adopted freely by peers (family, friends, neighbors, community members), while 11% and 12% were disseminated to producers or in startups, respectively. See Figure 5.

Figure 5. Dissemination of informal innovations, across five countries



Notes: Benchmark data are from de Jong & von Hippel (2022).

Given the differences in the types of innovators we reported previously, the numbers in Figure 5 are no surprise. South Africa has a larger fraction of helpers, to whom freely revealing innovations to peers is implicit. The country also has more innovators of the vendor type willing to generate income, a key route to diffusion.

Helpers and vendors reach broader diffusion, users and participators do not

Given their primary motivation, the four types of innovators differ in their efforts to disseminate their innovations. Helpers and vendors try hard. To accomplish dissemination, they also develop their innovations further so that people can adopt more easily (while users and participators are concerned with solving problems for themselves, and a rough prototype is enough). This is reflected in the share of innovations that disseminate: see Table 7.

Table 7. Dissemination across four types of informal innovators

	User	Participator	Helper	Vendor
<i>Dissemination accomplished:</i>				
Directly to peers	42%	28%	69%	41%
Commercialize yourself	10%	6%	11%	34%
Outsource commercialization	13%	3%	11%	31%
<i>Number of adopters:</i>				
At least one person	47%	30%	70%	59%
> 5 people	15%	11%	41%	59%
> 49 people	5%	1%	14%	17%

Notes: percentage based on sample of 210 innovations by South African citizens aged 18 and over.

As Table 7 shows, helpers are inclined to freely reveal their innovations so that their innovations disseminate directly to peers. In contrast, vendors pursue commercial pathways more often. Interestingly, helpers' innovations most often spread to a few others (e.g., 70% are adopted by at least one person), while vendors reach broader dissemination (i.e., the highest percentages of innovations that spread to more than five, or fifty people).

For users and participators, the dissemination rates are less favorable or even poor. This reflects users' and participators' lack of incentives to try. If adoption occurs, it is usually because other people accidentally observed the creation being used, and started asking for copies themselves. In the interview examples we already provided, this is what happened with the chicken plucker and cooking bag (Box 5), as well as the pod drainer (Box 6).

Dissemination does not differ much across demographic variables

Looking at the dissemination rates of innovations developed by demographic groups, differences are not significant (Table 8). Male, young and elder citizens reach better diffusion, but the differences are small.

Table 8. Dissemination across demographic variables and object of informal innovation

	Directly to peers	Commercialize yourself	Outsource commercialization
All citizens aged 18 and over	46%	12%	11%
<i>Gender:</i>			
female	44%	10%	10%
male	50%	15%	13%
<i>Age (years):</i>			
18-24	51%	14%	16%
25-34	42%	13%	13%
35-44	42%	10%	6%
45-64	53%	12%	9%
<i>University degree:</i>			
no	45%	10%	12%
yes	48%	17%	10%
<i>Innovation object:</i>			
household items	30%	6%	4%
transport/vehicle	55%	27%	46%

tools/equipment	43%	29%	21%
sports/hobby/entertainment	42%	15%	12%
children/education	52%	7%	7%
help/care/medical	57%	10%	10%
computer software	67%	33%	25%

Notes: percentage based on sample of 210 innovations by South African citizens aged 18 and over.

Interestingly, the kind of innovation object makes a bigger difference for dissemination. The differences between various innovation objects reflect the kind of innovations that are developed by users, participators, helpers and vendors, respectively. Household items diffuse poorly; these are mainly developed by users and participators. In contrast, transport- and vehicle-related innovations disseminate well across all channels; these are more often developed by helpers and vendors. As for children- and education-related innovations, these spread relatively well to peers, but not via commercial pathways.

A better job can be done at dissemination

While many South African informal innovations do spread, dissemination to improve general welfare can be improved. Users and participators lack diffusion incentives, and this calls for specific policy interventions (to be discussed in chapter 4). Likewise, vendors face specific challenges when trying to generate income in an informal business. If innovations diffuse, it is mostly within a local community. These challenges are elaborated upon in the upcoming chapters.

3. Informal business

3.1. Common insights about informality and business ownership

The informal sector is widespread, and important

The informal sector, also known as off-the-books, undeclared, shadow, cash-in-hand, or hidden sector, can be defined as the paid production and sale of products and services that are legitimate in all respects, besides the fact that they are unregistered, and in principle, invisible to public institutions (Williams & Nadin, 2010).

In high-income countries, the informal sector is relatively small. It is usually associated with business owners' tendencies to not play by the rulebook and with semi-illegal activities like having workers that are partially paid under the table. In lower income countries, however, the informal sector is often larger and generally accepted. For a long time, it was believed that the presence of an informal sector is a symptom of a 'backward' economy, that is supposed to vanish with economic growth. A more recent insight is that the informal sector is enduring, expanding, and an important condition to feed economic growth and development (Charmes, 2009). As we mentioned in our introduction, in sub-Saharan Africa, the informal sector represents around 74.5% of all non-agricultural employment and is a large reservoir of 'hidden' innovation (Kraemer-Mbula & Wunsch-Vincent, 2016).

Businesses may have good reasons to be informal

From a European or North American perspective, the existence of informal businesses is perhaps surprising: any serious business would register itself in the trade register, open a bank account, apply for a tax number, and maintain its financial records. If not, potential customers, suppliers and employees are likely to distrust the business, and avoid it. For this reason, the informal sector in high income economies is mainly restricted to small-scale transaction-based services like home cleaning, gardening, installation services, car mechanics, and personal care.

In lower income countries, however, informality is very common. Law enforcement is weaker and does not provide customers, suppliers and workers the same advantages as in developed countries. Also, the registration of a business can be burdensome (Williams et al., 2017). Another reason that informal businesses exist, is that many entrepreneurs apply risk-reduction strategies by combining employment with their emerging business first, and only later resign from their jobs to engage in full-fledged and formalized entrepreneurship (Williams & Nadin, 2010). In fact, in low-income countries, informal businesses that survive their initial period perform better than businesses that immediately comply with registration requirements (Williams et al., 2017).

Businesses vary in their degree of (in)formality

In line with Williams & Nadin (2010) we here define an informal business as one that participates in the paid production and sale of legitimate products or services that are unregistered and not visible to public authorities. In layman's terms, informal businesses are concerned with producing and selling regular products and services, but exclude criminal activities like theft, drugs and violence. Informal businesses are the kind of ventures that emerge from the household sector. Examples are street vendors and piece workers who (informally) employ others, but also home-based entrepreneurs using their private living areas to produce and sell goods and services (Mamayunusovna, 2017).

3.2. Informal business ownership in South Africa

Businesses can differ in their degree of formality; ranging from completely informal, to partially formal ('in-between'), to completely formal (Williams et al., 2016). In this survey, the degree of formality of a business was measured with four indicators:

- *Is officially registered.* An unregistered business is one not registered in the official trade register. This implies that the business is not visible to authorities as a legal entity.
- *Has a bank account.* When the business has its own bank account, it becomes more visible and legitimate in the eyes of outsiders. It leaves a footprint and can be traced – by authorities for example.
- *Pays annual taxes.* Paying taxes means that the business has a tax number and is visible to the corresponding authorities. Also, the business has sufficient volume to be regarded as a business, and not as a hobby project or nascent enterprise.
- *Keeps financial records.* The fourth indicator is whether the business keeps its financial records. Lack of complete formal accounts prevents the business from being separated from the other activities of its owners (Williams et al., 2016).

Based on these indicators, we distinguished three types of businesses in our survey: completely informal, in-between (has some but not all of the four indicators), and formal. This distinction reflects that some informal businesses remain permanently invisible, while others are in transition towards formality – in lower income countries, formalization is not a one-off event, but rather a journey or transition (Williams & Nadin, 2010). On top of this, to be regarded as a business we required that respondents generated a monthly income with their business, regardless of its size. Claimed businesses without income were excluded.

We find 2.5 million informal businesses, and another 2.4 million that are 'in-between'

As expected, informal businesses are a very common phenomenon in South Africa (Table 9). Based on our survey data we estimate that there are 2.5 million informal businesses in the country, and 2.4 million are in-between or partially formalized. The frequency of informal and partially formalized businesses is actually higher than the frequency of formalized business.

Table 9. Frequency of informal and formal business ownership

<i>Type</i>	<i>Description</i>	<i>Percentage</i>	<i>Number</i>
Informal	generates income with an informal business	6.2%	2.5 mln
In-between	generates income with partly formalized business	5.9%	2.4 mln
Formal	generates income with a formal business	<u>5.3%</u>	<u>2.1 mln</u>
Total	has business that generates any income	17.4%	7.0 mln

Notes: A formal business is registered, has a bank account, pays annual taxes and keeps its financial records. In-between businesses meet a subset of these criteria, and an informal business has none. Estimates are based on a survey of 1,096 South African citizens aged 18 and older.

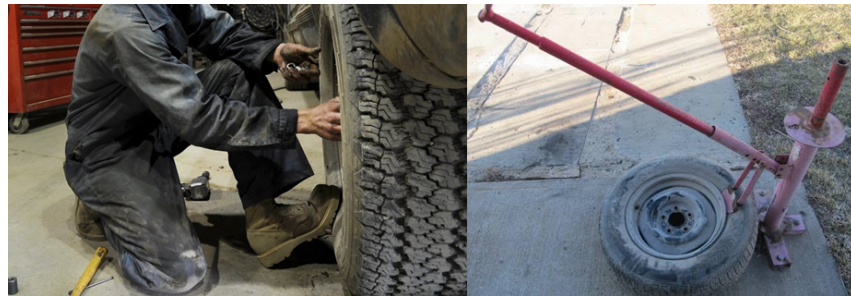
In Box 9 we provide examples of the three types of businesses that we encountered in our interviews. The first example is an informal entrepreneur selling cow head meat, pap and snacks by the roadside. Cow head meat is a delicacy and is especially valued by most cultural groups in Southern Africa. The business is not formalized in any way, as the entrepreneur sees no added value from doing so.

Box 9. Informal, in-between, and formal businesses

Informal business:
cooking and food
warming stand for
cow head meat and
pap



In-between business:
tire repair service
next to a taxi rank



Formal business:
podcast studio, with
three employees and
rotating staff



Notes: examples of informal innovations encountered in 26 interviews with South African citizens.

The second case is an ‘in-between’ business that started informally. The entrepreneur provides tire repair and replacement services to township residents, with mini-bus taxi drivers as his main target audience. This business is partially formalized to meet requirements of some customers (formal businesses themselves) that prefer the services of an organization that is registered.

The third example is a completely formalized business, that we encountered interviewing a business owner about his informal innovation (the bird feeder in Box 2). This business is a podcast studio in Johannesburg which serves a range of clientele. This type of business resembles the kind of businesses encountered in higher income countries.

Informal businesses are easily overlooked – also in the statistics

The existence of informal businesses implies that some populations, that are seen as lacking in entrepreneurial spirit, are more entrepreneurial than official statistics suggest (Williams & Nadin, 2010). Obviously, when businesses are unregistered and not visible to public authorities, it is hard to obtain estimates of their numbers. Informal businesses are at best partially recorded in official statistics. One example is the Global Entrepreneurship Monitor (GEM), the internationally leading source of entrepreneurship statistics based on annual surveys conducted in dozens of countries.

To illustrate, if we compare our estimates of informal business ownership (Table 9) with the most recently available GEM report for South Africa (Bowmaker-Falconer & Harrington, 2020), we find quite different percentages. In 2019, GEM South Africa reported that 3.7% of the adult population are new business owners (in business for less than 3.5 years), while 3.5% are established business owners. This sums up to 7.2% business ownership and is very different from the 17.4% we recorded in our survey. Acknowledging that both surveys rely on different questions and criteria, this comparison is only a ballpark estimate. Nevertheless, the frequency of business ownership seems easily twice the frequency that can be inferred from GEM data.

3.3. A closer look at the types of business ownership

In Table 10 a comparison is made on some key indicators that reflect the diverse nature of informal, in-between and formal businesses.

Formality increases with size of operations

Informal businesses are typically small. Only 11% of the informal business owners have employees. Almost all of these employees work without official contracts, or alternatively, they are family members that joined the business. Informal businesses generate on average R8,500 per month (USD \$455) – to South African standards, a modest income. Many informal businesses are supplemented with other activities, like piece jobs, a part-time job elsewhere, or household activities.

Table 10. Comparison of types of business ownership

	<i>Informal</i>	<i>In-between</i>	<i>Formal</i>
<i>Volume of the business:</i>			
Average monthly personal income from business (in Rand)	8,500 (USD\$445)	8,700 (USD\$456)	54,200 (USD\$2,480)
Business has employees	11%	37%	67%
Average total number of workers	0.3	1.4	10.8
<i>Types of customers:</i>			
Consumers (community)	68%	75%	62%
Consumers (other)	63%	71%	74%
Businesses (formal)	10%	19%	57%
Businesses (informal)	14%	25%	37%
Non-profit (government, NGOs)	3%	10%	31%
<i>Perceived growth barriers:</i>			
Access to finance	62%	63%	61%

Access to capital (e.g., equipment), resources or infrastructure	48%	53%	50%
Access to customers, lack of demand	47%	48%	48%
Business rules and regulations (e.g., licensing, permits, customs)	19%	29%	32%
Lack of good workforce	17%	22%	23%
Tax issues	8%	19%	21%
Legal issues (e.g., corruption, crime, theft, disorder, political instability)	6%	17%	22%

Notes: Estimates based on a survey of 1,096 South African citizens aged 18 and older.

In-between businesses are partially formalized – in other words, they fulfill some but not all of the four criteria (being officially registered, having a bank account, paying annual taxes, and keeping financial records). We observed in our interviews that formalization is mainly considered when it becomes ‘advantageous’. Sometimes a larger customer base can be served when the business is registered, or formalization enables doing business with the government. The business may also grow to a size where employees have to be recruited through official contracts, or where suppliers prefer and can only deliver if there is some standardization. Thirty-seven percent of the ‘in-between’ businesses have employees. Where in high income countries businesses are formalized at start-up, in South Africa (and probably other low-income countries) formalization revolves around the growth of the business.

Formal businesses are registered, pay annual taxes, have a bank account and keep their financial records. These businesses most closely resemble businesses observed in developed countries. Two out of three have employees; and they employ on average over 10 staff, mostly with formal contracts. Formal businesses generate a lot more income for their owners (average R54,200 (USD \$2,813) per month, as compared to the R8,500 (USD \$441) generated by informal businesses).

Informal businesses are in consumer markets, serving other businesses comes with formality

From Table 10 we can also see that informal businesses operate in different markets. They are mostly active in consumer markets, who can be members of the same community, or individuals in general. It is rare for informal business to serve other businesses and/or non-profit organizations. When the degree of formality increases, businesses are increasingly likely to (also) serve other formal businesses and public authorities. It could be assumed that entering or serving business-to-business markets triggers business owners to formalize in order to become legitimate trading partners.

All businesses face barriers, red tape is perceived more by formal businesses

Table 10 also shows that regardless of formalization, South African business owners perceive growth barriers related to finance, access to customers, resources (e.g., electricity, raw materials), infrastructure (e.g., land, vending places) and capital (machinery, equipment). This is partially due to the peculiarities of the South African economy. Loadshedding (i.e. scheduled power outages) due to electricity shortages, for example, is a common problem in the country. Likewise South Africa is geographically

distant from several higher income countries, which implies that importing advanced machinery and materials is relatively expensive and burdensome.

When it comes to growth barriers related to public institutions (red tape in taxes, permits, licenses, and corruption, etc.), then formal businesses experience more problems, while informal businesses obviously work around many of these by not being registered. Hence, formalization also comes with the downside of red tape, so informal businesses must have strong reasons to consider formalization.

Nonetheless, informal business owners are not free from barriers that prevent them from growth. Previously reported challenges of informal businesses include: limited access to markets, skills and financial resources, isolation from the broader innovation system, and limited access to government support (Kraemer-Mbula & Monaco, 2020). Our survey reveals that some of the usual suspect barriers (customer access, financial resources, infrastructure) are the most salient.

Informal businesses are more present in low-income groups

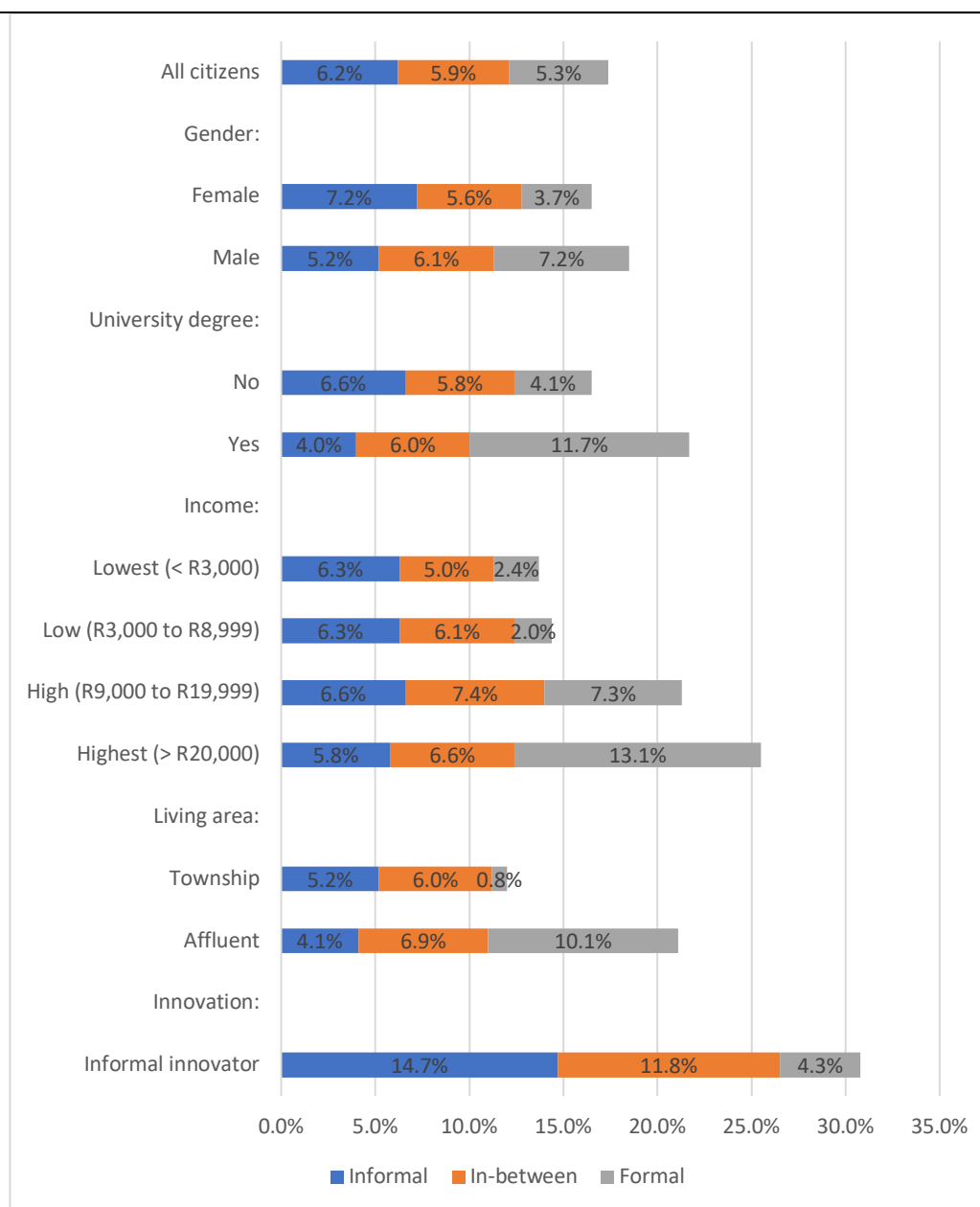
The frequency of business ownership varies with citizen's demographic characteristics, and likewise for the distribution across informal, in-between and formal businesses. See Figure 6.

In line with previous studies, we find that informal businesses are relatively important in under resourced areas and populations (Williams & Nadin, 2010; Williams et al., 2016). Women were found to start up their enterprises informally and continue to do so (Williams et al., 2016). Indeed, in our survey females are more likely to be informal business owners (7.2% vs 5.2% for males) and less likely in formal business (3.7% vs 7.2%).

People with low or average education (i.e., no university degree) are less often business owners, but if they are, they are inclined to run an informal or in-between business. Those with a university degree are predominantly running formalized businesses – this probably reflects the different kind of (B2B) markets in which they are active.

Obviously, income is related to frequency and distribution too. Figure 6 replicates earlier findings that completely informal businesses are clustered in low-income populations, while high-income populations tend to have formal businesses (Williams, 2009).

Figure 6. Types of business ownership across demographic variables



Notes: percentages based on survey of 1,096 South African citizens aged 18 and older

Township residents rarely run formal businesses

In township areas formal business ownership is nearly absent (0.8%, see Figure 6). Nearly all township businesses are informal or in-between. If we only considered formalized businesses, townships would barely have entrepreneurs, compared to the general population. Yet, in line with Williams & Nadin (2010), we find that townships are more enterprising than generally recognized, and that legitimizing informal entrepreneurship could be an important means of promoting enterprise and economic development.

Informal innovators are much more likely informal or in-between business owners

Last but not least, we find a very strong association between informal innovation and informal business ownership. In the general population, 6.2% and 5.9% are informal and in-between business owners. Amongst citizens who have developed informal innovations, the frequency of informal and in-between entrepreneurship is twice as high: 14.7% and 11.8%, respectively. The next section explains in detail how innovation and business ownership connect.

3.4. Relationship between informal innovation and business ownership

Two sides of a coin: informal innovation and business ownership are mutually related

In South Africa, informal innovation and business ownership are strongly related. Recall that in chapter 2, the conclusion is that business owners develop informal innovations more than average. Vice versa, in the previous section we found that informal innovators are more likely to run fully or partially informal businesses.

The relationship between informal innovation and business ownership works in both directions. From our interviews, we can make two important observations:

- First, informal innovation leads to the creation of new businesses.
- Second, existing business owners are more likely to innovate, from which other people benefit.

Observation 1: Informal innovation leads to (informal) new business development

We observed that in South Africa, when citizens engaged in informal innovation, they were more inclined to start informal businesses compared to non-innovators. This especially applied to innovators in difficult circumstances, that is, township interviewees.

These businesses start out as informal. Innovators first explore their environment and whether there is a commercial interest, then start producing and selling on a small scale from their own premises. With growing demand, the business expands: it finds new suppliers, hires uncontracted workers, and involves family members. In the examples we presented previously, this pattern applied to the cross-shoulder bags and floor polish (Box 8). Likewise, the creator of the chicken feather remover (Box 1) built a few copies of his device for people in his environment, charging a small fee.

Only later, when demand grows even further, is the business formalized – as the business requires more organization and expands its customer base to other areas. In this context, informality acts as a seedbed for the lower-risk experimentation and start-up entrepreneurship (Williams, 2009b; Kraemer-Mbula and Wunsch, 2016).

Innovations are sometimes process-related, enabling growth

As a side note, it is observed that informal innovations sometimes also help informal businesses to grow. Business owners then use their leisure time to develop process innovations that they apply in their business (examples in Box 9). One interview, with the owner of a food and cooking stand, was of interest because he had created a stove that was able to process large volumes of cow head meat, burn a range of materials including leftover wood and plastic, and was easy to carry. Likewise, in talking to the owner of a tire changing business, it was revealed he had developed an innovative tool to quickly remove tires from wheels by using manual force – existing devices were electrical, costly and not reliable given problems with public electricity supply. These innovations help the entrepreneurs to grow their businesses, and potentially take a step closer to formalization.

The link between informal innovation and new business emergence that was observed in South Africa is not new. Stebbins (2004) recognized that informal businesses are sometimes spin-offs from the informal entrepreneurs' employment, but alternatively, emerge from 'serious leisure' by which he meant the pursuit of an amateur, hobby or volunteer activity that participants find so substantial and interesting that they launch a business. Likewise, Shah and Tripsas (2007) coined the term 'user entrepreneurship' for individuals who innovated to solve a personal problem, but on second thought started a business to commercialize their solution after receiving signals from their environment about its market potential (e.g., community members asking for a copy).

Commercialization is hampered by down-to-earth challenges

Most business owners, when asked about their informal innovations, said they faced down-to-earth challenges, like lack of access to finance, vending spaces, basic supplies like electricity and costs required for importing materials or equipment. Also, the red tape that is expected when a business grows was mentioned. No one complained about access to scientific knowledge, challenges to collaborating on Research and Development (R&D) and access to highly educated workers, which are the usual innovation challenges mentioned in high income countries.

Observation 2: Existing (formal) business owners develop innovations for general benefit

Another observation is that compared to informal businesses, formal business owners are more likely to develop innovations that are unrelated to their business.

Our impression from the interviews was that successful formal business owners have particular personalities and competencies. These make them not only likely innovators, but also enable them to do a better job at dissemination by freely sharing their innovations. Formal business owners did not innovate for the sake of their business, but rather, they spent their leisure time voluntarily creating things for themselves and others:

- Some were eager to stay up to date with recent developments and enjoyed learning new skills such as CAD design and 3D printing (participator type). They

preferred to work on hobby projects that were also potentially useful to other people.

- Other business owners faced a personal problem/challenge (user type), or they volunteered to help people in their environment (helper type). They were running engineering, IT or design businesses, and they could easily apply their technical business skills to solve the problem/challenge.

Looking at the examples provided earlier on, the bird feeder (Box 2) was developed by the owner of a podcast studio who wanted to experiment and practice to learn new skills. The custom skeletal keyboard (Box 4) was created by an entrepreneur who needed the device for himself. He already possessed most of the required skills from his software business. The dragster launcher and platform Safe Home for Everyone (Box 7) were developed by owners of industrial design and software businesses, respectively. They voluntarily offered their skills to other people.

Our observation of formal business owners' inclination to innovate, even when it is unrelated to their commercial interests, is in line with academic findings that business owners have a high need for achievement, self-efficacy, innovativeness, stress tolerance, need for autonomy, and a proactive personality (Rauch et al., 2007).

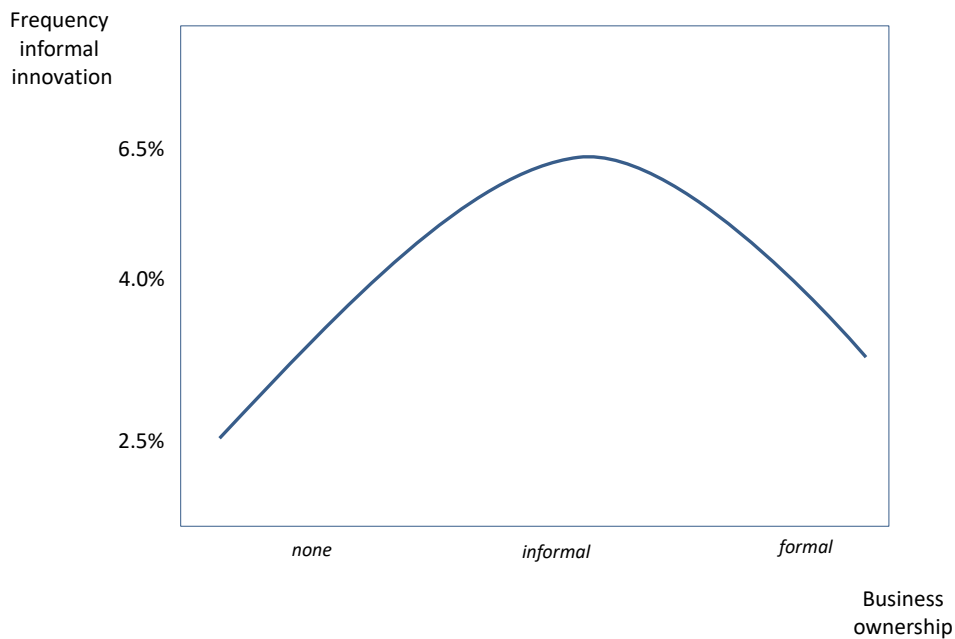
Business experience is helpful for dissemination

Interestingly, formal business owners did a much better job at disseminating their informal innovations to others, as did user or participator types. Their business experience gave them a good sense of how to design and document their creations to make adoption by other people easy. They also found it honorable if other people worked with their innovations, giving them a sense of achievement. For example, the bird feeder and skeletal keyboard were freely revealed on Thingiverse – an online platform for 3D printed innovations – and downloaded many times. Innovating business owners had professional experience in catering to the needs of other people, and were more willing to put effort into free revealing, with better dissemination rates as a result.

Relationship between business formalization and informal innovation is an inverted U

Figure 7 summarizes our insights about the relationship between the degree of business formalization and the frequency of informal innovation. The highest frequency for informal innovation is observed for informal business owners. As mentioned, their informal business is sometimes inspired by their innovation, and they are relatively often of the vendor type. Alternatively, their informal innovation is instrumental for the continued development of their business. These businesses are often found in low-income groups, such as in townships.

Figure 7. Relationship between types of business ownership and frequency of informal innovation



For formal business owners, the frequency of innovation is less but still higher than for non-entrepreneurs, and their innovations are usually unrelated to their business. In a sense, they resemble informal innovators who are not entrepreneurial, but their business experience makes them more likely to succeed at solving problems with innovation, and to accomplish better dissemination. Their businesses are more often located in affluent areas.

4. Ecosystem and policy

4.1 Priorities for policymaking

Policies should address dissemination incentives and commercialization barriers

From the previous chapters, we called attention to two reasons for policy intervention in innovation dissemination:

1. *Lack of incentives*. In total, 55% of the informal innovators in South Africa are of the user or participator type: they are driven by personal need (to use their innovation themselves) or hedonic motives (enjoyment, learning). These innovators lack strong incentives to disseminate their innovations. If diffusion occurs, it is usually only to people in their immediate environment. This 'diffusion failure' implies that other people cannot take advantage of the new functionalities or cost-saving potential embodied in their innovations. The lack of incentives justifies policies to facilitate the continued development of informal innovations and to lower the threshold to freely share innovations.
2. *Commercialization barriers*. The other 45% of the informal innovators are of the helper or vendor type; they assist other people in solving their problems or seek to generate income by commercializing their innovations. Instead of lacking diffusion, basic startup challenges (e.g., infrastructure, microfinance) hamper broad commercialization. Commercialization barriers justify policies to improve basic conditions for early-stage entrepreneurship.

4.2. Ecosystems approach

To develop an integral view of what policies for innovation and entrepreneurship look like, we use the concept of an ecosystems framework, which have become increasingly popular in the past decade. We first give a quick overview of the ecosystems literature, then discuss the ecosystem tailored to informal innovation and business development.

Ecosystems provide an integral framework for innovation policymaking

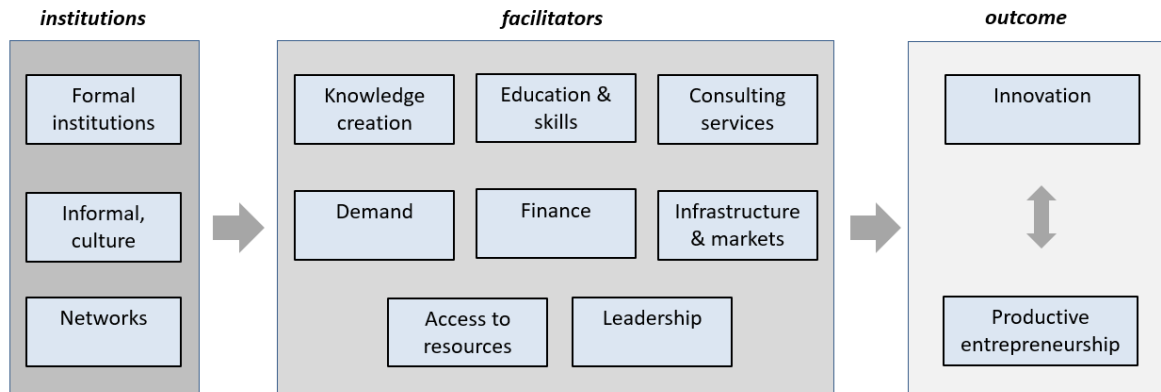
The ecosystems literature recognizes that innovation and entrepreneurship are the outcomes of a complex interplay between various factors with mutual relationships. In the business sector, two dominant ecosystem frameworks are:

1. the *national innovation system*, defined as all important economic, social, political, organizational, institutional and other factors, that influence the development, diffusion and use of innovations (Edquist & Hommen, 1999), and
2. the *entrepreneurial ecosystem*, defined as a loosely connected complex system of actors and factors that are governed in such a way to enable productive entrepreneurship within a particular territory (Stam, 2015).

The ecosystems literature explains the emergence of innovations and/or entrepreneurship as the outcome of factors like knowledge creation, human capital, finance, demand factors, infrastructure and markets, access to business resources, consulting services, leadership, institutions and networks. In practice, a range of ecosystems frameworks have been proposed that are tailored to specific purposes such

as innovation and productive entrepreneurship (e.g., Stam & Van de Ven, 2021; Edquist & Hommen, 1999; Lundvall, 1992). We summarized their insights in Figure 8.

Figure 8. Typical ecosystem for innovation and entrepreneurship in the business sector



Notes: this figure combines common factors in the literature on innovation systems (e.g., Edquist & Hommen, 1999) and entrepreneurial ecosystems (e.g., Stam & Van de Ven, 2021).

In a nutshell, innovations and entrepreneurship emerge from a system including facilitators like:

- Knowledge creation: The availability of new knowledge, generated by R&D activities of firms and public institutions.
- Education and skill development: The presence of human capital and, more broadly, the skillset and experience of a population – indicated by the level of education and investments in on-the-job training.
- Consulting services: The provision of services relevant for innovation, e.g., technology transfer, commercial information and legal advice.
- Demand factors: The potential demand for new products in society or the buying power that consumers and businesses have. This can be influenced positively by the creation of standards and public procurement procedures.
- Finance: The availability of finance for innovation processes and other activities that can facilitate the commercialization of knowledge and its adoption.
- Infrastructure and markets: All aspects of physical infrastructure (e.g., roads, railways, airports, internet) and product/market infrastructure (e.g., quality requirements for new products).
- Access to resources: The extent to which businesses have access to physical resources required for innovation and entrepreneurship, e.g., housing and materials.
- Leadership: The presence of actors that provide guidance for and direction to innovation and growth-oriented entrepreneurship; these actors can be singular persons but also organizations or private-public innovation partnerships.

Moreover, institutional factors play an indirect role:

- Formal institutions: Rules and regulations in a country that influence innovation and entrepreneurship processes. For example: intellectual property rights laws and tax laws.

- Informal institutions: The ‘unwritten rules’ of the game in society, like norms and values. For example: public appreciation of entrepreneurship as a career choice.
- Networks: The social context of the actors in an ecosystem and the information flows between them.
- Interactions between these factors (and their related actors) allow for specialization and co-creation of value (Adner and Kapoor, 2010). The synergy between these factors creates more value than would be generated separately (Holgersson et al., 2022).

Ecosystem frameworks explain the ratio of policy interventions

Ecosystem frameworks provide an integral overview of factors that matter for innovation or entrepreneurship at the level of an economy. This explains their popularity amongst policy makers. In practice, we can identify policy interventions for each ecosystem factor. Examples for the business sector are given in Table 11.

Table 11. Examples of policies for business innovation and entrepreneurship

<i>Ecosystem factor</i>	<i>Policy examples</i>
<i>Facilitators:</i>	
Knowledge creation	Tax credits for R&D
Education & skills	Subsidizing education/lifelong learning
Consulting services	Matchmaking & innovation support services
Demand	Public procurement of solutions and innovations
Finance	Tax reductions for start-ups
Infrastructure & markets	Internet access; standard setting processes
Access to resources	Business incubators; public guarantees for innovation investments
Leadership	Provision of (management) education
<i>Institutions:</i>	
Formal institutions	Patents/intellectual property rights
Informal institutions	Codes of conduct (e.g., transparency in recruitment procedures); entrepreneurship education
Networks	Subsidizing public-private innovation partnerships

Current ecosystem frameworks do not fit the informal sector

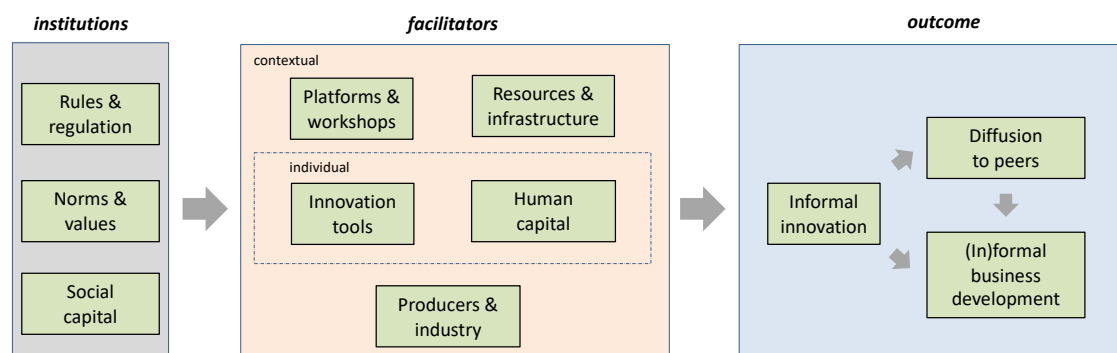
Existing ecosystem frameworks do not match the informal innovations and informal businesses that we encountered in South Africa, for few reasons. Unlike businesses, most informal innovators do not need incentives to engage in innovation. For most of them, the development of innovations is self-rewarding, or justified to solve a personal need. Instead, as we mentioned, informal innovators often lack incentives to *disseminate* (de Jong et al., 2015). Next, when it comes to commercial dissemination, their major challenges are issues like access to finance and optimal vending spaces. Informal innovators do not engage in R&D, nor do they work with business incubators or participate in public procurement procedures. As existing ecosystem frameworks barely apply, we developed a new ecosystem tailored to the informal sector.

4.3. Ecosystem for informal innovation and business development

Institutions and facilitators differ from business ecosystems

Based on extensive literature research and interviews with experts (appendix A, and documented in more detail in Mulhuijzen & de Jong, 2022), the ecosystem for informal innovation and business development includes outcomes, facilitators and institutions: see Figure 9. The overlap with formal business-oriented ecosystems is only partial.

Figure 9. Ecosystem for informal innovation and business development



Notes: based on Mulhuijzen & de Jong (2022).

The set of facilitators and institutions results in informal innovation. In turn, these innovations can be freely revealed or commercialized in a business. Free revealing can also be an intermediary step between innovation and commercialization (Shah & Tripsas, 2007; Kuusisto et al., 2013).

Individual facilitators: directly associated with innovation and dissemination success

Some facilitators are at the level of individual citizens or their intimate environment: human capital and innovation tools.

Innovation tools. People need tools, instruments, machines and devices to accomplish innovation tasks. This includes basic and advanced tools, ranging from toolboxes with hammers and scissors to CAD software, 3D printers and milling machines. Tools are first helpful to develop informal innovations as such. Next, they help innovators to develop more advanced solutions that are easy to disseminate. In the examples we discussed earlier on, the fuse holder (Box 1), drone stand (Box 2) and pod drainer (Box 6) could have been developed ‘quick and dirty’ by carving objects out of wood, or by folding metal parts. However, by using advanced tools like CAD software and 3D printers, dissemination became easier, as adopters now only require similar tools, not design skills. Especially in low-income areas (townships), such tools are missing, at the expense of dissemination.

Human capital. Central to a society's ability to develop and spread informal innovation are people's competences to innovate and to disseminate. This facilitator first includes education: level of education matters, as does education in a technical (for innovation) and commercial discipline (for dissemination) (von Hippel et al., 2011). Second, what matters is people's skills in tinkering and design (for innovation) and marketing, communication and organization (for dissemination). In our interviews, we found that owners of existing, formal businesses were more likely to innovate and also to freely reveal. This can be perfectly explained from a human capital perspective: those interviewees combined innovation and dissemination skills. Hence, relevant indicators of human capital are the level and type of education, experience in innovation/technical-related tasks, and experience in entrepreneurship, business and communication.

Contextual facilitators: create an environment where innovation and dissemination thrive

Other facilitators are in people's broader environment: platforms and workshops, resources and infrastructure, and producers and industry.

Platforms and workshops. Platforms are online knowledge repositories where informal innovators can find and share innovation-related information that is helpful in developing or disseminating innovations (Potts et al., 2021). Relevant types are 1. social media platforms (e.g., YouTube, Facebook) where enthusiasts can meet and share, 2. innovation platforms (e.g., Thingiverse, Instructables, Youmagine) where innovators can find CAD files, solutions and ideas and share their own innovations, 3. Sales platforms (e.g., Shapeways, CreativeMarket, Graphic River), where innovators can offer their innovations for sale, and 4. Funding platforms (e.g., Kickstarter, the People's Fund, Jumpstarter) where innovators can acquire micro-funding to support their informal business.

Workshops are physical spaces where innovators get access to advanced tools (e.g., 3D printers, milling machines, laser cutters) and can collaborate. The best known examples are Makerspaces and FabLabs. These spaces also play a role in commercialization, as innovators meet like-minded others and obtain dissemination advice and support (Halbinger, 2018). For people with limited incomes, such as those living in townships, workshops are generally harder to reach. Instead, the informal community enables them to lend or hire other people's tools. Access to workshops can even form the basis of a small/informal business.

Resources and infrastructure. Citizens have varied access to general resources useful for innovation and (commercial) dissemination: like houses with sufficient space to produce products for an informal business, suitable vending places in their neighborhood, and the availability of (micro)finance. In our township interviews, we noticed that many informal businesses leverage specific locations where lots of potential customers pass by. For example, the cow head meat business and the tire repair service (Box 9) were both located near a taxi rank where many customers (taxi drivers) were taking a break.

Infrastructure comprises both physical and online facilities. Roads, public transport and internet access come to mind first, but in South Africa additional infrastructure elements are lacking that are usually available in high income countries. For example, there is a shortage of electricity supply, causing many households to be shut off on a daily basis (known as 'loadshedding'). Informal businesses also face the challenge of finding production locations when they grow to the point where they leave the owner's house – land must be available, and this can be challenging when the business is embedded in a particular community (e.g., township).

Producers and industry. As discussed in section 2.1, informal innovation and business innovation are complementary paradigms (von Hippel, 2017). Formalized businesses may adopt the innovations that are developed in the household sector. Businesses develop improved versions, and bring these to the market for general sale (recall Figure 1).

For development and dissemination, it makes a big difference if firms in a country understand informal innovation and take action to benefit from it. Businesses can implement various methods to detect and help disseminate informal innovations. They may: a. organize crowdsourcing competitions to find promising innovation prototypes, b. provide toolkits to assist citizens in designing solutions for themselves, c. systematically search informal innovations with market potential by involving so-called lead users (who are ahead of important market trends and expect to receive substantial benefits from obtaining a solution), d. scrape the internet for promising designs that citizens shared online, and/or e. host knowledge-sharing platforms in their domain of interest (for a detailed discussion, see von Hippel, 2005; 2017). Awareness, and assistance of citizens with such tools and applications, greatly accelerates innovation development and dissemination.

Institutional factors: are remotely influential

Institutional factors are the formal and informal rules that organize social, political and economic relations (North, 1990). Institutional factors are reproduced through routine actions, often internalized and unconscious, but they shape people's behaviors in everyday life. Institutional factors also influence informal innovation and dissemination.

Rules and regulations. Formal institutions are the rules of the game in society as determined by regulators. These can incentivize or block the development of informal innovations and their dissemination. For example, in high income countries, one formal institution that has helped spread informal innovations is the Creative Commons license, which allows makers to be credited while allowing designs to be shared and adapted for free (von Hippel, 2005).

In our interviews with South African innovators, intellectual property rights were rarely used to appropriate value from innovations. Only one out of 26 interviewees had applied for a patent. When innovators had commercial intentions, they started an informal business that mainly served people in their immediate environment (e.g., the

examples shown in Box 8). None of them planned market entry at a scale that would justify the costs of acquiring and maintaining intellectual property rights. On top of that, in our township interviews, we learned that many innovators were completely unfamiliar with patents and trademarks. In contrast, interviewees in affluent areas repeatedly used Creative Commons licenses to share their innovations online – indicating that rules and regulations are meaningful but lack of awareness may create inequities.

Other formal institutions that affect dissemination of innovation are those related to business registration, dealing with tax authorities and in general, the red tape associated with formalizing a business in their country. Also, barriers mentioned in our interviews include high importing fees, red tape for getting specific specialized equipment into the country, or the geographic remoteness of South Africa.

Norms and values. Informal institutions are the unwritten rules of the game in society. This encompasses norms and values about (un)desired behavior and practices. For example, in South Africa, it is well accepted that informal businesses are legitimate ways of making a living, more so than in developed countries. In marginalised communities, social rules often encourage people to reciprocate the support received as part of a complex network of community support and solidarity (Kraemer-Mbula, 2016). Because of these social norms, it was observed that many informal innovators in townships freely shared their innovations (if they did not commercialize them). Examples are the fireless cooking bag (Box 5) and the weeder tool (Box 4).

In affluent areas, some informal innovators are operating in more dispersed communities, like enthusiasts with similar hobbies they met on the internet. These communities were governed by norms of openness, providing assistance and giving credit to the people on whose innovations one builds.

Social capital. Finally, what matters is the social context of the people in the ecosystem, and the information flows among them. Citizens are embedded in different kinds of networks – these can be small and large, composed of strong and weak ties, and individuals can take central positions, leverage contact and more. Some of the social capital embodied in networks can be instrumental in innovation and dissemination.

For interviewees in affluent areas (well-educated, high-income, prosperous), their innovation-related social capital was relatively formal and well-defined: for example, the members of the online knowledge-sharing platform Thingiverse, or in a Facebook group dedicated to innovating birdwatcher tools (recall Box 6). For people living in townships, innovation contacts were mainly local, with no clear-cut delimitations. For example, one township innovator stated that she was part of a group of people who meet regularly to discuss issues on how they can improve their livelihoods. Such a community is not directly related to innovation but provides a forum for the free sharing of ideas and innovations. In addition, such communities provide a ready market to those with creations that they may want to share.

Key difference with existing ecosystem frameworks: focus on individuals, not businesses

The added value of an ecosystem framework for informal innovation (Figure 9) is that it enables us to simultaneously consider all factors that are important for the development and dissemination of informal innovations, so that its societal benefits can be better reaped.

When we compare Figure 9 with Figure 8, the most salient difference is that key facilitators of informal innovation are concerned with individuals, not businesses. For example, it is individuals' competences and access to tools that matter, while factors such as leadership, access to scientific knowledge, and consulting services matter less, or not at all. From the perspective of informal innovation, existing businesses represent just one category of potential recipients of informal innovations (the 'producers and industry' box in Figure 9).

In contrast, classical innovation and entrepreneurship ecosystems revolve around the perspective of commercial businesses and public organizations that develop and diffuse innovations. In this literature, consumers are important too, but they are lumped together in the single box of 'demand' (see Figure 8). Of course, informal innovators may start informal businesses, and at some point they can be so successful that they become formalized and part of the business sector. By that time, the classical ecosystem depicted in Figure 8 becomes more relevant to the emerging business.

Again, informal innovation and business innovation are two complementary paradigms (von Hippel, 2017). Figure 1 in chapter 2 showed how both paradigms are related. The classical ecosystems in Figure 8 are relevant to the bottom arrow of the business innovation paradigm, while Figure 9 applies to the informal innovation arrow.

4.4. Policy implications

Policy makers should focus on creating practical opportunities for informal innovators

Informal innovators and their businesses do not benefit from R&D tax credits, public procurement procedures, venture capital or public-private-partnerships. Their everyday problems invite practical policies and investments. In Table 12 we offer initial directions, obtained from a review of the literature (see Mulhuijzen & de Jong, 2022), and inputs from our expert interviews (appendix A). These directions are certainly not exhaustive.

Table 12. Policy directions for informal innovation and (commercial) dissemination

<i>Ecosystem factor</i>	<i>Policy directions</i>
<i>Facilitators:</i>	
Human capital	Expand education in technical and commercial disciplines; expand opportunities for postgraduate training/lifelong learning; provide low-threshold facilities to develop skills (also to people without high levels of education, e.g., YouTube).
Innovation tools	Subsidize advanced innovation tools (e.g., CAD software, 3D printers); invest in and/or subsidize high diffusion of home computers and devices.

Platforms & workshops	Stimulate online platforms (to share and download, sell and buy, ask and receive help, donations or funding); subsidize Makerspaces and FabLabs (minor fees or Freemium model ² ; expand with commercialization services); facilitate lending equipment; subsidize community members who can be innovation skills mentors.
Resources & infrastructure	Secure/and or subsidize vending places; secure basic infrastructure (e.g., electricity) and internet access; stimulate infrastructures for micro-lending, especially for products ahead of existing demand.
Producers & industry	Educate existing firms about informal innovation; stimulate use of crowdsourcing, toolkits, lead user methods, firm-hosted innovation communities.
<i>Institutions:</i>	
Rules & regulation	Raise awareness on opportunities for informal innovators to obtain creative commons licenses; amplify grant permits to use public space for business; diminish red tape associated with formalizing businesses.
Norms & values	Promote creative citizen behavior (tinkering, DIY) in educational curricula; promote home-based forms of entrepreneurship; work with different role models to reach especially marginalized groups.
Social capital	Facilitate interaction between all actors in the informal innovation ecosystem through national innovation dialogues, events, and award ceremonies ³

How can these policy recommendations be implemented? Policies for informal innovation are still in their infancy (von Hippel, 2017; de Jong & von Hippel, 2022). In South Africa, we found innovative actors who are reaching low income groups and township innovators that fit the ecosystem framework well. The examples we describe below are meant as a first step towards a more complete overview – for many ecosystem factors, no proven policies are available yet. These institutions however, promise to support informal innovation and dissemination. As such, they should be engaged in an ecosystem dialogue.

Example 1: Asiye Etafuleni guards and stimulates informal economic spaces

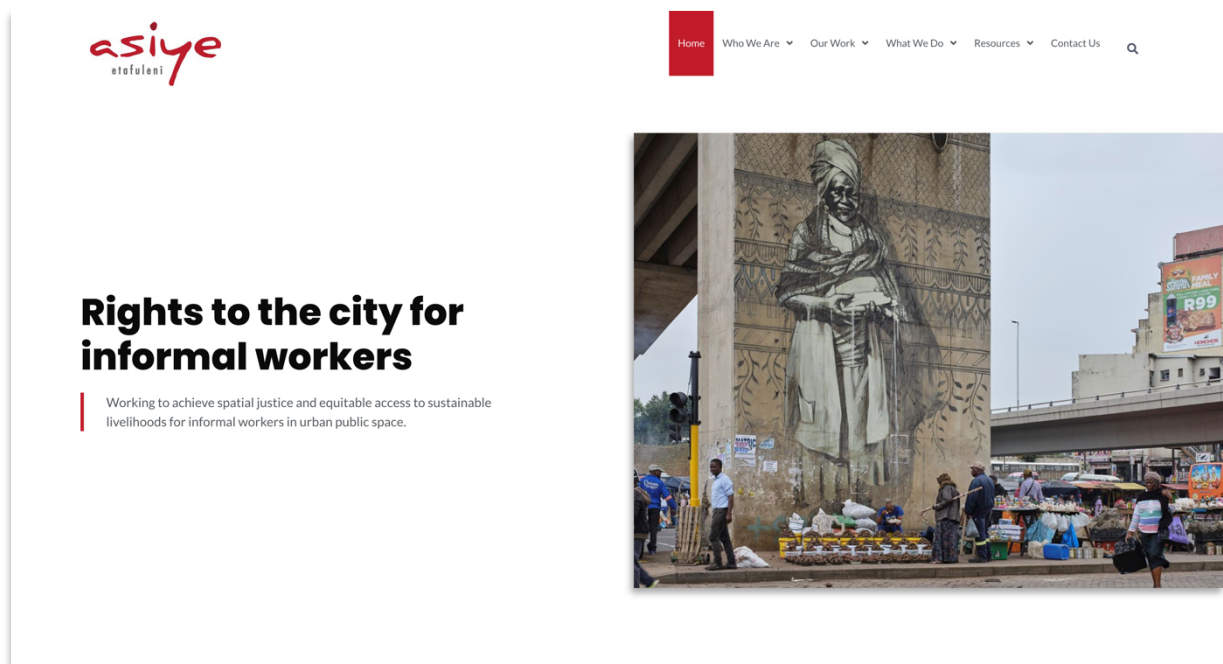
Asiye Etafuleni (AeT) is a non-governmental organization located in Durban, South Africa (Box 10). Its mission is to “achieve spatial justice and equitable access to sustainable livelihoods for informal workers in urban public space,” (aet.org.za/). Their activities include: ensuring that informal economic spaces, such as flea markets and street-side vending, are integrated in cities’ planning and budgeting priorities, securing urban environments that support the viability of informal businesses, and creating vibrant and culturally diverse spaces for the entire city. To accomplish this, AeT provides expertise and training to public authorities. It collaborates with informal businesses and professionals to develop inclusive urban spaces that support sustainable livelihoods.

AeT’s objectives are in line with the need for optimal vending spaces, which emerged in this research as a part of resources and infrastructure (See framework in Figure 9). Similar activities would help to implement a policy to move towards acknowledging and embracing informal business in cities’ public spaces. Our understanding is that AeT is

² Initial or basic use is free, pay for continued or advanced use/services.

³ For example, taking inspiration from the model of the Grassroots Innovation Augmentation Network in India

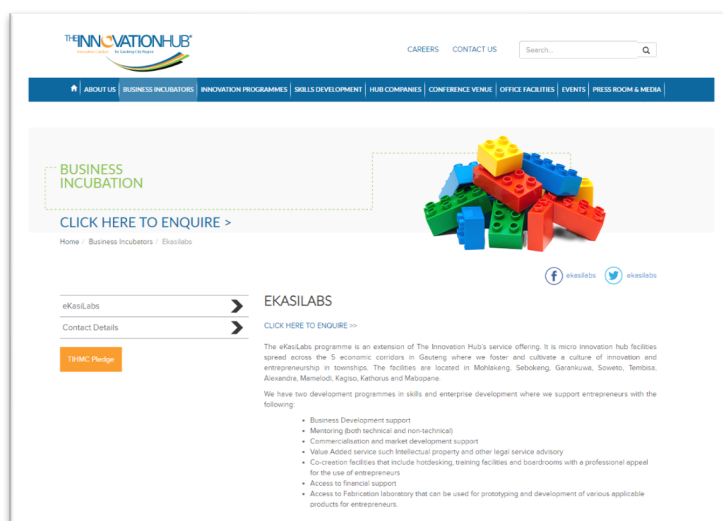
currently regionally oriented, but their line of thinking fits well with the challenges that informal innovators with commercial intentions face (especially when they lack resources) and is worth policy makers' attention.



Example 2: eKasiLabs provide innovative tools and business incubation services
The eKasiLabs program is initiated by the [Innovation Hub](#), which in turn, is subsidized by the local Gauteng provincial government (with corresponding geographical reach) (Box 11). eKasiLabs provides access for informal innovators to workplaces, technical and non-technical mentoring, prototyping tools, business incubating services and more.

In the context of our ecosystem framework (Figure 9), eKasiLabs corresponds with the provision of 'innovation tools' and 'platforms & workshops'. What sets eKasiLabs apart from many other Makerspaces is that it targets innovators in township areas and offers business incubation services that are helpful for accomplishing commercial dissemination. Currently, the kind of programs run by the Innovation Hub are not yet widespread throughout the country (South Africa's Gauteung area) and many rural areas, similar support is missing. Regardless, the kind of activities that eKasiLabs implements seem useful to support informal innovation development and commercial dissemination.

Box 11. eKasiLabs, initiated by Gauteung's Innovation Hub

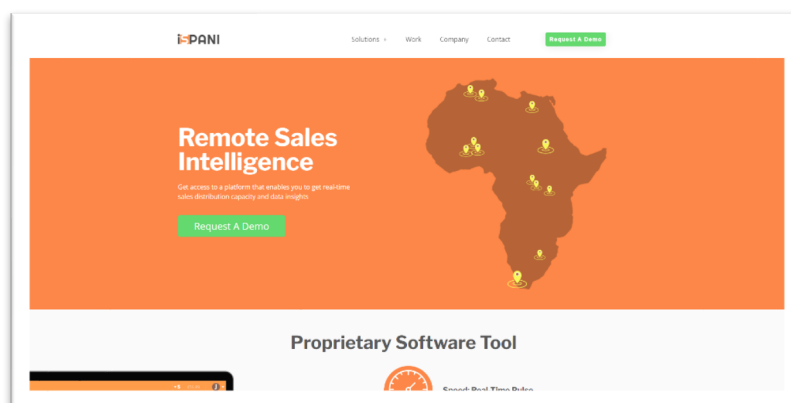


Example 3: IsPani funds for commercial dissemination, sponsored by existing large firms

The IsPani group is a social enterprise that works as an intermediary between citizens and existing firms (Box 12). Sponsored by large firms, IsPani provides funding and microloans to a network of so-called 'micro-entrepreneurs' who engage in various marketing research tasks (e.g., conducting interviews, snapping photos) using a cell phone app. Their collective insights are used by sponsoring firms. In return, participants receive micro-funding and learn entrepreneurship skills that they may deploy to disseminate their own innovations.

The example of IsPani group provides an example of how finance opportunities can enhance commercial dissemination. IsPani's activities correspond with the ecosystem factors 'resources and infrastructure' as it can be regarded as basic infrastructure for microfinance, and with 'human capital' as it helps citizens' to develop skills helpful for entrepreneurship. Policy makers should learn from such initiatives that enable learning on the job.

Box 12. IsPani, private intermediary between household innovators and industry



Example 4: Fibrepoint stimulates internet access for low income areas

Fibrepoint is a startup in Gauteng area, subsidized by the Technology Innovation Agency, an entity of South Africa's Department of Science and Innovation (www.fibrepoint.co.za/). Fibrepoint develops high-speed wireless internet antennas that should be accessible and affordable to all citizens of South Africa—including township citizens (Box 13).

The Fibrepoint initiative corresponds with the 'resources and infrastructure' box in our ecosystems framework. Their mission is particularly challenging given the problems in South Africa with electricity supply. Nevertheless, policy interventions to stimulate broad wireless Internet access would contribute to informal innovation development and dissemination.

Box 13. Fibrepoint, startup subsidized by Technology Innovation Agency to improve internet access



5. Conclusions

The informal innovation sector in South Africa is significant in scope and scale. Challenges associated with supporting informal innovation in the household sector and subsequent business development differ from those faced by the formal business sector. This study offers the following findings and recommendations about informal innovation and informal business :

Informal innovation

Many South Africans innovate in their leisure time. 2.5% of South Africa's citizens are innovators: they developed new products or applications in their leisure time during the past three years. Compared to other countries, the innovation frequency is similar in order of magnitude (the usual range varies from 1.5% to 6.2%), and is better than countries like South Korea and China. Compared to most countries the frequency is slightly lower, which is probably caused by lower education and income levels (both are well-known antecedents of informal innovation by citizens). Yet, 2.5% still represents around one million innovating citizens.

Younger people innovate a lot, and innovations are often related to children and education. Compared to other countries, we find that many citizens 18-24 years-of-age innovate: 5.8% versus 2.5% nationally. We also found no significant differences between males and females. Many informal innovations (36%) deal with applications for children and education. This again deviates from other countries and reflects South Africa's population pyramid with many youngsters and few elderly.

Innovations are developed with others and spread relatively well. Unlike high income countries, South Africans innovate a lot with the help of other people (33%, while collaboration percentages of 10% to 25% were common in other countries studied so far). Their innovations spread to other people relatively often: direct and free diffusion to peers is > 50% , while commercial diffusion is > 10% (in other countries these percentages are closer to 25% and 5%, respectively).

Motives for informal innovation are diverse: personal need, enjoyment, helping and commercial. Informal innovators can be users (driven by the necessity to use innovations themselves), participators (primarily motivated by enjoyment and opportunities to learn), helpers (developing solutions to help others' problems) or vendors (commercializing innovations to generate income). At the bottom-of-the-pyramid (poor, township residents, low educated) innovators are often users and vendors. Amongst the affluent, they are often participators and helpers.

Informal Business

Informal business ownership is common. We estimate that 2.5 million citizens run informal businesses that generate incomes (6.2%). These businesses come on top of formalized ventures (estimated 5.3% of the population) and businesses that are

partially formalized (5.9%). Informal businesses – and their innovations – are mostly undetected in statistics like the Global Entrepreneurship Monitor.

Marginalized groups are more likely to have informal businesses. We find that the frequency of informal business ownerships is particularly high amongst female, low-educated and township residents; compared to male, high-educated and people living in affluent areas. If we were able to include informal business ownership in official entrepreneurship statistics, the incidence rates of entrepreneurship for deprived groups would be higher.

Informal businesses face down-to-earth challenges. They are not hampered by access to scientific knowledge or high-end technology, nor by a lack of competences related to advanced managerial practices. Their challenges are related to microfinance, infrastructure (e.g., vending places and electricity), and access to resources, including basic tools.

Informal businesses only become formalized when it is 'advantageous'. For example, formalization occurs when the business grows, the variety of the customer base expands, the business develops activities for formalized businesses or governments, or formalization is required to secure key resources (e.g., permits, new locations).

The relationship between informal innovation and business

Informal innovation leads to informal new business development. Informal innovators are likely to become informal business owners: 14.7% have an informal business, while amongst all citizens, this is 6.2%. Especially at the bottom of the pyramid, people use informal ventures to generate (extra) income from their innovations. Informality then acts as a seedbed for the lower-risk experimentation and start-up entrepreneurship.

Existing formal business owners develop informal innovations for general benefit. They are likely to develop informal innovations that are unrelated to their business, but that will help other people. Compared to regular citizens, formal business owners have good technical, commercial and communication skills. These enable them to effectively disseminate their informal innovations freely. Prosperous formal business owners especially appreciate the impact they can make on others by disseminating their innovations.

Business ownership goes together with informal innovation. The relationship between the degree of formality of businesses, and the frequency of informal innovation, is an inverted U. Those without any type of business are least likely to be innovators. Those with an informal business are highly likely, while citizens who are running formal businesses are in the middle (less likely innovators than informal business owners, but more likely to be innovators compared to non-business owners).

Public policy

Policy should address dissemination incentives and commercialization barriers. We estimate that 55% of informal innovations are developed by South Africans who lack incentives to disseminate their innovations to the benefit of others (as they innovated

to solve a personal problem, have fun, or develop a new skill). Another 45% are developed by citizens facing barriers especially related to commercialization.

Measures differ from classical innovation policy instruments. The ecosystem in which informal innovations are developed and disseminated differs from the classical innovation and entrepreneurship ecosystem. What matters is people's competencies and access to tools, as well as environmental facilitators like platforms, workshops, general infrastructure and interactions with commercial businesses. Also, institutional factors related to rules and regulation, norms and values, and citizen networks play a role. A different ecosystem comes with different policy interventions.

Policy interventions address individuals more than businesses. A balanced policy mix is recommended to accommodate the challenges that individuals face when developing informal innovations and subsequently, businesses. Examples of policy interventions and initiatives in South Africa that already match with informal innovation are related to securing business locations, access to basic tooling and micro-finance, to name a few.

Appendix 1: Research methods

Our research included a survey, interviews, literature and desk research. What follows is a brief description, details are available from the corresponding author on request.

Survey

We surveyed 1,096 South Africans for population estimates of informal innovation and business ownership. We added a convenience sample of 951 citizens who were likely innovators and/or business owners, to deepen our insights about both phenomena.

Questionnaire. Topics covered in our survey are summarized in Table 13. Average response time was 10 minutes (range 4-18 minutes). We applied existing guidelines to measure informal innovation in the household sector, as has been done in other countries (e.g., United Kingdom, Finland, Emirates, and China) (de Jong, 2016; de Jong & von Hippel, 2022).

Table 13. Overview of the survey

Section	Main topics covered
Innovation frequency	<ul style="list-style-type: none"> Engagement in... <ul style="list-style-type: none"> ...do-it-yourself/modification... ...creation of own product or applications... ...creation of products or applications with functional novelty (innovations)... ...in the past three years Objects of innovation (categories: household items, transport and vehicles, tools and equipment, sports hobby and entertainment, children and education, health care and medical, computer software, other)
Innovation process	<ul style="list-style-type: none"> Motives to innovate (categories: personal need, enjoyment, learning, helping, commercial) Collaboration with others for innovation Expected general use value of innovations (commercial potential, novel functionality, time/money saving)
Diffusion of innovations	<ul style="list-style-type: none"> Effort to diffuse (directly to peers, by transferring commercialization to other people or businesses, or by starting a venture/personally commercializing the innovation) Accomplished diffusion (directly to peers, by transferring commercialization to other people or businesses, or by starting a venture/personally commercializing the innovation)
Business ownership	<ul style="list-style-type: none"> Scale of diffusion (number of adopters) Business ownership, either formal or informal Motivation for business ownership (categories: opportunity seeking, necessity, improvement compared to job) If innovator: uses business to commercialize innovation Personal income generated with the business (average Rand per month) Degree of informality of the business (indicators: registered, pays taxes, has bank account, keeps financial records) Number of employees (categories: total, fulltime, part-time, contracted, informal, co-working family members) Types of customers (consumers, community members, formal businesses, informal businesses, government/NGOs)

	<ul style="list-style-type: none"> • Perceived growth obstacles (customers, finance, capital/resources, workforce, rules/regulation, tax issues, legal issues) • Business' collaborators (consumers, community members, formal businesses, informal businesses, government/NGOs, education/training/incubator organizations)
Other	<ul style="list-style-type: none"> • Demographics (gender, age, race, province, living area) • Income and education • Employment/source of income (e.g., job, business, pension, social grants)

As for business ownership, our survey leveraged recent insights about the presence of informal businesses in developing economies (e.g., Williams, 2016; Kraemer-Mbula & Wunst-Vincent, 2016). We designed our questions to enable a comparison between formal and informal businesses based on key concepts as mentioned in Table 13.

Sample 1: broad and representative. We collaborated with AskAfrica, a market research company in Pretoria, South Africa. Two samples of data were collected. First, computer-assisted telephone surveys (CATI) were done to collect a broad sample of mature citizens (age 18+). In advance, soft quotas were applied to respondents' gender, age, education and living area to better assure representativity. AskAfrica contacted 3,877 citizens drawn from a database with national coverage. Of these, 1,096 participated in the survey (28%) while the other prospects refused, were cancelled because their quotas were reached, or did not answer after an initial appointment was made. AskAfrica supplied us with a table including South Africans' gender, age, education and income distribution. To obtain best possible population estimators, we weighted our data to completely represent the distribution of these variables (that are important antecedents of innovation and business ownership). Table 14 specifies our broad sample before and after weighing.

Table 14. Sample and population characteristics

	Sample (n=1,096)	Population / Sample after weighing
<i>Gender</i>		
Female	55%	51%
Male	45%	49%
<i>Education</i>		
No university degree	66%	83%
University degree	34%	17%
<i>Age (years)</i>		
18-24	6%	17%
25-34	36%	28%
35-44	24%	23%
45-64	26%	24%
65+	9%	9%
<i>Income</i>		
Less than R3,000	41%	24%
R3,000 to R8,999	20%	37%
R9,000 to R19,999	19%	18%
Above R20,000	20%	20%

Sample 2: likely innovators and business owners. We added a convenience sample of citizens who were likely to be innovative and/or business owners. This subsample helps us to expand the number of relevant cases to analyze the characteristics of informal innovations and businesses. For this purpose, AskAfrica invited a subset of their online panel of South Africans who regularly engaged in marketing research. Members of this panel are selective: they are generally younger people, proactive, open to experience, and up to date with the latest trends. AskAfrica contacted 7,041 of its online panel members, of whom 951 completed the survey (the others refused, did not meet the screening criteria (e.g., 18+ years old) or no longer fit with the soft quota that was applied to avoid overrepresentation of particular groups).

Analysis. Combining both samples, we identified 210 cases of informal innovation – people developing products or applications in their leisure time, that enabled them to perform a novel function, and that could not be done with an existing product available on the market (see de Jong, 2016, for a description for how household innovations are screened). We also identified 573 respondents who were owners of a business – they ran a formal or informal business that generated a personal income for them (businesses that did not generate income were regarded as nascent businesses and excluded from most of our analyses).

In summary, findings reported in this study are based on 1,096 respondents (population estimates of the frequency of innovation and business ownership – based on weighted data), 210 innovations (when we talk about the nature, process and diffusion of innovation – unweighted data) and 573 business owners (when we report about informality of businesses and related characteristics – unweighted data).

Interviews

In-depth interviews were done with 26 South Africans to more deeply investigate the nature, process and diffusion of informal innovation, and how these are related to any entrepreneurship behaviors. Most interviews were conducted in person, but some were done online.

Interview script. The interview script is summarized in Table 15. Prior to the interview we had identified whether an interviewee had developed an informal innovation – by searching the Internet or by observation.

Table 15. Interview script

A. Your innovation	1. What did you create? 2. Why did you create this innovation? (e.g., personal need, helping, learning, selling) 3. What is it that your innovation does for you? (e.g., novel function, cost-saving)
B. How you developed it	1. Did you work with others to create this innovation? With whom? How many? 2. What tools did you use? 3. How much time and money was spent? 4. Did you protect the thing you created? How? (e.g., patent, trademark) 1. What is the potential benefit of your innovation to other people? (if any)

C. Benefits to others	2. Did you try to make your innovation available to other people? (e.g., sharing for free) 3. Did you try to sell or trade it yourself? 4. Did another business (not owned by you) commercialize your innovation? 5. Do you know other people who are now using or working with your innovation?
D. Business ownership	1. Do you have a business, either formal or informal? 2. If yes: What kind of products/services? What kind of business is it? 3. If yes: What kind of value does your business generate? 4. If yes: Why did you start the business? 5. If relevant: Do you use your business to commercialize/spread your innovation?
E. Community and policy	1. Do you know any local communities that help with creating objects or (informal) businesses? If yes: what kind of members? What kind of support? Are you active yourself? 2. Can you think of facilitators and blockers of innovation? Which ones? What kind of policies do you recommend?
F. You	1. How have you been educated? In general, are you a tinkerer, do-it-yourselfer?

Interviewees. We aimed for a broad variety of the kinds of innovations developed. Accordingly, we selected interviewees in two extreme environments: townships (i.e., innovations developed by the poor and relatively uneducated) and makers (who are typically well-educated, with high incomes, and living in affluent areas). Township innovations were mostly found by direct observation and asking for referrals. We secured 11 interviews in the townships of Orange Farm and Soweto in the Johannesburg area. Maker innovations were primarily found online, in online knowledge-sharing platforms like Thingiverse, and on the websites of public and private makerspaces. Here we secured 15 interviews. An anonymized overview is in Table 16.

Table 16. Interviewees and innovations

Interviewee	Innovation	Date
M2	Platform Safe Home for Everyone	14-4-2022
M14	CO2 Dragster Launcher	26-4-2022
M15	Bird Feeder	10-5-2022
M19	Automotive Fuse Holder	12-5-2022
M31	Clothes Peg	19-5-2022
M32	BirdBrain	10-5-2022
M33	Drone Stand and Cover	12-4-2022
M41	Gas Bottle leveler	19-5-2022
M42	Dulce Gusto Pod drainer	18-4-2022
M43	NeoPixel ring Holder with strap holes	17-5-2022
M44	Wanhao D9 Spool holder	3-5-2022
M47	Parametric Hinge	21-5-2022
M51	Sisanda App Universe	20-5-2022
M52	Reusable Spool Hub	28-5-2022
M55	Custom Skeletal Keyboard	2-6-2022
T1	Chicken feather remover	26-4-2022
T2	Fireless cooking bag	23-4-2022
T3	Special purpose cooking stand	8-6-2022
T5	Rainwater harvester	29-5-2022
T7	Grocery stokvel	7-5-2022
T9	Rotating child care	7-5-2022
T10	Investment stokvel	2-5-2022

T12	Wire weeder tool	3-5-2022
T14	Tire changer tool	4-5-2022
T15	Light cross-shoulder bag	16-5-2022
T16	Stoop and floor polish	17-5-2022

Notes: * interviewees were found online on knowledge-sharing platforms (M) or in townships (T).

Analysis. The average interview time was 70 minutes (range 45-90 minutes). We immediately processed the interviews into full case reports. Where we had expected stark contrasts, township and maker innovations appeared to have many things in common – both followed the innovation process and diffusion patterns that we describe in this report. We did find that township innovations were developed more often for personal needs and commercial motives, while maker innovations were relatively hedonic and built to help other people. Also, in townships, we found a stronger correlation between informal innovation and informal business ownership.

Literature and desk research

Finally, we took a dive into the academic literature relevant to informal innovation and business ownership, especially to develop the ecosystem framework presented in this report. We started with insights from the existing literatures on national innovation systems, ecosystems for innovation, and entrepreneurial ecosystems. To identify relevant ecosystem elements, we used insights from the literatures on household sector innovation, open and user innovation, sustainable/grassroots innovation, makers and maker entrepreneurship, informal business, do-it-yourself and consumer tinkering.

To identify policy practices and examples, we also studied a range of policy reports, and asked the UNDP Accelerator Labs to come up with examples that they have observed in their countries. A full reference list of our literature and desk research is in Appendix 2.

Finally, we did online interviews with eleven experts in informal innovation, informal business and/or ecosystems, for feedback on initial versions of the framework presented in this report (Table 17). This also helped us to identify missing literature and think through policy implications.

Table 17. Expert interviewees

<i>Interviewee</i>	<i>Name</i>	<i>Affiliation</i>
1	Carliss Baldwin	Harvard Business School
2	Jason Potts	RMIT University
3	Katherine Strandburg	NYU
4	Erik Stam	Utrecht University
5	Shtefi Mladenovska	WU Vienna
6	Mziwandile Madikizela	UNDP / Government of South Africa
7	Evan Jacobs	UNDP
8	Phumlani Nkontwana	University of Stellenbosch
9	Prince Nwadeyi	Private company in Johannesburg
10	Geci Karuri-Sebina	University of the Witwatersrand Johannesburg
11	Bonakele Kunene	Government of South Africa

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