



# Towards an Alternative Assessment of Innovation in Africa

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## Abstract

This background paper is drafted with the purpose of revisiting the literature on innovation in general, and in Africa in particular, in an attempt to expand the existing definitions and metrics that capture them. We argue that there are several dimensions to innovation that are not being fully captured by conventional innovation metrics. **We highlight the complex interactions of formal and informal innovation activities within the spectrum of the formal and informal sectors. Such combinations bring up four main scopes in which innovation occurs in the developing world: informal innovation in the informal sector, informal innovation in the formal sector, formal innovation in the formal sector and formal innovation in the informal sector.** Developing countries, more specifically, African countries, are characterized by a significant informal sector, which encompasses widespread unmeasured innovation. We also complement conventional indices by proposing components of an index of innovation activities, which would capture the aspects of innovation that our previous research in Africa has highlighted. These are collaboration, human capital development, and knowledge governance, all of which take place formally and informally in both the formal and informal sectors.

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## Keywords

Innovation, Metrics, Informal Economy, Africa, Development, Intellectual Property, Traditional Knowledge

## Executive Summary

This paper reviews current definitions of innovation, as well as attempts and models of measuring innovation in different contexts. We present key works in innovation literature that point to process and product innovation as the essential constituents of innovation. We review both the macro and micro indicators that attempt to measure innovation, and argue that both approaches do not capture the full extent of innovation that is occurring in the contexts of the developing world – the continent of Africa in this case.

Our first goal is to identify measurement tools that build upon new grounded theories about knowledge and innovation developed by the Open African Innovation Research network (Open AIR), which might be generally useful for anyone conducting research on innovation in Africa. Our second goal is to prepare a concrete framework that can be used in our own specific situational analyses of on-the-ground practices of African innovators. Therefore, we end by outlining a way forward, with specific recommendations for further research to implement our proposed measurement agenda.

Macro indicators of innovation include the Global Innovation Index (GII) and the innovation component of the Knowledge Assessment Methodology (KAM). Both measures look at national statistics and use a common yardstick to assess individual country innovation performance. One critique some scholars have put forth of macro indicators is that they miss capturing incremental innovation, sectoral innovation, user innovation and the social impacts of innovation – elements that need to be captured because of the differing and dynamic nature of the concept of innovation, coupled with the fact that African economies lag behind other emerging and advanced economies in their development cycle. This means that the dominant indices are inherently tailored to highlight the innovative achievements of advanced economies, while understating those of less developed economies.

Micro indicators focus on innovation assessment conducted at the firm level, and attempt to standardize innovation measures for the purposes of comparative cross-country/sector analyses and policy implications. The Oslo Manual is the most recognized among these indicators, but there are also others. A critique of these measures is that, not unlike macro indices, they are more focused on formal means of innovation such as research and development (R&D) expenditures than on informal

means such as informal learning, learning on the job and apprenticeships. Further, these measures value the standardization of innovation through formal intellectual property processes, often in contexts where intellectual property (IP) rights and processes are not fully developed or even relevant to the local environment. In surveying and presenting global definitions and metrics of innovation, this paper reveals gaps in the current understanding and measurement of innovation in developing economies, such as those in the African continent.

Specific examples of innovations that fall outside the boundaries of established definitions and metrics include products and processes that are developed and modified through the feedback and engagement of users. Additionally, innovations that are not typically commercialized by firms may go unnoticed by some current measures. Social innovation is an entire field of activity occurring in both commercial and non-commercial contexts, with innovation directly responding to social needs, but not always accounted for in orthodox measures. Soft innovation occurs in the creative industries and is the ethos of fields such as arts and culture, and is also not currently accounted for in most measures of innovation. Finally, collaborative innovation points to processes, products and services that emerge at the intersections of collaboration among multiple players and as an outcome of different forms of engagement, all of which are not always captured in global indices thus far, henceforth termed “conventional” indices. These examples challenge the strict definition of single-party innovation that goes towards appropriating intellectual property.

In the paper, we review innovation-specific indicators that have already pushed the boundaries of traditional measures. Examples are indicators that attempt to capture innovation in the informal sector, user innovation, social innovation as well as efforts at capturing aspects of collaborative innovation. We build on this work in moving forward to devise a **new grounded theory** and associated measures of innovation in the African context.

Generally, there is a need to expand the measurement of innovation and its link to macroeconomic performance. Surveys need to be restructured to capture a broader and non-conventional view of innovation, linking it to economic growth. It is also important to focus on a wider view of innovation that incorporates knowledge domains beyond science, engineering and technology, paying more attention to innovation metrics that capture spontaneous, process-based, and needs-driven innovations occurring on the demand-side of the economy. This is particularly important in instances where innovation processes are driven by end beneficiaries rather than researchers, something that has been on the rise in Africa. Furthermore, there is a need to invest more time and detailed study, using high quality and comprehensive data infrastructure, to better capture both the determinants and impacts of innovation.

Specifically, in the context of our research with Open AIR, we make recommendations for moving forward to develop a sharper lens that zooms in on innovation at the micro level to capture a more accurate reflection of Africa’s innovation reality. First, acknowledging previous research on assessing innovation in the informal sector, there is need to widen the definition of informality to go beyond the informal sector to incorporate informal operations occurring in the formal sector as well.

Examples are collaboration and knowledge-sharing within formal technology hubs and related institutions. Most importantly, there is a need to widen the definition of innovation inputs and

outputs, redefine their existing components, and incorporate additional ones, all of which organically spring up from African realities. For example, there is a need to incorporate apprenticeship, and learning by doing, in looking at human skill development. We need to consider the value of informal collaboration, rather than formal interactions between firms. Alternative forms of knowledge governance, appropriation and sharing should also be considered alongside conventional commercialization and intellectual property protection. The starting point, therefore, is to assess unmeasured innovation through two different entry points. On the input side, we use an appropriate lens to properly assess the roles played in innovation by collaboration and by human capital development, and on the output side, we capture how knowledge embedded in innovation is governed, i.e., appropriated and capitalized upon.

Based on this, and in light of our previous research within the Open African Innovation Research network, we propose studying three pillars of innovation that exist on both the input and output side of the innovation process: **1. collaboration, 2. human capital development, and 3. knowledge governance**. In all three, our hypothesis is that significant innovation takes place in Africa— in modes that are collaborative and based on openness, sharing, and a wealth of skills development—and that most or all of these innovation elements go unmeasured. Details follow.

First, we probe **collaboration**, searching for proxies that assess the innovation linkages, interactions, and sources of knowledge within and between different communities and users, as well as with universities and large firms.

Second, on the **human capital development** front, the means of human capital development in Africa are not limited to formal education and training systems. Other means of accumulating knowledge include, but are not limited to: learning by doing, learning by using, learning on the job and apprenticeship. While the role of formal educational and training institutions remains pertinent, it is equally important to capture these other forms of knowledge acquisition, keeping in mind Indigenous learning and tacit flows of knowledge. This pillar will measure the comparative difference between formal and informal training in terms of their contribution to innovation.

Third, in respect of **knowledge governance**, we set out to explore alternative forms of knowledge governance in Africa, and pose the hypothesis that a great portion of African innovative outputs are appropriated and/or shared outside the mainstream IP regime. Based on this, our questions aim to gauge the value of knowledge sharing and alternative mechanisms of appropriation. This includes measuring the frequency of reliance on formal and informal means of knowledge appropriation, knowledge protection and knowledge sharing.

In sum, this paper offers a survey of the literature on innovation, its definitions, and the metrics that attempt to capture it. It concludes that the current metrics do not take into consideration the characteristics pertinent to African economies. Focusing on collaboration, human capital development and knowledge governance should bring us closer to a more accurate depiction of innovation in Africa. This will be key moving forward when suggesting how to complement the conventional global indices for measuring innovation.

## I. Introduction

The purpose of this paper is to revisit the definition and assessment of innovation in light of empirical evidence from developing countries, specifically in Africa, and propose new metrics that complement conventional innovation measures. These include, but are not limited to, novel interpretations of existing components of conventional indices. While there is considerable literature that defines different types of innovation and discusses the metrics that capture them, gaps still exist, particularly when it comes to assessing innovation in African economies. Our interest emanates from our empirical research with the Open African Innovation Research (Open AIR) network,<sup>1</sup> which has worked to craft new grounded theories about the current realities of knowledge and innovation in Africa<sup>2</sup> and to strategically explore scenarios for the future.<sup>3</sup>

Our goals now are twofold. First, we aim specifically to create a framework to implement our network's ongoing analyses of situations where innovation happens in Africa. Second, we aim to identify tools that can improve the ability to quantitatively measure the African innovation we have observed and theorized, for our own and others' research.

Innovation, in its simplest forms, refers to the process by which new ideas and knowledge created are transformed into new goods (products) and services for the benefit of groups, communities, or individuals.<sup>4</sup> Some of the earliest research, such as Schumpeter's (1912), identified this process as including the introduction of a new product, outlining a novel way to produce this product, access to a broader market where the product can be sold, access to raw material, and the entry of the producer into the market.<sup>5</sup> As will be explained in more detail below, the definition of innovation has evolved to include various modalities of innovation that may not necessarily be limited to commercialization. Indeed, some of the most recent research, such as Von Hippel's (2017), takes a step further by highlighting that there are innovation processes developed by individual consumers which are not rewarded, simply because they do it during their free time and for their personal use.<sup>6</sup>

Innovation is intricately connected to knowledge creation. At times, innovation is a component of knowledge metrics as in the World Bank Knowledge Assessment Methodology; at others, knowledge

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<sup>1</sup> See <https://openair.africa>

<sup>2</sup> De Beer, J., C. Armstrong, C. Oguamanam and T. Schonwetter (Eds.) (2014). *Innovation and Intellectual Property: Collaborative Dynamics in Africa*. UCT Press.

<sup>3</sup> Elahi, S. and J. De Beer, with D. Kawooya, C. Oguamanam and N. Rizk (2013). *Knowledge and Innovation in Africa: Scenarios for the Future*. Open AIR.

<sup>4</sup> Wamae, W. (2009). "Enhancing the Role of Knowledge and Innovation for Development," *Innovation for Development: Converting Knowledge to Value*.

<sup>5</sup> Schumpeter, J. (1912). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Cambridge, MA: Harvard University Press.

<sup>6</sup> Von Hippel, E. (2017). *Free Innovation*. Cambridge, MA: The MIT Press.



is itself an innovation output metric, as in the Global Innovation Index. This paper focuses on innovation both as a knowledge component and output.

The paper is divided into six sections. After this introduction, section 2 provides an overview of the mainstream definition of innovation and its measurement. Section 3 starts the critique of the mainstream definition and measurement by highlighting modalities of innovation that do not fit the orthodox definition and hence escape the conventional measures, noting whenever applicable efforts made to assess these modalities. Section 4 provides a conclusion of those critiques and suggestions for ways forward. Section 5 provides specific suggestions for action for current Open AIR field research, and section 6 provides a final word on the need for better metrics in order to support effective policymaking.

## II. Innovation: Definition and measurement in mainstream realms

### A. The mainstream definition

The mainstream definition of innovation is provided by the Oslo Manual, a key document produced by the Organization for Economic Cooperation and Development (OECD) and Eurostat, as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.”<sup>7</sup> By mainstream, we mean the definitions provided in the formal indices capturing innovation. The pre-requisite for innovation under this definition is that “the product, process, [and] marketing method[s] must be new (or significantly improved) to the firm.”<sup>8</sup>

First, a *product* could be a new good or a service. Product innovation refers to a product, made available to potential users, that is new or considerably altered either in terms of its features or proposed uses. This comprises “significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.”<sup>9</sup> Product innovation is, hence, key in determining how firms innovate.<sup>10</sup> The definition additionally highlights the importance of the product’s availability to potential users,<sup>11</sup> which is what the second edition of the Oslo Manual defined; product innovation is the commercialization of a product with improved performance that offers considerably improved services to the consumer.<sup>12</sup>

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<sup>7</sup> OECD and Eurostat (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. Paris: OECD Publications, 46.

<sup>8</sup> Ibid.

<sup>9</sup> Ibid.

<sup>10</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Measurement*. Cheltenham, UK: Edward Elgar.

<sup>11</sup> Gault, F. (2015). *Measuring Innovation in All Sectors of the Economy*. Maastricht: UNU-Merit Working Paper.

<sup>12</sup> OECD and Eurostat (1997). *Oslo Manual: Proposed Guidelines for Collecting and Interpreting Technological Innovation Data*. Paris: OECD Publications, 47.

Second, a *process* includes production or delivery, organisation,<sup>13</sup> or marketing processes that involve significant changes or developments in techniques and equipment.<sup>14</sup> Similar to product innovation, process innovation is portrayed as “new or significantly changed processes are implemented when they are brought into actual use in the operation of the institutional unit, including the making of product available to potential users.”<sup>15</sup> This goes to emphasize the importance of commercialization, whether within the “institutional unit” or with other potential users.

In detail, process innovation includes three components. First, *production or delivery innovation* is “the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.”<sup>16</sup> Second, *an organisational innovation* is “the implementation of a new organisational method in the firm’s business practices, workplace organisation or external relations.”<sup>17</sup> Gault (2015) adds the implementation of a “significantly changed organisational method in workplace organisation or external relations of the institutional unit.”<sup>18</sup> Third, *a marketing innovation* is “the implementation of a new or significantly changed method of promoting products of the institutional unit.”<sup>19</sup>

Conventional definitions go on to a discussion of *innovation systems*, which involve a number of *actors* such as governments, education and research institutions and firms. These actors normally engage in *activities* such as Research and Development (R&D), invention, diffusion of technologies and practices, design, and human resource development. They also engage in linkages: “any interaction between the actors such as contracts; licensing of intellectual property; flows of data, information or knowledge from or to public or private sources, collaboration; and exchange of human resources.”<sup>20</sup> Actors engage in these activities and linkages with the hope of achieving economic and social outcomes such as job creation, economic growth, productivity, or equality.<sup>21</sup> In a well-developed innovation framework, innovation activities comprise acquiring “machinery, equipment, software and licenses; engineering and development work, design, training, marketing and R&D ... undertaken to develop and/or implement a product or process innovation.”<sup>22</sup> This goes to show that conventional definitions of innovation are limited to the formal framework, whether on a macro or a micro level. With this in mind, innovation measures can credibly reflect innovation in developed or advanced economies, however, they do not capture the whole picture when it comes to developing countries.

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<sup>13</sup> OECD and Eurostat (2005). *Oslo Manual: Guidelines*, 46.

<sup>14</sup> Gault, F. (2015). *Measuring Innovation*.

<sup>15</sup> Ibid.

<sup>16</sup> OECD and Eurostat (2005). *Oslo Manual: Guidelines*, 49.

<sup>17</sup> OECD and Eurostat (2005). *Oslo Manual: Guidelines*, 51.

<sup>18</sup> Gault, F. (2015). *Measuring Innovation*.

<sup>19</sup> Ibid.

<sup>20</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Measurement*. Cheltenham, UK: Edward Elgar.

<sup>21</sup> Gault, F. (2015). *Measuring Innovation*.

<sup>22</sup> Charmes, J., F. Gault and S. Wunsch-Vincent (2015). “Formulating an Agenda for the Measurement of Innovation in the Informal Economy.” Presentation at the 8<sup>th</sup> Conference on Micro Evidence on Innovation and Development, New Delhi.



Typically, innovation has been associated with businesses, whereby innovators are both firms as well as private non-profit organizations.<sup>23</sup> Firms innovate in order to expand market share or enter new markets, to develop a product range, to be able to produce new goods, and to lower costs.<sup>24</sup> The standard definition of innovation centres on its connection to the market; it excludes public sector entities such as government departments, education institutions, health institutions, and research institutions. It also excludes groups not constituting a firm, such as social and professional interest groups, and peer groups.<sup>25</sup> Moreover, conventional innovation descriptions do not account for other dimensions of innovation such as organic collaboration between employees within firms, free innovation for personal use, and collaborations between users and formal institutions. Therefore, even when limited to the formal frame, there are still other areas of innovation that are yet to be captured.

## **B. Conventional measurement of innovation**

Emanating from the above definition, measuring innovation has been approached from two perspectives: a macro angle where national statistics are used to assess countries' respective performance on the innovation scale, and a micro perspective where field studies are conducted on firms and other individual entities to highlight innovation performance on that level.

Innovation metrics evolved over four generations. The first generation in the 1950s and 1960s focused mainly on R&D expenditures, capital and technology intensity, namely the inputs. The second-generation indicators, emerging between the 1970s and 1980s, focused on output indicators such as patents, publications and products. The third generation was in the 1990s and focused on indexing, innovation surveys and benchmarking innovation capacity, providing a more comprehensive approach relative to the first two. The fourth generation, the current one which dates since the last decade, has focused on knowledge-based capital, networks, as well as management techniques.<sup>26</sup> This generation attempts to compile relevant inputs that were not previously taken into consideration. Inputs such as knowledge, intangibles, system dynamics, demand and risk/return<sup>27</sup> shift the innovation metrics to a new level where it gathers data on knowledge transfer and diffusion. Our work is in line with this updated generation of innovation metrics, except that the latter only includes innovation activity within formal organizations.

### **Macro indicators**

We choose to focus on three macro indicators. The core and most-used macro indicator assessing national figures is the Global Innovation Index (GII) developed and co-published by Cornell University, Institut Européen d'Administration des Affaires or European Institute of Business Administration (INSEAD) and the World Intellectual Property Organization (WIPO) of the United Nations. Another less used indicator is the innovation component of the World Bank's Knowledge Assessment

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<sup>23</sup> Gault, F. (2014a). "New Trends and Challenges in Innovation Measurement." UNU-MERIT and TUT-IERI.

<sup>24</sup> Charmes, J., F. Gault and S. Wunsch-Vincent (2015). "Formulating an Agenda for the Measurement of Innovation in the Informal Economy".

<sup>25</sup> Gault, F. (2014a). "New Trends and Challenges in Innovation Measurement."

<sup>26</sup> Bund, E., et al. (2013). *Blueprint of Social Innovation Metrics*. Brussels: TEPSI.

<sup>27</sup> Ibid.

Methodology (KAM), which was used along economic incentives, education, information and communication technologies (ICT) to assess countries' index of knowledge. A third Index reviewed here is the Global Competitiveness Index (GCI) where innovation is a core pillar. Related macro indicators such as the Technology Achievement Index, Global Information Technology Report and others are included in Annex II.

### **Global Innovation Index (GII)**

The Global Innovation Index (GII) is intended to capture different aspects of innovation and provide the necessary toolkit that enables a policy making process to support "long-term output growth, improved productivity, and job growth."<sup>28</sup> The index focuses both on ways to improve the measurement of innovation as well as understanding it, and to identify targeted policies and good practices. The GI ranks the world economies' innovation capabilities, attempts to continuously evaluate innovation factors particularly as they evolve, and offers innovation-related data for 128 economies.

The GI depends on two sub-indices –the Innovation Input Sub-Index and the Innovation Output Sub-Index –each of which is composed of several pillars. The Innovation Input Sub-Index is comprised of five input pillars that capture elements of the national economy enabling innovative activities: (1) institutions, (2) human capital and research, (3) infrastructure, (4) market sophistication, and (5) business sophistication. The Innovation Output Sub-Index provides information about outputs that are the results of innovative activities within the economy. There are two output pillars: (6) knowledge and technology outputs, and (7) creative outputs. Each of the seven pillars is divided into three sub-pillars, with each sub-pillar composed of two to five individual indicators, for a total of 82 indicators in the latest (2016) Global Innovation Index. The overall GI score is the simple average of the input and output sub-indices. The Innovation Efficiency Ratio is the ratio of the Output Sub-Index score over the Input Sub-Index score and reflects how much innovation output a given country has for its inputs, highlighting those economies that have achieved more with less as well as those that lag behind in terms of achieving their innovation potential.<sup>29</sup>

The GI gathers data from more than 30 data sources, including covering a large spectrum of innovation drivers and results; privileging hard data over qualitative assessments (only five survey questions were included in the GI 2016). Country/economy rankings are provided for indicator, sub-pillar, pillar, and index scores.

<sup>28</sup> Lanvin, B. and S. Wunsch-Vincent (2016). "The Global Innovation Index 2016." Geneva: WIPO, [http://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_gii\\_2016.pdf](http://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2016.pdf).

<sup>29</sup> Each sub-pillar score is calculated as the weighted average of its individual indicators. Each pillar score is calculated as the weighted average of its sub-pillar scores. This is used to calculate four measures:

- Innovation Input Sub-Index: is the simple average of the first five pillar scores
- Innovation Output Sub-Index is the simple average of the last two pillar scores
- The Innovation Efficiency Ratio is the ratio of the Output Sub-Index over the Input Sub-Index
- The overall GI score is the simple average of the Input and Output Sub-indices

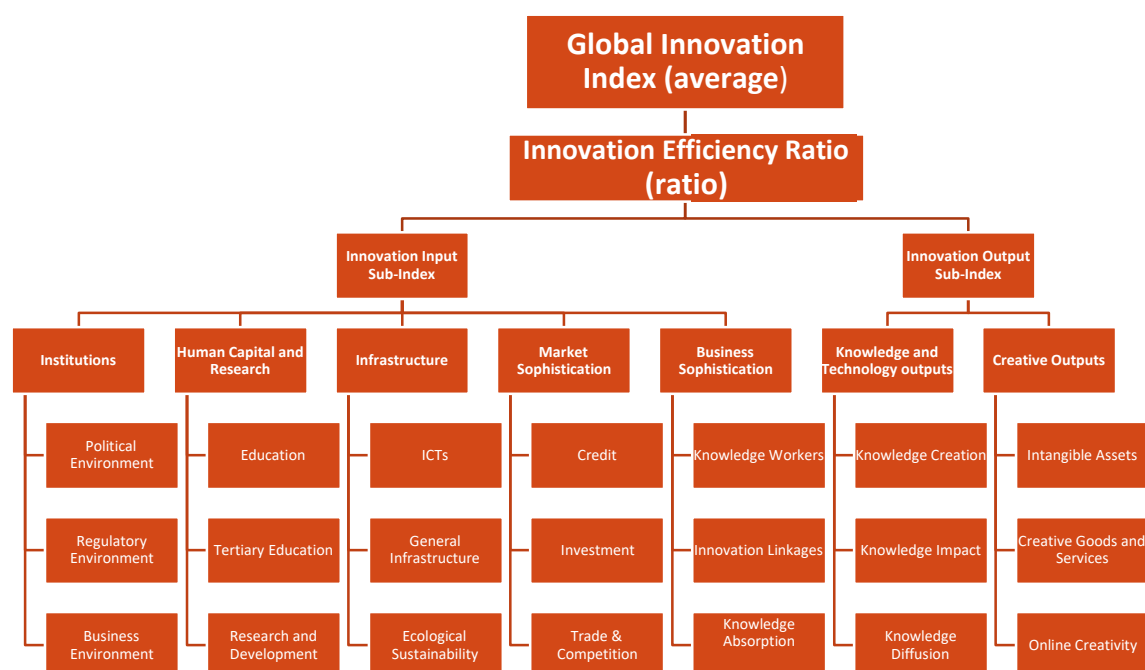


Figure 1: Global Innovation Index. Source: Compiled based on WIPO, Cornell University and INSEAD (2016).

The GII relies on a mix of quantitative hard data (58 indicators), a composite indicators/index data (19 indicators) and survey qualitative data (five indicators). Indicators are often correlated with population, gross domestic product (GDP), or some other size-related factor such as total trade; they require scaling by some relevant size indicator for economy comparisons to be valid. All 82 indicators were normalized to numbers between the [0, 100] range, with higher scores representing better outcomes (in cases where the original data had higher values indicating a deterioration, the scaling/normalization inverts the deterioration indication from the high values (in the original data) for consistency purposes, i.e. in order to be consistent with all other indicators where high scores represent better outcomes).<sup>30</sup>

This index serves as a useful tool for cross country comparisons and is frequently updated to accommodate for changes and fluctuations. Nevertheless, some of its components may not tell the full innovation story of developing countries. For instance, the Innovation Linkages category, in the Business Sophistication pillar, comprises university/industry research collaboration, state of cluster development, gross expenditure on R&D (GERD) financed by abroad, joint venture/strategic alliance deals, and patent families filed at three or more offices. These are usually deficient in developing countries where, instead, one is likely to find evidence of informal collaborative innovation governance mechanisms. Our work looks for this evidence and incorporates it to complete the picture of innovation in developing countries, specifically Africa.

### ***Innovation as a pillar of World Bank knowledge indexes***

The Knowledge Index and the Knowledge Economy Index (KEI), produced by the World Bank Institute under the umbrella of the Knowledge Assessment Methodology (KAM), measure a country's aptitude

<sup>30</sup> Details of GII methodology are provided in Annex I.

to create, implement and diffuse knowledge. The KEI focuses on the extent to which the overall environment is favourable for knowledge to efficiently contribute to economic development. The KAM uses four pillars to assess the knowledge economy and is calculated through an average of the normalized performance scores of a country in those four pillars. They include: economic incentive and the institutional ecosystem, education and human resources, innovation and information and communication technologies.<sup>31</sup> An effective innovation system is highlighted as one that should “keep up with the knowledge revolution and tap into the growing stock of global knowledge and assimilate and adapt it to local needs.”<sup>32</sup> Innovation of firms, research centers, universities, consultants and other organizations is measured by royalty payments, patent count and scientific journals.

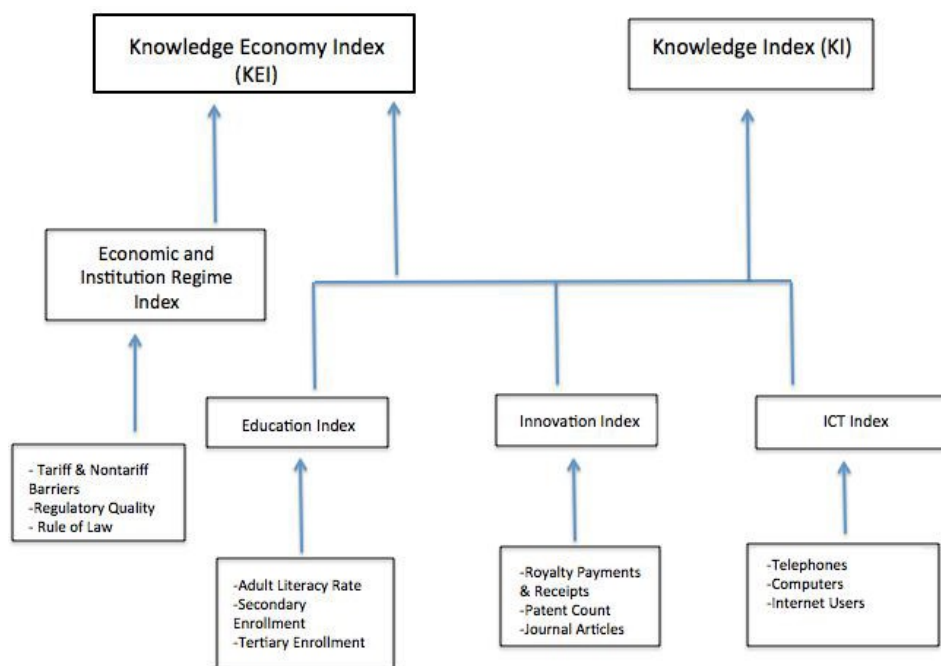


Figure 2: Knowledge Measurement Component., Source: Compiled based on The World Bank's Knowledge Assessment Methodology (KAM), Knowledge Economy Index (2012).

### **Innovation as a component of the Global Competitiveness Index (GCI)**

Innovation is an integral component of the Global Competitiveness Index (GCI), originally created in 1979, and used by the World Economic Forum to measure competitiveness.<sup>33</sup> The index is divided into 12 categories (also, pillars) that build the framework of the index. Since it is updated frequently, the categories change to make room for updates however, the core is homogeneous. The pillars/categories are categorized into institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labour market

<sup>31</sup> Chen, D. and C. Dahlman (2005). "The Knowledge Economy, the KAM Methodology and World Bank Operations." World Bank. [http://siteresources.worldbank.org/KFDLP/Resources/KAM\\_Paper\\_WP.pdf](http://siteresources.worldbank.org/KFDLP/Resources/KAM_Paper_WP.pdf)

<sup>32</sup> Ibid.

<sup>33</sup> Sala-i-Martin, X. and G. Marti (2015). "Chapter 1.2: Drivers of Long-Run Prosperity: Laying the Foundations for an Updated Global Competitiveness Index," *The Global Competitiveness Report 2015-2016*. World Economic Forum, 43.

efficiency, financial market development, technological readiness, market size, business sophistication and innovation.<sup>34</sup>

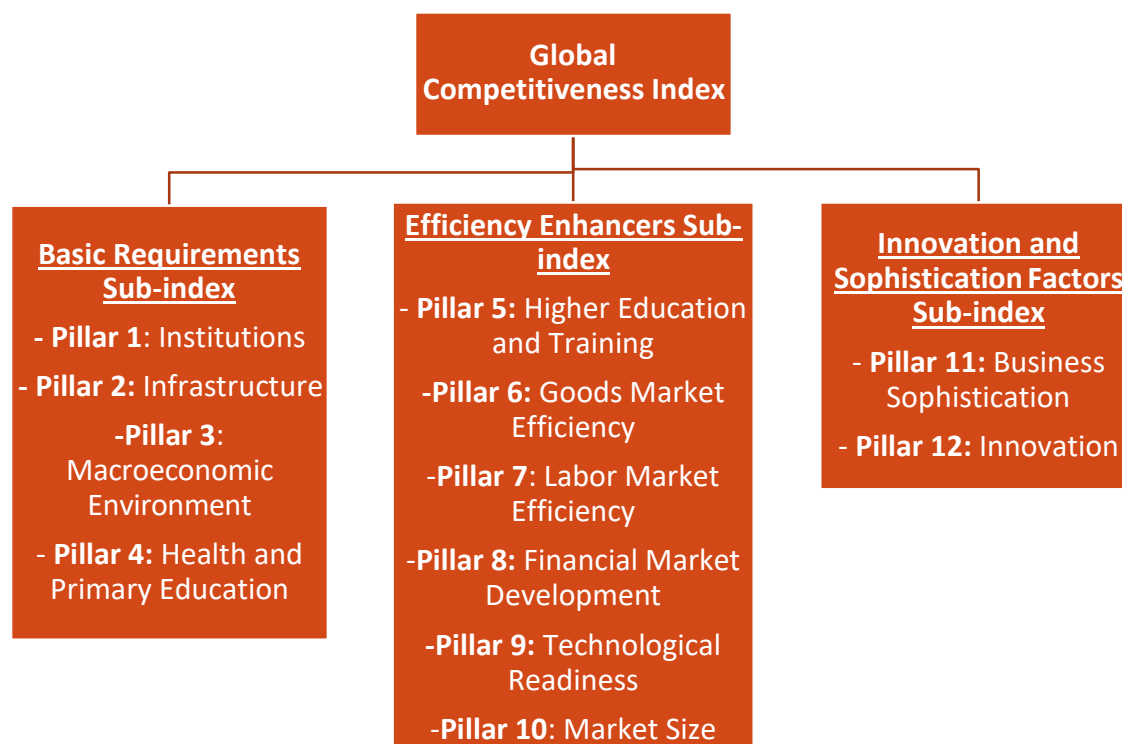


Figure 3: Global Competitiveness Index. Source: Compiled based on the Global Competitiveness Report (2016-2017).

Innovation is the twelfth pillar. The index emphasizes the importance of innovation within firms/companies. It highlights how crucial it is to invest in R&D and research institutions that “can generate the basic knowledge needed to build new technologies.”<sup>35</sup> Moreover, it underlines the extent to which collaboration between universities and industries are crucial in order to maximize knowledge and creation.

In addition to the explicit Innovation pillar, factors related to innovation are featured in other pillars of the index. For example, pillars 5 and 9 are directly linked to innovation in the sense that first, higher education and training have been proven to be a factor of innovation, in previous studies such as Von Hippel’s case studies as well as in ours. As a matter of fact, human skill development is one of our three pillars in our work for developing the innovation activity index. It is a main factor to innovation because education is usually linked with knowledge creation, diffusion and transfer and in this way innovation is created. Second, technological readiness contributes to a great extent to the

<sup>34</sup> Schwab, K. and X. Sala-i-Martin (2016). “Appendix A: Methodology and Computation of the Global Competitiveness Index 2016-2017,” *The Global Competitiveness Report 2016-2017*, World Economic Forum, 35.

<sup>35</sup> Ibid.

“innovation ecosystem.” There are two sources of technology adoption: “local firms investing to bring in technology from abroad or from other sectors or companies and a country exploiting spill overs from the foreign direct investment (FDI) of international companies.”<sup>36</sup> Even though technology’s integration in the index is limited to the formal framework, it is still emphasized as one of the crucial elements for innovation.

The remaining pillars include institutions because they “set formal, legally binding constraints – such as rules, laws and constitutions – along with their associated enforcement mechanisms.”<sup>37</sup> In addition, they include “informal constraints such as norms of behaviour, conventions, and self-imposed codes of conduct such as business ethics and corporate governance.”<sup>38</sup> Second, the infrastructure pillar consists of the quality of domestic and international transport networks (physical and digital infrastructures), in addition to, highlighting the importance of ICTs in facilitating innovation within the economy. Third, as was mentioned, education plays a major role in “boosting a country’s capacity to create new knowledge, products and technologies.”<sup>39</sup> Fourth, the market size pillar is affected by two ways of productivity: economies of scale in production and incentives for innovation. The latter might be seen as more important than the former since “larger markets create substantially bigger incentives for generating new ideas.”<sup>40</sup> In fact, larger markets prevail “positive externalities in the accumulation of human capital and transmission of knowledge because of increasing returns to scale embedded in technology or knowledge creation.”<sup>41</sup>

An important note to make is that the concept of innovation has changed significantly in recent years; it is highlighted as an “ecosystem” because it is the generation of ideas “in the form of new products, services and processes in the market place.”<sup>42</sup> The report highlights the extent to which innovation is one of the most crucial factors in a country’s growth. The updated GCI attempts to capture different aspects related to innovation. It is presented as this a first step towards a better reflection of innovation. In addition, it strives to integrate motives behind firms’ innovations and the development of societal behaviour in order to get the bigger picture.

Taking it a step further, the innovation ecosystem is highlighted to be based on connectivity, collaboration, diversity and creative thinking. In conclusion, the main drivers for such innovation are “related to human capital factors such as curiosity and the capacity to observe, understand and use ideas from different fields.”<sup>43</sup> This is a commendable change towards accurate assessment of innovation. Our work takes further steps towards precise depiction of actual innovation activities occurring on the ground, especially in developing countries.

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<sup>36</sup> Ibid, p. 52.

<sup>37</sup> Sala-i-Martin, X. and G. Marti (2015). “Chapter 1.2: Drivers of Long-Run Prosperity: Laying the Foundations for an Updated Global Competitiveness Index,” *The Global Competitiveness Report 2015-2016*.

<sup>38</sup> Ibid.

<sup>39</sup> Ibid, p. 49.

<sup>40</sup> Ibid, p.53.

<sup>41</sup> Ibid.

<sup>42</sup> Ibid.

<sup>43</sup> Schwab, K. and X. Sala-i-Martin (2016). “Appendix A: Methodology and Computation of the Global Competitiveness Index 2016-2017,” *The Global Competitiveness Report 2016-2017*.



## Micro indicators

Micro indicators focus on assessment of innovation conducted at the firm level through attempts at standardizing innovation measures for better comparisons, cross-country analysis and policy implications. Below is a summary listing of selected micro measurement initiatives including the Oslo Manual, the Frascati Manual, regional manuals such as the Bogotá Manual, Africa NEPAD STI and the National Experts on Science and Technology Indicators (NESTI).<sup>44</sup>

### *The Oslo Manual*

The Oslo Manual was the first to define innovation based on surveys in the 1970s and 1980s. The first Oslo Manual (OECD, 1992) focused on innovation for measurement purposes, with a particular emphasis on innovation in the manufacturing sector.<sup>45</sup> Innovation in this context focuses on technological product and process innovation,<sup>46</sup> and can be influenced from within the firm,<sup>47</sup> or outside it.<sup>48</sup>

The manual was revised in 1997 and a third edition was published in 2005. In 1997, it included services and continued to revolve around technological product and process innovation, production and supplying the products to the market. The third edition took into account developments in understanding “the innovation process and its economic impact, and the experience gained from recent rounds of innovation surveys in OECD member and non-member countries.” It defines four types of innovations: product innovations, process innovations, organizational innovations and marketing innovations. It also investigates non-technological innovation and the relationships between different innovation types.<sup>49</sup>

Furthermore, Annex A of the Oslo Manual highlights the importance of how innovation is measured in developing countries. It identifies the questions that should be taken into consideration such as “why do we measure innovation, what should we measure, and how we measure.”<sup>50</sup> These questions are a priority in past studies, yet the approaches are different. In the Manual, analysis of “innovation strategies” is sought from innovation surveys when it comes to developing countries. This is because it impacts competitiveness between firms, which directly affects economic and social development. Innovation strategies, as opposed to innovation enterprises or innovation counts, are used to

<sup>44</sup> We focus on global indicators and have not included indices such as the United States Business R&D and Innovation Survey (BRDIS), which came into being through the United States National Science Foundation (NSF) and the Economic Directorate of the Bureau of the Census, to produce the Business R&D and Innovation Survey (BRDIS) which first was used as a pilot survey in 2009. The survey covered a sample of 40,000 firms with five or more (Gault, 2010). Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Measurement*. Available Online. <https://prd-idrc.azureedge.net/sites/default/files/openbooks/484-0/index.html>

<sup>45</sup> OECD and Eurostat (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Technological Innovation Data Third Edition*. Paris: OECD Publications

<sup>46</sup> Gault, F. (2015). *Measuring Innovation*.

<sup>47</sup> For more information, see Gault (2014b); innovation in the firm can be triggered by direct interventions that support R&D. Externally, government regulations, intellectual property policies, and other broader policy also can have an influence on firm-level innovation.

<sup>48</sup> Gault, F. (2014b). Innovation Indicators and their Applications: Implications for Africa. Institute for Economic Research on Innovation (IERI), <http://www.ieri.org.za/sites/default/files/outputs/WP%202014%20FDG%2001>

<sup>49</sup> OECD and Eurostat (2005). *Oslo Manual*.

<sup>50</sup> Ibid.

measure innovation in developing countries because “it is widely accepted that dissemination mechanisms and incremental change account for most of the innovation” occurring in these countries. The main issues of innovation strategies are “innovation activities, obstacles, capabilities, linkages and results.”<sup>51</sup>

Thus, while the Oslo manual offers a blanket definition of innovation, its annex<sup>52</sup> acknowledges that characteristics of innovation of developing countries should be taken into account, including the size and structure of the market and firms. As well, there is acknowledgement in the annex that macroeconomic uncertainty, instability and physical infrastructure are among the exogenous/systemic facts that affect innovation in developing countries.

### **Community Innovation Surveys**

The Community Innovation Surveys (CIS) are part of the European Union science and technology statistics. The CIS is a survey of innovation activity in enterprises, which offers information on innovation by type of enterprises on different aspects of innovation and its development process. The enterprise represents the basic unit of measurement of the CIS; results are tallied and then percentages are calculated. Survey questions ask about objectives, public funding, expenditure on innovation and sources of innovation. Statistics are divided by country, type of innovators, size and economic activity.<sup>53</sup>

The CIS provides an indication of the extent to which formal innovation impacts competitiveness, employment and economic growth. It is mostly conducted on firms in developed countries, in line with the Oslo Manual. Each CIS covers the preceding three-year period, the latest of which is the CIS 2012, covering activity from 2010.<sup>54</sup> The CIS includes a core or harmonised surveys and then leaves room for country specific inquiries.

### **The Frascati Manual**

Earlier in 2002, the Frascati Manual was developed by OECD member countries to work with R&D data, and evolved into the standard scheme for R&D surveys and data collection beyond OECD member countries.<sup>55</sup> Similar to the Oslo Manual, the Frascati Manual focuses on R&D in firms and formal institutions. It studies the concept and definition of R&D, how to measure it and the extent to which governments support it. This manual also measures formal innovation, which is limited to the boundaries of formal frameworks as defined in developed countries.

### **The Bogotá Manual**

The Bogotá Manual stemmed from a project in 1999/2000 that aimed to standardize technological innovation indicators in Latin America and the Caribbean. This project has the objective of encouraging the use of surveys on technological processes in Latin America to create indicators that

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<sup>51</sup> Ibid. 141

<sup>52</sup> Drafted by the UNESCO Institute for Statistics.

<sup>53</sup> “Eurostat: Your Key to European Statistics.” *Community Innovation Survey (CIS)*.

<sup>54</sup> “Results of the community innovation survey 2012.” Europa.

[http://ec.europa.eu/eurostat/cache/metadata/en/inn\\_cis8\\_esms.htm](http://ec.europa.eu/eurostat/cache/metadata/en/inn_cis8_esms.htm).

<sup>55</sup> OECD (2002). *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*. Paris: OECD Publications.

can be comparable with other advanced and emerging economies. It is a regional manual that aims to reach a consensus on definitions, methodology and data collection, which allow the building of sophisticated indicators that reflect innovation.<sup>56</sup> One significant feature of the Bogotá Manual is its emphasis on human resource issues, their organization, training aspects and network. This goes in line with Gault's work (2010) which holds that human resources, technologies and external knowledge are significant features of innovation and that these topics have been debated in tandem at OECD and the EU communities as well as in Latin America.<sup>57</sup>

### ***The African Science, Technology and Innovation Indicators***

The African Union New Partnership for Africa's Development (AU-NEPAD) programme on African Science, Technology and Innovation Indicators (ASTII) is a continent-wide R&D and innovation survey compiling data science, technology and innovation published in the African Innovation Outlook. The survey focuses on several dimensions of innovation. These include product innovation, process innovation, on-going or abandoned innovation activities, innovation activities and expenditure, sources of information and cooperation for innovation activities, effects of innovation during the last two years, factors hampering innovation activities, intellectual property rights, and organization and marketing innovations.<sup>58</sup> According to Kahn (2008), the survey employs both the Frascati and Oslo manual guidelines to facilitate cross-country comparisons in such a way that overtime, African innovation manuals will be developed.<sup>59</sup> ASTII innovation surveys are also based on the Eurostat Community Innovation Survey (CIS).<sup>60</sup>

The findings of the ASTII innovation surveys are well found in the 2010 and 2014 African Innovation Outlook and in country-specific reports, but with a large informal sector, challenges in undertaking innovation surveys remain.<sup>61</sup> Even though intended for cross country comparisons, they argue that current challenges include the variation of sector coverage, and the variation in survey methodologies employed which makes it hard to conduct cross-country comparisons. Another challenge is the fact that small and micro-enterprises in the formal sector may not be included since there is an employee size cut-off. Most importantly is the fact that not one of these business surveys in the formal sector attempts to take innovation in the informal sector into consideration. This is because innovation surveys are business surveys, and the necessary infrastructure to capture the

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<sup>56</sup> Lugones, G. (2006). "The Bogota Manual: Standardising innovation indicators for Latin America and the Caribbean," in *Measuring Innovation in OECD and NON-OECD Countries*, ed. Blankley, W., M. Scerri, N. Molotja, and Imraan Saloojee. Online.

<sup>57</sup> Gault, F. (2010). *Innovation Strategies*.

<sup>58</sup> Kraemer-Mbula, E. and S. Wunsch-Vincent (Eds.) (2016). *The Informal Economy in Developing Nations*. Cambridge University Press.

<sup>59</sup> Kahn, M. (2008). "Africa's Plan of Action for Science and Technology and Indicators: South African Experience." *African Statistical Journal*, 6.

<sup>60</sup> The harmonized Community Innovation Survey 2012- as an example- includes questions about "1. The General information about the enterprise 2. Product (good or service) innovation 3. Process innovation 4. Ongoing or abandoned innovation activities for product and process innovations 5. Activities and expenditures for product and process innovations 6. Sources of information and co-operation for product and process innovation 7. Competitiveness of your enterprise's product and process innovations 8. Organisational Innovation 9. Marketing Innovation 10. Public sector procurement and innovation 11. Strategies and obstacles for reaching your enterprise's goals" (Charmes et al. 2015)

<sup>61</sup> Kraemer-Mbula, E and S. Wunsch-Vincent (Eds.) (2016). *The Informal Economy in Developing Nations*.

informal sector is not available. Kraemer-Mbula et al. (2016) argue that it is important to ensure that the questions related to the informal sector are tested and managed carefully.<sup>62</sup>

Despite the existence of inconsistencies, there are some general conclusions that could be reached from the African innovation surveys.<sup>63</sup> Most notable is the conclusion that innovation is pervasive, is both technological and non-technological; goes beyond R&D, and involves linkages between firms and clients.

### ***The OECD Measurement Agenda***

Meanwhile, a paper compiled by the OECD in 2010 titled “A Measurement Agenda for Innovation,” aims to present key action plans for new approaches of traditional indicators, in order to develop indicators that are broader and more encompassing of diverse perspectives on innovation.<sup>64</sup> This document and the 2015 update of the OECD Innovation Strategy<sup>65</sup> have influenced the third revision of the Oslo Manual. The aim of the 2015 strategy was to assess the definition of innovation for measurement purposes, and its implementation, to consider options for moving from innovation in the business enterprise sector to innovation across the broader system of national accounts.<sup>66</sup>

The Innovation Strategy contains an annex with an action plan that pinpoints the limits of previous studies and highlights the importance of going beyond the traditional approaches in dealing with innovation. The plan highlights five broad areas in which international action is needed:

- Develop innovation metrics that can be linked to aggregate measures of economic performance;
- Invest in a high quality and comprehensive statistical infrastructure to analyse innovation at the firm-level;
- Promote metrics of innovation in the public sector and for public policy evaluation;
- Find new and interdisciplinary approaches to capture knowledge creation and flows; and
- Promote the measurement of innovation for social goals and of social impacts of innovation.<sup>67</sup>

In addition to the above, the OECD Blue Sky Forum is a product of review of OECD STI agenda with data users, the policy community and providers. In 2007, the OECD Blue Sky Forum took place to examine new uses of existing science, technology and innovation (STI) indicators for the purpose of STI policy making, completely new STI indicators, and a synthesis of findings leading to an agenda for the next decade of work on STI indicators.<sup>68</sup> The objectives of the Blue Sky Forum 2016 include the creation of a forward looking roadmap on STI measurements for the OECD and other countries, exploring the role of digital infrastructure that supports the creation of new opportunities to improve

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<sup>62</sup> Ibid.

<sup>63</sup> Konte, A. and P.K. Mawoko. *Innovation Measurement in Africa*. 2010. Malabo, Equatorial Guinea: African Observatory for Science, Technology and Innovation. Online.

<sup>64</sup> OECD. *Towards a Measurement Agenda*, 12.

<sup>65</sup> OECD. “Innovation Strategy 2015 An Agenda for Policy Action.” OCED. June 3, 2015. <https://www.oecd.org/sti/OECD-Innovation-Strategy-2015-CMIN2015-7.pdf>.

<sup>66</sup> Ibid.

<sup>67</sup> OECD. *Towards a Measurement Agenda*.

<sup>68</sup> OECD (2007). *Science, Technology and Innovation Indicators in a Changing World, Responding to Policy Needs*. Paris.

STI measurement, and provide more scope for policy dialogue and indicator development among different stakeholders.<sup>69</sup>

The above indicators are managed by the OECD Working Party of National Experts on Science and Technology Indicators (NESTI). NESTI is responsible for supervising, overseeing and managing statistical work on science, technology and innovation (STI), contributing to indicator development and the quantitative analysis required to meet the targets and priorities of the Committee for Scientific and Technological Policy. Its on-going projects include the implementation of the OECD Frascati Manual (R&D), the revision of the Oslo Manual on Innovation (Community space), and the OECD Blue Sky Forum on the future of STI data.<sup>70</sup>

Similar to the macro indicators, micro indicators that assess innovation do not consider the informal aspects of the innovation process within the formal institutions, i.e. firms and governmental bodies. This includes, for instance, the culture of collaboration which takes place organically between individuals and teams, especially when is not a strict requirement within the firm. Innovation in formal institutions may also include informal sources of knowledge what employees use in developing their innovation activity. Our goal is to complement conventional metrics in order to capture all aspects of innovation occurring on the ground.

### III. Beyond the mainstream: Other ways to think about innovation

Innovation can occur through different modalities, all of which revolve around novelty in one form or another. A further exploration of these modalities provides a better understanding of how innovation occurs and the extent of its diversity. It also lays the ground work to measure innovation more accurately and better capture its extent and understand its dynamics. The above sections offered an overview of the conventional definition and measures of innovation. In this paper, we argue that this definition is not comprehensive and that these conventional measures need to be complemented. To make this argument, we start by highlighting aspects of innovation that do not typically fit the mainstream definition and argue that a proper assessment of innovation should take into account all such forms and related interactions. Accordingly, in the following section, we outline these non-conventional modalities of innovation. By describing these modalities, we aim to expand the scope of innovation beyond the conventional understanding. As such, the following examples of non-conventional modalities provide a more inclusive definition of innovation – one that considers the specificities of economies in the developing world.

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<sup>69</sup> OECD (2016). Blue Sky Forum on Science and Innovation Indicators. 2016.

<sup>70</sup> OECD Working Party of National Experts on Science and Technology Indicators (NESTI). Innovation Policy Platform. <https://www.innovationpolicyplatform.org/oecd-working-party-national-experts-science-and-technology-indicators-nesti>.



## A. Informal innovation

Informal innovation is a crucial form of innovation that escapes conventional metrics. It refers to innovation in the informal sector, but we also take it to describe innovation that takes place informally *within* the formal sector – most commonly in smaller enterprises. Indeed, one can argue that on the ground, there exist four main dimensions:

1. Formal innovation in the formal sector, such as R&D departments in institutions/firms (FI/FS).
2. Informal innovation in the formal sector (II/FS), such as the culture of collaboration between employees within a formal entity for innovation activity.
3. Informal innovation in the informal sector (II/IS), such as innovation for personal use, user innovation, and innovation for enterprise purposes (outside of R&D channels).
4. Formal innovation in the informal sector (FI/IS), such as collaboration in innovation activity between informal groups and formal entities.

	Formal Sector	Informal Sector
Formal Innovation	FI/FS	FI/IS
Informal Innovation	II/FS	II/IS

We are trying to understand the extent to which informal innovation takes place. Most literature has focused on formal innovation in the formal sector and other studies have highlighted informal innovation in the informal sector. Building on this, we use the framing of the above matrix to probe into the combinations of formal and informal innovation activities in different sectors of African economies that have been largely overlooked. To supplement the existing literature, we will provide a description of: (1) informal innovation in the informal sector; and (2) informal innovation in the formal sector. By describing these forms of innovation, we are expanding conventional knowledge about the modalities of innovation. These particular modalities of innovation are abundantly found in African economies. As such, their inclusion in our understanding and definition of innovation at the same time acts to incorporate the specificities of developing economies into mainstream scholarship.

### Informal innovation in the informal sector (II/IS)

A broad and classic description of the informal sector by the International Labour Organization holds that the informal sector consists of “units engaged in the production of goods or services with the primary objective of generating employment and incomes to the persons concerned. These units typically operate at a low level of organisation, with little or no division between labour and capital as factors of production and on a small scale. Labour relations – where they exist – are based mostly on casual employment, kinship or personal and social relations rather than contractual arrangements with formal guarantees.”<sup>71</sup>

An additional important characteristic of the informal sector is that its constituent enterprises are not registered. This lack of registration can be explained by institutional weakness in three areas:

<sup>71</sup> ILO (1993). “Resolution concerning statistics of employment in the informal sector, adopted by the Fifteenth International Conference of Labour Statisticians.” [http://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/normativeinstrument/wcms\\_087484.pdf](http://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/normativeinstrument/wcms_087484.pdf)



taxation, regulation and private property rights. Activities are unlikely to be formalized due to high taxes and complicated fiscal processes. Furthermore, long requirements for registration, licensing, and inspection also hinder the formalization and registration of activities. This lack of documentation makes it hard to grasp an accurate measure of its output, let alone its innovation. Common critiques to informal sector framing and definitions are centred on the casting of a trait of underdevelopment on it, which precludes the possibility of capturing innovative practices on organizational and productive levels among others. Meanwhile, the informal sector is a key edifice in several economies such as those of the African continent, where it is dominated by micro and small enterprises (MSEs).<sup>72</sup> Yet, there is limited information on the dynamics of how new products, processes and innovation are created and monetized in the informal economy.<sup>73</sup>

While difficult to measure accurately, broad estimates of the informal sector place it as comprising almost half of the Gross Domestic Product (GDP) of most Sub-Saharan Africa, and almost 80 percent of its labor force.<sup>74</sup> The African Development Bank has argued that the predominance of this sector stems “from the opportunities it offers to the most vulnerable populations,” while also being linked with the weak institutional environment explained above. Therefore, it plays a vital role in the livelihood of many, both directly and indirectly,<sup>75</sup> and links to the formal sector, in some cases more strongly than others. Indeed, informal activities have been crucial in poverty alleviation, job creation, increasing competition and the production of goods for “the low-income majority...and fostering adaptation and innovation.”<sup>76</sup>

Despite this, innovation that occurs in the informal sector is not captured to the extent that reflects its significance in reality. Indeed, measuring innovation in the informal sector is challenging. To this end, surveys of informal entities run by members of the tested households have been produced in a number of countries, especially in Africa. Initially most surveys were focused on capitals, big cities or urban areas, due to the lack of resources. This has been gradually changing to cover larger territories.<sup>77</sup> Most importantly is how the informal sector is reflected in these surveys.

“In particular, two types of survey should be considered for the purpose of surveying innovation in the IE (informal economy): (i) Mixed households/establishments surveys which fit particularly countries with a large informal economy, and the (ii) combined surveys which associate a household survey with a separate establishment survey able to capture small micro-enterprises as well as small and medium enterprises, which often escape surveys on the formal sector.”<sup>78</sup>

<sup>72</sup> Note that traditional health care, for example—one of many—goes unaccounted for in the “classical” metrics of innovation.

<sup>73</sup> Wunsch-Vincent, S., J. De Beer, and E. Kraemer-Mbula (2012). “The Informal Economy, Innovation and the Role of IP.” WIPO.

<sup>74</sup> African Development Bank Group (2013, March 27). “Recognizing Africa’s Informal Sector.”

<sup>75</sup> Wunsch-Vincent, S., J. De Beer, and E. Kraemer-Mbula (2012). “The Informal Economy, Innovation and the role of IP.” WIPO.

<sup>76</sup> Elahi, S. and J. De Beer, with D. Kawooya, C. Oguamanam, and N. Rizk (2013). *Knowledge and innovation in Africa: Scenarios for the Future*.

<sup>77</sup> Charmes et al. (2016). *Measuring Innovation in the Informal Economy – Formulating an Agenda*.

<sup>78</sup> The paper contains more details on how such surveys are constructed, but this is beyond the scope of this Working Paper.

It is important to note that these innovation surveys measure behaviour.<sup>79</sup> They question whether firms employed new or considerably enhanced goods or services, introduced organizational or marketing activities.<sup>80</sup> Questions normally asked attempt to gather general information about the enterprise in question, product and process innovation, innovation about current and abandoned activities, expenditure on innovation, types and determinants of collaboration, the competitiveness of the firm's product and process innovations as well as bottlenecks and strategies of reaching the firm's targets.<sup>81</sup>

In addition to mixed and combined surveys, Charmes et al. (2016) recommend conducting more ad hoc surveys based on semi-structured interviews within specific clusters or sub-sectors of the informal economy. This would give a clearer picture of how innovation in informal sectors occur, and is a good way to ensure objective responses from the participants in the survey.<sup>82</sup>

Surveys conducted by Charmes et al. (2016) portray efforts to measure innovation in the informal sector where questions about collaboration, business organization, technological support and product innovations/modifications have been asked. Annex VI of this paper shows in detail the work, which contributed to innovation studies. The surveys are divided into several segments. The authors first identify employment and skills development, i.e. how employees are trained and the value they contribute to a product/service innovation. Other segments focus on business expenditures, access to information, business income and level of turnover. Noticeably, innovation in the informal sector is substantial. Research done by Charmes et al. (2016) provides a solid foundation to build on for further analysis as the surveys/questions used pave the way to get a closer, more credible reflection of the informal sector's reality.

Konte (2012) also highlights that measuring innovation in the informal sector requires the employment of surveys with a particular focus on selected case studies. The author notes the case study of the informal ICT sector in Senegal whereby the goal was to try to develop indicators for a better understanding of the innovation process there. The methodology depended on a survey, a review of the literature, as well as a life/success story to capture innovation. The survey identified the parent population, and sites where those working in the ICT field were more of a representative sample in Dakar, and employed the snowball technique<sup>83</sup> (whereby the people are employed as a source of identification of additional units). The literature involved defining the informal sector used in the study, while the success story involved interviewing entrepreneurs who developed in the sector.<sup>84</sup>

Moreover, Kraemer-Mbula et al. (2016) underline to what extent the magnitude of innovation is present in developing countries' informal sectors, and particularly, African countries. The research

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<sup>79</sup> Charmes et al. (2016). *Measuring Innovation in the Informal Economy – Formulating and Agenda*.

<sup>80</sup> Ibid.

<sup>81</sup> Ibid.

<sup>82</sup> Ibid.

<sup>83</sup> This is more of a statistical term, and is beyond the scope of this analysis.

<sup>84</sup> Konté, A. and M. Ndong (2012). "The Informal ICT Sector and Innovation Processes in Senegal." *African Journal of Science, Technology and Innovation*.

consists of three main case studies: South Africa, Kenya and Ghana.<sup>85</sup> Surveys, interview, field observation and photographic documentation were used. Questions on educational background, value of business, motives to create/modify a product, obstacles, employment and sources of knowledge were put forward in order to get a sense of the expanding innovation that is clearly present.

The World Intellectual Property Organization (WIPO) describes innovation in the informal sector as taking place to “overcome shortcomings of the formal economy and/or to adapt foreign products to local conditions.”<sup>86</sup> Typically, firms in the informal economy “operate in clusters,” have little capital intensity, and both limited technical upgrading and skills. Skills in this context are “acquired through early formal education, learning by doing through work experience, and learning by training through apprenticeships in the informal or formal sector.”<sup>87</sup>

De Beer et al. (2014) argue that there is no shortage of “epochal innovative and creative accomplishments in virtually all categories of human endeavour.”<sup>88</sup> They hold that innovation in the informal sector has particular characteristics: it is more driven by adopting, adapting and improving knowledge to solve problems. Innovation in informal economies is also driven by “large amounts of constraint-based innovations [that] take place under conditions of survival, scarcity and constraints” and that adopting ideas is quite quick as a result of apprenticeships and the lack of means to use the adequate know-how.<sup>89</sup> Focusing on the informal economy and its innovation dynamics provides a more accurate depiction of innovation activity in Africa.

The above-mentioned studies have shown the possibility of capturing innovation in the informal sector. We build on this work by making a clear distinction between formal and informal innovation activities in the sector. We will use this distinction to explore types of collaboration, sources of knowledge and interactions, human skill development and knowledge governance models in the informal sector. By making this distinction clear, we also are creating an expanded and more inclusive definition of innovation. This expanded understanding is, as a result, more attuned to the modalities of innovation that are common in developing economies.

### **Informal innovation in the formal sector (II/FS)**

Significant innovation can occur informally in the formal enterprises, most likely the smaller ones. Africa is abounding with small enterprises with innovations that are not the outcome of formal R&D activities, nor are they part of a formal collaboration with a university or documented within the formal IP system. Still, these innovations play a significant role in a firm’s efforts and performance, and that go unaccounted for by orthodox metrics.

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<sup>85</sup> Kraemer-Mbula, E. and S. Wunsch-Vincent (2016). *The Informal Economy in Developing Nations*.

<sup>86</sup> Wunsch-Vincent, S., J. De Beer, and E. Kraemer-Mbula (2012). “The Informal Economy, innovation and the Role of IP.” WIPO, 8.

<sup>87</sup> Ibid, 9.

<sup>88</sup> J. De Beer et al. (2014). “Innovation, Intellectual Property and Development Narratives.” 5.

<sup>89</sup> Ibid, 29.

Hartmann and Hartmann (2016) define informal innovation within the formal sector “as the development and putting-into-use of novel solutions by non-R&D employees without prior formal approval from or subsequent revealing to superiors.”<sup>90</sup> Bodger and Lhuillery argue that such innovations include marketing, design and engineering capabilities, training and learning by doing, monitoring external sources of innovation, developing new production facilities, acquiring new technologies and technical information or know-how, and organizational investment and change “where some activities such as engineering can still have significant informal attributes.”<sup>91</sup>

Such informal effort is generally embodied in people and organizations and its cost is hard to trace. Therefore, this is a source of technological innovation that receives no direct expenditures. It is in these lines that informal innovation is defined as innovation that is not explicitly planned or budgeted and therefore remains largely hidden in aggregate innovation data. In this sense, informal innovation can be contrasted to formal R&D activities that are traditionally considered as a systematic and organized activity by innovation or R&D surveys.<sup>92</sup>

As such, non-R&D specific capabilities play a significant harmonizing role in enabling knowledge creation and even commercialisation. For example, Bell (2006)<sup>93</sup> holds that “R&D leaves out many other S&T [science and technology] activities and capabilities that play centrally important roles in creatively exploiting knowledge for economic, social and political aims (e.g. a wide variety of design and engineering activities).”<sup>94</sup> A firm can also innovate through the “intensive use of existing knowledge generated by innovation activities in a specific sector.”<sup>95</sup> Garcia-Torres and Hollanders (2009) hold that the flow of informal knowledge is continuously improved and is accessible by all firms and could have “an impact on the overall innovation performance of a sector...[In fact, the] flow of informal knowledge is being constantly renewed and ...is accessible to all firms.”<sup>96</sup> While one would expect such informal innovation to be dominant in smaller formal firms, Hartmann and Hartmann (2016) hold that informal innovation is also prevalent within the operational environment of large organizations as well.<sup>97</sup>

The above mentioned recent studies bring us closer to the bigger picture as they point to dimensions of innovation that were not previously conveyed previously. We build on this work and attempt to devise measures and formulate proxies to capture this unmeasured innovation.

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<sup>90</sup> Hartmann, M., and R. Hartmann (2016). “Informal Innovation: A Hidden Source of Improvement in Work and Organizations.” MIT Sloan Working Paper Series, # 5150-15.

[https://oui2016.exordo.com/files/papers/15/initial\\_draft/OUI\\_2016.pdf](https://oui2016.exordo.com/files/papers/15/initial_draft/OUI_2016.pdf).

<sup>91</sup> Bogers, M., and S. Lhuillery (2006). “Measuring Informal Innovation: From Non-R&D to On-line Knowledge Production.” Ecole Polytechnique Fédérale de Lausanne.

<sup>92</sup> Ibid.

<sup>93</sup> Bell, M. (2006). “Background Paper for the L20 workshop on Furthering Science and Technology.” UNU-MERIT Maastricht.

<sup>94</sup> Wamae, W. (2009). “Enhancing the Role of Knowledge and Innovation for Development.” *Innovation for Development: Converting Knowledge to Value*, March.

<sup>95</sup> Garcia-Torres, M., and H. Hollanders (2009). “The Diffusion of Informal Knowledge and Innovation Performance: A Sectoral Approach.” Maastricht Economic and Social Research and Training Centre.

<sup>96</sup> Ibid.

<sup>97</sup> Hartmann, M., and R. Hartmann (2016). “Informal Innovation: A Hidden Source of Improvement in Work and Organizations.”

## B. Collaborative innovation<sup>98</sup>

Collaborative innovation is defined by the 2014 Global Knowledge Initiative (GKI) as “the creation of a good, service, or process using the shared knowledge, resources, and capacity of partners who seek to solve challenges that are beyond the capability of an individual partner.”<sup>99</sup> Sharing is emphasized by Andrea Jimenez Cisneros where collaborative innovation is defined as “an innovation process in which members of a group or community share ideas, information and work to achieve common goals,”<sup>100</sup> where ideas are shared in a process that relies on “strong linkages” and trust.

Collaborative innovation is also integral to the interactions between formal and informal innovation in a context like Africa. De Beer et al. (2014) hold that the emergence of “conceptualisations of collaborative innovation and creativity” offer significant scope to examine the interaction between formal and informal innovation.<sup>101</sup> They highlight significant collaborative models that are central to innovation and livelihood development in Africa, and range from tremendously informal to noticeably more formal models. Openness is the central factor in these initiatives of collaborative innovation/creation. Furthermore, De Beer and Armstrong (2015) hold that *open innovation* implies that the firm is open to innovation in collaboration with outsiders and that this innovation is “open for use without proprietary restrictions.”<sup>102</sup> The African Union (2014) holds that collaborative open innovation and entrepreneurship are crucial to achieving the desired knowledge economy as well as “sustainable socio-economic development across Africa”<sup>103</sup> (via De Beer and Armstrong, 2015).<sup>104</sup>

In practice, collaboration in innovation is categorized into two forms: structured institutional (and often contractual) form between individuals and institutions, vs. organic and spontaneous between different players.<sup>105</sup> Structured collaboration is featured in linkages and cooperation, whilst organic collaboration consists of knowledge spill over and informal sharing through peer-to-peer/members of the community. While structured collaboration is commonly measured by established indicators, organic collaboration receives less emphasis. In the following, we set forward organic collaboration as a non-conventional indicator that is better able to assess the forms innovation occurring in African economies. A measurement of organic collaboration captures these particular forms of innovation, which are more common in developing economies. Below is more detail on each type and its respective measurement.

To begin, structured collaboration is what is usually defined and measured by conventional metrics. In a PricewaterhouseCoopers (PwC) study, collaborative innovation is defined as “creation of innovations across firm (and perhaps industry) boundaries through the sharing of ideas, knowledge,

<sup>98</sup> Collaborative innovation is of direct relevance to Open AIR’s objective of working towards a ground-up definition of collaborative innovation in the African context.

<sup>99</sup> “2014 Annual Report - Global Knowledge Initiative.”

<sup>100</sup> Jimenez Cisneros, A. (2015). “An Attempt to Define Collaborative Innovation: Thoughts from the Fieldwork.” ICT4D blog.

<sup>101</sup> De Beer et al. (2014). “Innovation, Intellectual Property and Development Narratives.”

<sup>102</sup> De Beer, J. and C. Armstrong (2015). “Open Innovation and Knowledge Appropriation in Africa Micro and Small Enterprises (MSEs).” *The African Journal of Information and Communication (AJIC)*, Issue 16.

<sup>103</sup> African Union (AU). (2014). Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024). Addis Ababa: African Union Commission.

<sup>104</sup> De Beer, J. and C. Armstrong (2015). “Open Innovation and Knowledge Appropriation in Africa Micro and Small Enterprises (MSEs).”

<sup>105</sup> Ketchen et al. (2007) categorize collaboration as structured (organized processes) or unstructured (organic).



expertise, and opportunities.”<sup>106</sup> In that context, “joint innovation” is defined as when “the enterprise collaborates interactively with partners, resulting in an exchange of knowledge to develop an innovation; this is notably the case with companies that have complementary skills or subcontractors.”<sup>107</sup> This perspective of collaborative innovation is presented in other studies as well, e.g. Ketchen et al. (2007),<sup>108</sup> Swink (2006),<sup>109</sup> Bund et al. (2013)<sup>110</sup> and Duncan et al., (2013).<sup>111</sup>

Despite these conventional metrics, which exclusively measure structured collaboration, a significant portion of collaboration is organic, particularly in developing countries. There, collaborative innovation includes joint efforts from interactions between various players including members of the family, peers, teachers, apprentices, community, users and informal work spaces. In most cases this collaboration is spontaneous, open and informal, occurring in informal sectors and communities, as well as between those groups and formal sector firms, and even within formal institutions and firms. Sources of knowledge for innovation can also be completely outside of the mainstream, e.g. oral histories and traditional knowledge.

Baldwin and von Hippel (2010) define an open collaborative innovation project as one that involves “contributors who share the work of generating a design and also reveal the outputs from their individual and collective design efforts openly for anyone to use.” Under collaborative innovation, participants are not always opponents regarding the innovative design, and they do not always independently or jointly intend to sell products or services integrating the innovation or intellectual property rights related to it. One of the most common examples of collaborative innovation is open source software.<sup>112</sup> While open source software may typically illustrate the case of relatively developed economies, the ethos and the dynamics provide an excellent illustration of informal collaborative innovation, which is more present in developing economies. This form of collaboration is more representative of the manner in which innovation occurs in African economies.

Gloor (2006) argues that the creative output of a team working openly and sharing ideas is more than the sum of all the creative outputs of the individual’s team members, presenting Swarm’s notion of creativity as based on the principle of “openly sharing ideas.”<sup>113</sup> Team members need a risk free, supportive work environment to succeed. This allows for a flow of ideas where thoughts are exchanged openly. Similarly, Blomqvist and Levy argue that knowledge creation is necessarily “social in nature” and innovation comes about as the result of “synthesis of complementary knowledge of asymmetric actors.”<sup>114</sup>

<sup>106</sup> Sauniere, J.-C.. “Collaborative Innovation and Intellectual Property: Best Practices.”

<sup>107</sup> Ibid.

<sup>108</sup> Ketchen et al. (2007). “Strategic Entrepreneurship, Collaborative Innovation, and Wealth Creation.”

<sup>109</sup> Swink, M. (2006). “Building Collaborative Innovation Capability.” Taylor & Francis, 48.

<sup>110</sup> Bund et al. (2013). “Blueprint of Social Innovation Metrics.”

<sup>111</sup> Duncan, A.J., Le Borgne, E., Maute, F. and Tucker, J. (2013). “Impact of innovation platforms.” Innovation Platforms Practice Brief. Nairobi: ILRI.

<sup>112</sup> Baldwin, C. and E. Von Hippel. (2010). Modeling a Paradigm Shift: From Producer Innovation to Open User and Collaborative Innovation. <http://www.hbs.edu/faculty/Publication%20Files/10-038.pdf>

<sup>113</sup> Gloor, P. (2006). *Swarm Creativity: Competitive Advantage through Collaborative Innovation Networks*. New York: Oxford University Press, 22.

<sup>114</sup> Blomqvist, K. and J. Levy (2006). Collaboration Capability – a focal concept in knowledge creation and collaborative innovation in networks. *Int. J. Management Concepts and Philosophy*, Vol 2, No.1.



Von Hippel (2017) provides novel and unconventional means of measuring collaborative innovation. Through field surveys, Von Hippel explores the type of collaboration, its purpose to the innovator, diffusion efforts and the value of the collaboration. For example, to quantify the latter, Von Hippel converts the time consumed in innovation to money spent. In other words, he converts the hours spent on innovating to the wage/hour in the given country. The more individuals collaborate, the more value they create into their innovation.<sup>115</sup>

Von Hippel (2017) also builds a quantitative foundation where he introduced collaboration in an economic model for measuring innovation, applied to a number of developed countries.<sup>116</sup> We take up the task of applying this work to Africa, and in the process, attempt to quantify the impact of collaboration on innovation activity in Africa.

Collaborative innovation characterizes a lot of what we witness in the field in Africa, and hence, warrants further attention in measuring innovation in less developed countries, Africa in our case. Collaborative innovation is one of the significant factors when it comes to measuring innovation. We thus identify collaborative innovation as one of three main pillars of our Innovation Activity Index, and proceed to assess its different manifestations on both the formal and informal scopes. We divide collaboration into two sub-pillars; sources of knowledge and interactions in both, the formal and informal sectors.

### C. Free and user-centred innovation

Free and user-centered innovation is another important example of innovation occurring within a non-conventional framework. Moreover, our hypothesis remains that innovation in Africa is relatively less structured when compared to innovation in developed economies. This characteristic form of African innovation therefore does not appear on formal innovation measures. Instead, we posit that innovation in Africa occurs as informal, free and user-centred innovation. Accordingly, the modality of free and user-centred innovation can be harnessed as a useful tool for understanding innovation in the African context.

Von Hippel defines free innovation as “a functionally novel product, service, or process that was developed by consumers at private cost during their unpaid discretionary time and is not protected by its developers, and so is potentially acquirable by anyone [...] for free.”<sup>117</sup> For example, Von Hippel describes the development of the Nightscout project as an example of free innovation. Parents of children with Type 1 diabetes, in diverse geographic locations, collaboratively developed a software and home-display system to monitor their children’s blood sugar levels over the internet remotely. The project began when a software engineer developed a way to upload data from blood sugar monitoring devices onto the internet. Another systems engineer, a parent of a child with diabetes, simultaneously designed a home display system for glucose-monitor data. Both innovations were shared freely on the internet and eventually merged to create the glucose-monitoring system called Nightscout. As this example illustrates, free innovation occurs when consumers innovate without any

<sup>115</sup> Von Hippel, E. (2017). *Free Innovation*. Cambridge, MA: The MIT Press.

<sup>116</sup> See next section.

<sup>117</sup> Von Hippel, E. (2017). *Free Innovation*. Cambridge, MA: The MIT Press, 1.

financial compensation in return. Von Hippel's findings conclude that "household free innovators are self-rewarded," in other words, they innovate for their own personal use and their reward is "the benefit that they derive from it."<sup>118</sup>

His findings are extracted from national surveys conducted about the type of innovation product, the time and money consumed by the free innovator, the value of the innovation to the innovator and others, collaboration, diffusion to other consumers and commercialization. The results convey that consumer innovation is highly significant; "nationally representative surveys find that from 1.5 percent to 6.1 percent of members of the household sector in six countries engage in product innovation. That is a lot of people: tens of millions."<sup>119</sup> Furthermore, he documents, through field empirical studies that free innovation goes beyond product innovation. He finds "significant levels of free innovation [...] in services, processes, marketing methods, and new organizational methods."<sup>120</sup>

Von Hippel's recent work builds on his seminal research on user innovation. He differentiates the concepts of user-centered innovation and traditional innovation, led by the manufacturer, in the sense that users could "develop many and perhaps most new industrial and consumer products."<sup>121</sup> User-centered innovation refers to users that benefit directly from their innovation as opposed to the more traditional form of innovation that must be sold first prior to usage.<sup>122</sup> Users manipulating technologies for their own needs have been greatly facilitated by the increased prevalence of ICTs.<sup>123</sup>

Gault (2010; 2013) unpacks user-centered innovation into user driven and user innovation. User driven innovation is defined as "the exchange of information between a user of a product and the producer," to improve the product.<sup>124</sup> It entails collaboration between users and producers and user knowledge spills-over to the producer, which result in improved products. User innovation, according to Gault (2013),<sup>125</sup> refers to users, both firms and consumers, who innovate to serve their own, in house needs. Process innovation studies have shown that a significant percentage of users develop or modify process equipment and software for personal purposes.<sup>126</sup>

However, there is a difference between the free innovation and the producer innovation paradigms that has to be highlighted. "Unlike producers, free innovators do not protect their innovations from free adoption, and they do not sell them."<sup>127</sup> Consequently, a free-rider problem occurs. For this

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<sup>118</sup> Ibid, 2.

<sup>119</sup> Ibid, 16.

<sup>120</sup> Ibid.

<sup>121</sup> Von Hippel, E. (2007). "Democratizing Innovation: The Evolving Phenomenon of User Innovation", in OECD, *Science, Technology and Innovation Indicators in a Changing World, Responding to Policy Needs*, Paris: OECD, pp. 125-138. <http://www.oecd.org/sti/inno/37450155.pdf>.

<sup>122</sup> Ibid.

<sup>123</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Measurement*, <https://prd-idrc.azureedge.net/sites/default/files/openbooks/484-0/index.html>. <sup>124</sup> Ibid.

<sup>125</sup> Gault, F. (2013). *Handbook of Innovation Indicators and Measurement*. Edward Elgar: Northampton, MA, USA. p.127.

<sup>126</sup> Gault, F., and E. Von Hippel (2009). "The Prevalence of User Innovation and Free Innovation Transfers: Implications for Statistical Indicators and Innovation Policy." MIT Sloan School of Management Working Paper #4722-09.

<sup>127</sup> Von Hippel, E. (2017). *Free Innovation*, 14.

reason, “free innovators may often have too little incentive, from the perspective of social welfare, to invest in *actively* diffusing their free innovations.”<sup>128</sup>

Von Hippel (2017) argues that producers will often benefit from investing in supporting free innovators and not investing in R&D. In other words, producers should focus on where the free innovators are not, namely commercializing the innovation. He concludes “social welfare, we find, will benefit from public policies that encourage producers to transition from a focus on in-house development to a division of innovation labor with free innovators.”<sup>129</sup>

Flowers et al. (2010) stress the fact that despite its importance in both the industrial and commercial sectors, user innovation remained hidden from policymakers since it does not belong to the “dominant, producer centered understandings of the innovation process.”<sup>130</sup> This has limited the attempts to measure and include it in existing statistics.

Currently, there is more on-going work on user innovation and how to measure it. One such attempts is that of Bradonjic et al. (2016), where the authors examine whether or not policy makers underestimate user innovation. This is work in progress that aims to understand the extent of underestimation of user innovation, via analysing the differences in individual characteristics of different subgroups based on a number of personal and social factors that affect user innovation.<sup>131</sup>

Von Hippel’s work is seminal in studying innovation beyond the mainstream. It creates a foundation for further work. Specifically, as his methodology has so far been applied to developed countries, there is a great opportunity to extend it to the developing world, Africa in our case. We take up this task within the current research.

#### **D. Innovation, network capital, and social capital**

Another important non-conventional modality of innovation is network capital. Network capital “describes the knowledge stored in the networks which contribute to innovation.”<sup>132</sup> This notion is important in understanding innovation and entrepreneurship as it sheds light on the access to knowledge that is available to maximize gains. Access to knowledge, in this sense, is “sought as [a] means of increasing economic returns.”<sup>133</sup> Huggins and Thomson (2014) argue that along with the usual suspects of growth models – physical capital, labor, human capital, and R&D – network capital

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<sup>128</sup> Ibid.

<sup>129</sup> Ibid, 15.

<sup>130</sup> Flowers, S., E. Von Hippel, J. De Jong and T. Sinozic. (2010). Measuring User Innovation in the UK: The Importance of Product Creation by Users. [https://www.nesta.org.uk/sites/default/files/measuring\\_user\\_innovation\\_in\\_the\\_uk.pdf](https://www.nesta.org.uk/sites/default/files/measuring_user_innovation_in_the_uk.pdf).

<sup>131</sup> Bradonjic, P., N. Franke, and C. Luethje (2016). The Underestimation of User Innovation: Extent, Reasons, and Consequences. [https://oui2016.exordo.com/files/papers/133/initial\\_draft/Bradonjic\\_Franke\\_Luethje\\_OUI\\_2016.pdf](https://oui2016.exordo.com/files/papers/133/initial_draft/Bradonjic_Franke_Luethje_OUI_2016.pdf)

<sup>132</sup> Gault, F. (2010). Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Measurement, 42-32. <https://prd-idrc.azureedge.net/sites/default/files/openbooks/484-0/index.html>

<sup>133</sup> Huggins, R. and N. Clifton. (2013). *Innovation-Led Entrepreneurship and Inter-Organizational Knowledge Flow: The Formation of Network Capital*.

should be a vital capital input driving growth models as it facilitates the flow of knowledge.<sup>134</sup> This emphasizes our work since knowledge-sharing contributes significantly to collaborative innovation and as mentioned previously. Von Hippel (2017) highlights the substantial contribution of diffusing innovation to social welfare.

Furthermore, the formation of *network capital* has been linked to the targets of innovation-led growth. “For the majority of firms, the rationale for network capital formation is embedded within the strategic requirements of firms, in particular the requirement to... access knowledge from beyond the boundaries in order to meet the innovation objectives.”<sup>135</sup> Network capital is created, in this context, to identify the latest research that can support a firm in developing new tools that can work in tandem with their existing processes.

Related to network capital is *social capital*. Rauf (2009) examines the role of “informal institutions of norms, customs and traditions” on innovations within firms, and argues that the social capital arising from there can both help innovation and inhibit it within small enterprises.<sup>136</sup> The paper attempts to provide a conceptual framework of how social capital fosters innovation within small firms. Social networks become an essential element in the economic activity of small businesses, as they are more likely to rely on them to obtain information and learn about new techniques of productions due to their smaller resource base.<sup>137</sup> Rauf also notes that social capital can act as a liability: dense networks can inhibit innovation, whereas weak and absent ties can generate new ideas and bridge gaps in support networks.

## E. Indigenous knowledge

*Indigenous knowledge, or traditional knowledge*, is defined as knowledge that includes “traditional medicinal, ecological and other knowledge, as well as folklore and traditional cultural expressions (e.g. beadwork, music, designs).”<sup>138</sup> Indigenous knowledge is pertinent to the global south, particularly Africa, and has hardly been formalized.<sup>139</sup> Accordingly, we argue that its inclusion within the broader definition of innovation would acknowledge the specific forms of innovation occurring in African economies.

Traditional knowledge is not commonly included in the mainstream understanding of knowledge and innovation. As perceived by a mainstream lens, knowledge and innovation in developing countries are taken to refer to “an exogenous scientific and technological base [which] includes a set of rather

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<sup>134</sup> Huggins, R. and P. Thompson. (2014). “A Network-Based View of Regional Growth.” *Journal of Economic Geography*, 14(3), 511-545. [http://irep.ntu.ac.uk/11960/1/216267\\_Thompson\\_Pid216267.pdf](http://irep.ntu.ac.uk/11960/1/216267_Thompson_Pid216267.pdf)

<sup>135</sup> Huggins, R. and N. Clifton (2013). Innovation-Led Entrepreneurship and Inter-Organizational Knowledge Flow: The Formation of Network Capital, 19.

<sup>136</sup> Rauf, M. (2009). Innovations and Informal Institutions: An Institutional Approach to the Role of Social Capital for Innovation. <http://www.jare-sh.com/volume1-issue1/innovations.pdf>

<sup>137</sup> Ibid.

<sup>138</sup> Elahi, S. and J. De Beer, with D. Kawooya, C. Oguamanam, and N. Rizk (2014). Knowledge and Innovation in Africa, Scenarios for the Future. 2014, Open AIR.

<sup>139</sup> Sagasti, F. (2004). “Knowledge and Innovation for Development: The Sisyphus Challenge of the 21st Century.” Edward Elgar Publishing Limited, UK.

limited scientific, technological and production capabilities.”<sup>140</sup> Knowledge and innovation as such defined are “seldom related to the stock of traditional knowledge, techniques and production in the country.”<sup>141</sup>

This comes in contrast to the reality in developing countries, where traditional knowledge often plays a significant role in innovation. Wamae (2009) highlights the example of Chinese traditional medicine and the ability of the Chinese to bridge the gap between modern and traditional medicine, managing to commercialize Indigenous knowledge. Chinese investments in Africa thus offer fertile grounds for exploring metrics for innovation.<sup>142</sup> Similarly, Ouma (2014) asserts that there is a rising interest in traditional or Indigenous knowledge particularly in biological resources and cultural goods providing evidence for further commercialization of traditional knowledge in agricultural, pharmaceutical and cosmetic industries.<sup>143</sup> Elahi et al. (2014) highlight the fact that the process of turning back towards Indigenous forms of knowledge could be crucial to the sustainability of the agricultural sector in Africa, particularly as costs of production – labour, fuel, irrigation and machinery costs – diminish, leaving room for additional surplus.<sup>144</sup>

There is value in the sharing of knowledge, in network capital and in social capital that is built within innovation particularly in developing countries. Moreover, it is imperative that the value of traditional knowledge be acknowledged. This acknowledgement hinges on some type of collaboration with other players that can assist in the development, diffusion, and possibly even the commercialization of traditional knowledge. Furthermore, in a collaborative context, traditional knowledge can empower other types of knowledge and innovation. This is an important component of our research. Indigenous knowledge is significantly widespread in African countries, since rural communities are prevalent. This form of knowledge transfer takes place organically on the ground and creates an open environment for the development of informal innovation activity. This is what our research attempts to capture; the organic ways in which knowledge transfer feeds into innovation.

## F. Knowledge-sharing

The building of social capital and human networks is likely to produce a platform for knowledge-sharing, which is another key factor in the innovation processes. We hypothesize that this form of knowledge-sharing is important to understand the processes of innovation in Africa. Hurmellina-Laukkanen (2011) argues that the success of R&D and innovation activities depends on the effectiveness through

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<sup>140</sup> Ibid, 8.

<sup>141</sup> Ibid.

<sup>142</sup> This paper is also very interesting because not only do they discuss disruptive innovation which has been a recent characteristic of advanced economies, but they also discuss the potential rise of the “disruptive market” and the role of demand/consumers in making an innovation successful or not. Within this context, something like the M-Pesa in Kenya and its wide-use could provide a relevant example; the widespread use of this mobile method created an innovative example. Within this context we can examine other examples of innovation that have led to wide use/implementation and see if this could provide a ground for metric to be included.

<sup>143</sup> Ouma, M. (2014). The Policy Context for a Commons-Based Approach to Traditional Knowledge in Kenya. In de Beer et al. (Eds.) (2014). *Innovation and Intellectual Property- Collaborative Dynamics in Africa*.

<sup>144</sup> Elahi, S, and J. de Beer, with D. Kawooya, C. Oguamanam, and N. Rizk (2014). *Knowledge and Innovation in Africa, Scenarios for the Future*.



which firms are able to “gain, create and transfer” knowledge.<sup>145</sup> Because of the rapid pace of technological change, gaining knowledge collaboratively from complementary sources has become essential to this process.<sup>146</sup>

However, Hurmelinna-Laukkanen (2011) also acknowledges the importance of balancing between knowledge sharing and protecting knowledge from imitation. Formal means of protection such as patents are complemented with informal means such as “human resource management, lead-time, tacit nature of knowledge, and technical methods of concealment.”<sup>147</sup> There are several ways that the appropriability regime can allow new ways for knowledge to be shared.

Von Hippel’s (2017) case studies have shown most individual innovators diffuse freely their innovations because of altruism, or the high cost of issuing patents and the time it consumes, or simply because they are unaware of the value of their own innovations to others.<sup>148</sup> While it creates social welfare, it also encourages free riding.

In Africa, knowledge-sharing is an important part of knowledge appropriation. De Beer and Armstrong (2015) and de Beer et al. (2013) highlight that MSEs may appropriate knowledge in three ways; 1) formal appropriation with “[l]egally anchored, formal mechanisms of intellectual property appropriation, e.g., IPRs such as patents, trademarks, industrial designs and copyrights; 2) Semi-formal: [i]ndirect means of appropriation with a lesser degree of legal formality, e.g., secrecy, publishing, non-competition clauses, non-disclosure agreements and contracts; and 3) Informal: [i]ndirect and informal, e.g., lead-time, complexity (of design/technology), after-sales and other services, customer loyalty but also family/community mechanisms, in tandem with community sanctions/ostracism for copying/imitation.”<sup>149</sup> Within an African context, appropriation normally occurs semi-formally and informally.<sup>150</sup>

Related to this is the presence of economically more efficient knowledge-sharing and how public policy can support it.<sup>151</sup> Gault (2010) provides examples such as “support for ‘open licensing’ infrastructures such as the Creative Commons license for text and the General Public License for open source software code.” In this case, public policy may prop up “defensive publishing” as a mechanism to guarantee some protection to user innovators who are not after formal IP protection.<sup>152</sup> This

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<sup>145</sup> Hurmelinna-Laukkanen, P. (2011). “Enabling Collaborative Innovation – Knowledge Protection for Knowledge Sharing.” *European Journal of Innovation Management*.

<sup>146</sup> Ibid.

<sup>147</sup> Ibid.

<sup>148</sup> Von Hippel (2017), *Free Innovation*.

<sup>149</sup> For more information on knowledge appropriation, see de Beer and Armstrong (2015).

<sup>150</sup> de Beer, J. and C. Armstrong (2015). “Open Innovation and Knowledge Appropriation in Africa Micro and Small Enterprises (MSEs)” (2015). *The African Journal of Information and Communication (AJIC)*, Issue 16.

<sup>151</sup> Gault, F. and E. Von Hippel, (2009). “The Prevalence of User Innovation and Free Innovation Transfers: Implications for Statistical Indicators and Innovation Policy.”

<sup>152</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Management*. Available Online. <https://prd-idrc.azureedge.net/sites/default/files/openbooks/484-0/index.html>



enables them to make use of their own inventions and innovations at a later point.<sup>153</sup> This could help the problem of the under estimation of user innovation discussed above.

## G. Social innovation

Social innovation is another non-conventional modality of innovation. We offer this non-conventional modality as a tool to identify the characteristic forms of innovation that are happening in the African context. This is because we hypothesize that the innovation occurring in Africa tends to be oriented towards a social purpose. In the following, we will outline the various definitions of social innovation that have been offered thus far and identify the challenges to developing indicators that can adequately monitor this non-conventional modality of innovation.

Social innovation can be broadly defined as new ideas in the form of products or services that are able to meet social goals.<sup>154</sup> Gault (2014b) acknowledges that social innovation is still evolving as a field, and that communities attempt to alter particular technologies or practices for their own advantage.<sup>155</sup> Nicholls and Murdock (2012) consider social innovation as a “sixth wave of macro-level change[...] which has the potential to be as disruptive and influential as the technological-economic waves that went before.”<sup>156</sup> Social innovation thus, is in ways similar to the industrial revolution, coming through to the age of steam, steel, oil and information and telecommunications.<sup>157</sup> Konte and Ndong (2012) find that social innovation specific to the informal sector in Senegal is inspired by the community and tends to have a social purpose permitting the community to preserve its identity, and are adapted to a specific social and economic environment.<sup>158</sup>

Hubert et al. (2010) define social innovation, with a particular focus on Europe, as new ideas in the form of products or services that can meet social needs as well as generate novel social relationships or collaborations in such a way that not only are these ideas socially beneficial, but they also improve a society’s ability to perform.<sup>159</sup> Meanwhile, Gault (2013) discusses social innovation whereby communities perform novel or considerably improved activities to advance their welfare, and is said to be a vital area for future research, particularly as “governments transfer more public services to the voluntary sector and better indicators are required to understand, promote and evaluate social ‘innovation.’”<sup>160</sup> Furthermore, Ruede and Lurtz (2012)<sup>161</sup> have introduced seven features of social

<sup>153</sup> Henkel, J. and S. Pangerl (2008), Defensive Publishing: An Empirical Study, Working Paper, Munich: Technical University of Munich.

<sup>154</sup> Mulgan, G., S. Tucker, R. Ali, and B. Sanders (2007). Social Innovation: What it is, Why it Matters, and How it can be Accelerated. Online. [http://eureka.sbs.ox.ac.uk/761/1/Social\\_Innovation.pdf](http://eureka.sbs.ox.ac.uk/761/1/Social_Innovation.pdf).

<sup>155</sup> Gault, F. (2014b). Innovation Indicators and Their Applications: Implications for Africa. Online. <http://www.ieri.org.za/sites/default/files/outputs/WP%202014%20FDG%2001.pdf>

<sup>156</sup> Nicholls, A. and A. Murdock (2012). Social Innovation: Blurring Boundaries to Reconfigure Markets. Palgrave Macmillan.

<sup>157</sup> Ibid.

<sup>158</sup> Konté, A. and M. Ndong (2012). “The informal ICT sector and innovation processes in Senegal,” African Journal of Science, Technology and Innovation.

<sup>159</sup> Hubert, A. (2010). *Empowering People, Driving Change: Social Innovation in the European Union, Report*.

<sup>160</sup> Gault, F. (2013). Measuring innovation: the use of indicators in developing policy. Online. <https://elgarblog.com/2013/08/15/measuring-innovation-the-use-of-indicators-in-developing-policy-by-fred-gault/>.

<sup>161</sup> Ruede, D. and K. Lurtz (2012). Mapping the Various Meanings of Social Innovation: Towards a Differentiated Understanding of an Emerging Concept, EBS Business School Research Paper No. 12-03, July 19.

innovation: human well-being, social practices, urban/community development, human resource management, social success factors of technological innovations, social work professionals, digital connectedness and innovation potential. Each of these concepts are distinct.<sup>162</sup>

The literature on social innovation has been growing to address recent social problems such as food security, youth unemployment, and climate change.<sup>163</sup> Within this context, it is important to note that social innovation is not restricted to a particular type of institution; social innovation can occur in non-profit organizations, business corporations, and universities, as well as in technology centres.<sup>164</sup> Social innovation may also have sectorial linkages<sup>165</sup> such as innovation occurring in the agricultural sector.

Social innovation is therefore a significant platform that should be included in our understanding of innovation. However, there are significant challenges in developing indicators, which measure social innovation. Maree (2005) highlights that the use of indicators is limited in scope as indicators usually measure a *single dimension* of performance, similar to the mainstream metrics, while the impact of social innovation is normally diverse. Therefore, social innovation is particularly hard to capture by an indicator.<sup>166</sup> Manzini (2015)<sup>167</sup> holds that the current surveys of South Africa's National System of Innovation (NSI) do not cover the wide array of innovation activities that are crucial for South Africa's economic and social well-being. This was also highlighted by the OECD Innovation Strategy (2010) whereby the existing framework is not capable of capturing the social impacts of innovation.<sup>168</sup>

Accordingly, a major challenge concerns the methods by which social innovation is assessed particularly because it is a feature of production whose effects are not normally observed by prices.<sup>169</sup> Nicholls (2006) holds that social entrepreneurship is more prone to produce social and public goods through innovation relative to commercial enterprises.<sup>170</sup>

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<sup>162</sup> Ibid.

<sup>163</sup> Howaldt, J. and M. Schwarz (2010). Social Innovation: Concepts, research fields and international trends. Research Rapport. Sozialforschungsstelle Dortmund. ZWE der TU-Dortmund Murray, R. Caulier-Grice, J. y Mulgan, G. (2010). The Open Book of Social Innovation. London: NESTA.

<sup>164</sup> Resindex: A Regional Index to Measure Social Innovation. 2013 Annual Report. Online. [http://www.simpact-project.eu/publications/indicators/2014\\_RESINDEX\\_eng.pdf](http://www.simpact-project.eu/publications/indicators/2014_RESINDEX_eng.pdf)

<sup>165</sup> For more information, see Letty, B., Z. Shezi & M. Mudhara (2012). "An exploration of agricultural grassroots innovation in South Africa and implications for innovation indicator development." Working Paper 2012-023, Maastricht: UNU-MERIT. Published in abridged form in the African Journal of Science, Technology and Innovation, Vol.4, No. 3, 2012, pp. 32-60.

<sup>166</sup> Marée, M. (2005). "Les impacts collectifs de l'insertion. Définition, typologie et techniques de mesure", in Nicaise, I., Nyssens, M. and Marée, M. (eds) Economie sociale, inclusion sociale et intérêt général, Politique Scientifique Fédérale/Academia Press, Gand.

<sup>167</sup> Manzini, S. (2015) "Measurement of Innovation in South Africa: An Analysis of Survey Metrics and Recommendations." *South Africa Journal of Science*.

<sup>168</sup> OECD (2010). Towards a new measurement Agenda for Innovation. Online. <https://www.oecd.org/site/innovationstrategy/45392693.pdf>

<sup>169</sup> Maree, M. and S. Mertens (2012). The Limits of Economic Value in Measuring the Performance of Social Innovation. In *Social Innovation: Blurring Boundaries to Reconfigure Markets*. Edited by Alex Nicholls and Alex Murdock. Palgrave Macmillan.

<sup>170</sup> Nicholls, A. (2006). *Social Entrepreneurship: New Models of Sustainable Social Change*, Oxford University Press.

Furthermore, Schmidt et al. (2013) stress that there is overlap<sup>171</sup> between social innovation and technological innovation, but since social innovation is more service-based and includes new markets or processes, having a clear metric/indicator that captures social innovation becomes a difficult task. That is why attempts to capture social innovation should be viewed as a response to social needs, and should capture the social value it adds to improving welfare.<sup>172</sup> Manzini (2015) suggests the use of social impact indicators such as social cohesion and social impact of innovations as proxies for measuring social innovation.<sup>173</sup>

Within an African context, Manzini (2015) acknowledges that social cohesion may be “difficult to define or measure” but that more innovation “will manifest in social cohesion. This could be in the form of a more inclusive society, with low rates of income inequality, poverty and other social maladies and divides.”<sup>174</sup> Social cohesion, therefore, can be regarded as both an instrument and a goal for innovation policy.”<sup>175</sup>

Maree and Mertens (2012)<sup>176</sup> suggest that the best approach to measure the many different aspects involved in social innovation and its production process is to employ a number of indicators in tandem, rather than one particular tool. Boelman et al. (2015) hold that there is no single measure<sup>177</sup> that is able to capture the diverse nature of social innovation.<sup>178</sup> They thus discuss three dimensions that should be taken into consideration when measuring social innovation: the framework conditions (allowing policy makers to get feedback on how to create an enabling environment to support social innovation),<sup>179</sup> the organisational output and societal outcomes (allowing an understanding of the impact of social innovation, and provides policy makers with data that can help in providing support) and the entrepreneurial activities (policy makers require empirical survey data on organisations that are socially innovative).<sup>180</sup>

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<sup>171</sup> Both are forward looking, and this overlap exists in how both are practised and researched. For more information, see Schmidt et al. (2013).

<sup>172</sup> Schmitz, B., Krlev, G., Mildenerberger, G., Bund, E., and D. Hubrich (2013). Paving the Way to Measurement – A Blueprint for Social Innovation Metrics. A short guide to the research for policy makers. A deliverable of the project: “The theoretical, empirical and policy foundations for building social innovation in Europe” (TEPSIE), European Commission – 7 the Framework Programme, Brussels: European Commission, DG Research Online.  
<http://www.siresearch.eu/sites/default/files/D2.5%20final.pdf>

<sup>173</sup> Manzini, S. (2015) “Measurement of Innovation in South Africa: An Analysis of Survey Metrics and Recommendations.” *South Africa Journal of Science*.

<sup>174</sup> Ibid.

<sup>175</sup> Ibid.

<sup>176</sup> Maree, M. and S. Mertens (2012). The Limits of Economic Value in Measuring the Performance of Social Innovation. In *Social Innovation: Blurring Boundaries to Reconfigure Markets*. Edited by Alex Nicholls and Alex Murdock. Palgrave Macmillan.

<sup>177</sup> The authors referred to metrics that capture the social aspect of innovation by focusing on social, normative or environmental dimensions, such as the OECD Better Life Index, European System of Social Indicators (GESIS), Civil Society Index (CIVICUS), and the National Footprint (Global Footprint Network). Related to this is the regional social innovation index (RESINDEX). More on this will be found in the Measurement section.

<sup>178</sup> Boelman, V., A. Kwan, J. R. K. Lauritzen, J. Millard, and R. Schon (2015). Growing Social Innovation: A Guide for Policy Makers, 20. Online. [http://youngfoundation.org/wp-content/uploads/2015/04/YOFJ2786\\_Growing\\_Social\\_Innovation\\_16.01.15\\_WEB.pdf](http://youngfoundation.org/wp-content/uploads/2015/04/YOFJ2786_Growing_Social_Innovation_16.01.15_WEB.pdf).

<sup>179</sup> Ibid.

<sup>180</sup> Ibid.

While still in its early stages, some work has been done in attempts to measure social innovation and assess its impact. Some examples of trials to quantify social innovation include the Regional Social Innovation Index (RESIDENX), which attempts to come up with a model of social innovation, its dimensions and indicators, and the European Social Innovation Index (2011).<sup>181</sup> RESINDEX theoretically relates the concept of the absorptive capacity of knowledge with social innovation.<sup>182</sup> Absorptive capacity is the aptitude of organisations to recognize, integrate, alter and employ external knowledge to the accrued internal knowledge.<sup>183</sup> RESINDEX is based on the following pillars:

- *Potential Capacity for Innovation Index*: An index that comprises five sub-pillars of innovation: knowledge, learning, internal socialisation, external association and development.
- *Social Orientation Index*: This index contains four factors in the execution of social projects: knowledge acquisition, development of social projects, impact of social projects and governance on social projects.
- *Social Innovation Index*: This index contains four factors in the implementation of innovative social projects – “projects that have generated new or improved products, processes, methods and/or services: knowledge acquisition, development of innovative social projects, and impact of innovative social projects and governance of innovative social projects.”

RESINDEX employs a structure methodology in its attempt to measure social innovation based on the following: defining a model of social innovation, dimensions and indicators, developing a model, drafting a social innovation questionnaire, applying the survey to different types of regional organisations: businesses, non-profit organisations, universities and technology centres, validating the Regional Index of Social Innovation empirically and distributing the results. RESINDEX is a substantial platform for capturing social innovation; however, one might wonder that there is unmentioned space, specifically in developing countries, that should be included, i.e. the wide-ranging informal sectors.

While in our research we do not proceed to directly measure social innovation per se, we do explore many related aspects such as collaboration, non-market innovation and informal innovation in the formal and informal sectors. In sum, we have described the definitions of social innovation, which we have encountered thus far and outlined the difficulties in developing indicators to measure its occurrence.

## H. Public sector innovation<sup>184</sup>

While most discussions on innovation highlight innovation on the firm level, and how to deliver products into the market, significant innovation takes place in the public sector. In the following, we

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<sup>181</sup> This index focuses on six policy areas (urban mobility, healthcare, education, labour market, cultural heritage, and energy) in six countries (Italy, UK, Hungary, Greece, Romania and Austria) with the purpose of coming up with a better definition of social innovation and test its validity, as well as to measure social innovation in these countries and sectors.

<sup>182</sup> Resindex: A Regional Index to Measure Social Innovation. 2013 Annual Report. Online. [http://www.simpact-project.eu/publications/indicators/2014\\_RESINDEX\\_eng.pdf](http://www.simpact-project.eu/publications/indicators/2014_RESINDEX_eng.pdf).

<sup>183</sup> Cohen, W. M. and D. A. Levinthal (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128-152.

<sup>184</sup> Our research will not tap into public sector innovation.

define public sector innovation and highlight the challenges involved in developing indicators to measure its progress. Mulgan (2007) holds that “the simplest definition” of public sector innovation is that it “is about new ideas that work at creating public value. The ideas have to be at least in part new (rather than improvements); they have to be taken up (rather than just being good ideas); and they have to be useful.”<sup>185</sup>

Research on public sector innovation has been growing, based on work in the 1960s and 1970s that attempted to observe the characteristics of innovative governments and states. Newer research focuses on diffusion patterns, the interaction between politics and bureaucracies, and the gaps that innovation aims to fill.<sup>186</sup>

Gault (2014b) holds that public sector innovation does not have a market but has potential users, and that a public institution can be involved in the same innovation activities that a private sector firm conducts.<sup>187</sup> In addition, Gault (2015a) mentions that there have been on-going debates on innovation in public institutions, as well as in households, but neither resulted in anything similar to the *Oslo Manual* when it comes to measuring innovation and interpreting the results.<sup>188</sup>

Gault (2010) holds that most innovation “accomplishments” including R&D, capital investment, training and development and acquisition of intellectual property are conducted within the public sector.<sup>189</sup> This is where the importance of public sector innovation stems from. Within this context, it is important to note that the public sector also enters into the equation as a supplier of the enabling environment needed for innovation, such as the infrastructure that supports innovation activity. Specifically, Gault (2010) highlights this environment as the necessary framework conditions and infrastructure, in other words, the enabling environment, which props up private sector innovation activity.<sup>190</sup>

Bloch and Bugge (2013) hold that a suitable framework for measuring and understanding innovation in the public sector continues to be unavailable. Their work managed to show how public sector innovation relies on interacting with the private sector and those who use public sector services. Thus, the systemic nature of public sector innovation entails “an *integrative approach*” that is most suited to understand public sector innovation.<sup>191</sup>

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<sup>185</sup> Mulgan, G. (2007). “Ready or Not? Taking Innovation in the Public Sector Seriously.” NESTA Provocation 03.

<sup>186</sup> Ibid.

<sup>187</sup> Gault, F. (2014b). Innovation Indicators and Their Applications: Implications for Africa. Online.

<http://www.ieri.org.za/sites/default/files/outputs/WP%202014%20FDG%2001.pdf>.

<sup>188</sup> Gault, F. (2015a). Measuring Innovation in All Sectors of the Economy. UNU-Merit Working Paper 2015-038.

<sup>189</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Management*. Available Online. <https://prd-idrc.azureedge.net/sites/default/files/openbooks/484-0/index.html>.

<sup>190</sup> For more information, see Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Management*. Available Online. <https://prd-idrc.azureedge.net/sites/default/files/openbooks/484-0/index.html>.

<sup>191</sup> Bloch, C. and M. Bugge (2013). Public Sector Innovation: From Theory to Measurement. *Structural Change and Economic Dynamics*. 27 (2013) 133–145.



Innovation in the public sector also has not been fully integrated into conventional metrics. The Oslo Manual acknowledges innovation in the public sector, stating that “(m)uch work remains to be done to study innovation and develop a framework for the collection of innovation data in the public sector.”<sup>192</sup> Gault (2010) argues that policy makers should come up with concepts, definitions and indicators/statistics on innovation activities related to public sector innovation.<sup>193</sup> He recommends that questionnaires should be developed in such a way that they are comparable to the Community Innovation Survey (CIS) used in the private sector to be used to produce relevant indicators. More attention will have to be given to consider whether private and public sector innovations should be merged to have a single innovation manual.<sup>194</sup> One possible adjustment to the Oslo Manual would be to adjust paragraph 50 to replace “on the market” with “to potential users,” or with something similar; this could permit public sector bodies and consumers to be “admitted to the class of innovators.”<sup>195</sup>

The OECD (2010) holds that accounting for the efficiency of creating public policies and services, and delivering them are needed as well as the use of public funds in innovation activities.<sup>196</sup> Gault (2010) argues that policy makers should come up with concepts, definitions and indicators/statistics on innovation activities related to public sector innovation.<sup>197</sup> Increasing the learning outcomes via public sector innovation is also required. Key actions to achieve this include establishing a framework for measuring public sector innovation for the provision of public services, health and education and developing indicators that represent the “nature, direction and intensity of public support for innovation, at national and sub-national levels.”<sup>198</sup> The key indicators of public sector innovation should comprise several innovation activities and innovation surveys should be adapted to capture public sector innovation.<sup>199</sup>

## IV. Assessment of mainstream innovation metrics – a summary of our critique

In the above section, we highlighted modalities of innovation that go beyond mainstream metrics<sup>200</sup> which look at formal outputs and inputs of textbook definitions of innovation such as patents, scientific publications on the one hand, and formal R&D expenditures and skills developed through

<sup>192</sup> OECD and Eurostat (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. Third Edition.

<sup>193</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Management*. Available Online. <https://prd-idrc.azureedge.net/sites/default/files/openebooks/484-0/index.html>.

<sup>194</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Management*, 77. Available Online. <https://prd-idrc.azureedge.net/sites/default/files/openebooks/484-0/index.html>.<sup>195</sup> Gault, F. (2014b). *Innovation Indicators and Their Applications: Implications for Africa*. Online. <http://www.ieri.org.za/sites/default/files/outputs/WP%202014%20FDG%2001.pdf>.

<sup>196</sup> OECD (2010). *Towards a Measurement Agenda for Innovation. Measuring Innovation: A New Perspective*. Print.

<sup>197</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Management*. Available Online. <https://prd-idrc.azureedge.net/sites/default/files/openebooks/484-0/index.html>.

<sup>198</sup> OECD (2010). *Towards a Measurement Agenda for Innovation. Measuring Innovation: A New Perspective*. Pg. 16. Print

<sup>199</sup> Ibid, 12.

<sup>200</sup> Appendix VI offers information on lesser-tracked forms of innovation: communication, drastic, component, architectural, frugal, soft, disruptive.

formal education on the other. In reality, there is unaccounted innovation that occurs in the informal sector, as well as the formal sector, in communities and at homes. Examples are collaborative, user-driven, informal, organic, accidental, incremental and other local types of innovation. Conventional metrics do not capture informal skill development, unregistered innovation outputs and shared innovations. All these are reflective of the true innovation scene that occurs on the ground across different terrains such as that of Africa.

Our critique is rooted in the belief that in the developing world, Africa included, innovation is often devised to solve context-specific problems and issues, reflecting the intricate realities of knowledge production settings – unique community histories, experiences and cultures. Statistics purporting to measure African innovation do not adequately capture the breadth of activity occurring on the continent. Policymakers rely on these indicators and try to simulate the “Western innovation” that these indices measure – for example, the acquisition of formal intellectual property rights (IPRs). These indicators fall short of capturing the wealth of knowledge and innovation in Africa. Our research aims to reveal the unique socio-economic factors that characterize innovation on the African continent, identify areas where the current understanding, and hence the measurement, of innovation in Africa could be complemented. We aim to develop a tool to assess the unmeasured components of innovation activity in Africa.

Further to the above discussion, the section below summarizes our critique. We acknowledge attempts made to go beyond the mainstream, and we propose moving further into key areas that bring us closer to an accurate depiction of Africa’s innovation realities.

### **A. Conventional metrics view innovation inputs and outputs through a formal lens**

Predominant innovation metrics mostly capture formal processes that are conducive or reflective of innovation. For instance, the Global Innovation Index (GII) and the innovation components of the Global Competitiveness Index and the World Bank Knowledge Assessment Methodology all focus on formal innovation. Indeed, GII sub-indices looking at knowledge creation consist of scientific and technical publications, national office resident patent applications, patent cooperation treaty resident application and citable documents. Equivalently, knowledge diffusion comprises of royalties and license fees receipts, high-tech exports, communications, computers and information services exports along with FDI net outflows. Human capital is measured in terms of R&D personnel and holders of formal educational degrees.

According to this lens, a significant portion of Africa’s innovation inputs and outputs immediately escapes the radar of conventional metrics. First, much of the innovation processes occur through informal channels, both in the formal and informal sectors. On the input side, the development of human capital involved in the innovation process does not take place through formal training, nor indeed formal degree education. On the contrary, much of the human skill development in a context such as that of Africa takes place through informal training, apprenticeships and internships.

In fact, some formal channels do include unconventional skill development initiatives that do not fit the checklist of conventional metrics, e.g. vocational training. A case in point is Ghana’s Ashesi

University, where students acquiring vocational training through an alternative curriculum succeeded in developing mobile technologies for the finance sector.<sup>201</sup>

In line with this, conventional metrics look at R&D expenditure as another critical input in the innovation process. Much of innovation in Africa, in both the formal and informal sector, will be the product of experimentation on the ground, which is not the output of formal R&D. Innovation then becomes the output of implicit innovation activities rather than explicit science and technology policies whose main focus is on measures for funding and organizing scientific research.<sup>202</sup> A good part of that involves collaboration between formal and informal players, and this goes unmeasured.

On the output side, much of the innovative output and the knowledge produced does not go through the formal knowledge appropriation path and does not seek formal intellectual property appropriation. A great deal of the innovative output is shared, and/or appropriated through informal mechanisms, such as family secrets and verbal agreements. In fact, if the innovative output is not shared freely and organically, it can be protected by secrecy within a family, tribe and/or a certain community, or by trust, i.e. the innovator can trust the user with the innovative output through a verbal agreement or an informal contract.

Beyond R&D, de Beer et al. (2014) hold that intellectual property (IP)-related variables that attempt to capture innovation do not adequately capture how innovation and creativity realistically happen in Africa. Within this context, it is no longer a question of whether or not innovation in Africa exists, but rather whether or not IP can properly capture and reflect Africa's innovative activities.<sup>203</sup>

In our research, we attempt to assess such informal processes. We build on the work of others. For example, while human capital has been historically associated with formal education, Kraemer-Mbula (2009) holds that human capital creation that occurs in the workplace must be taken into account in innovation surveys in frontier markets, particularly those with large informal sectors.<sup>204 211</sup> Kraemer-Mbula and Wamae (2009) also highlight literacy and learning to learn as crucial for any country facing the hurdles in developing its science and technology, and should be a focus moving forward.<sup>205</sup>

In our research, we identify, acknowledge and assess informal means of human skill development, sources of knowledge, interactions and knowledge governance. We include these as seminal inputs and outputs of the innovation process.

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<sup>201</sup> Awuah, P. (2012). *Path to a New Africa*, Stanford Social Innovation Review: Informing and Inspiring Leaders of Social Change.

<sup>202</sup> Mugabe, J. (2009). *Knowledge and Innovation for Africa's Development: Priorities, policies and program*. Prepared for the World Bank Institute.

<sup>203</sup> de Beer, J., C. Armstrong, C. Oguamanam and T. Schonwetter, (Eds.) (2014). *Innovation & Intellectual Property: Collaborative Dynamics in Africa*.

<sup>204</sup> Kraemer-Mbula, E. (2009). Part Three: Report of the Rapporteur General. In *Innovation for Development: Converting Knowledge to Value*. Summary Report. Online. <http://unesdoc.unesco.org/images/0018/001832/183288e.pdf>.

<sup>205</sup> Kraemer-Mbula, E. and W. Wamae, (2009). *Innovation and the Development Agenda*. OECD/IDRC.

## **B. Conventional metrics are primarily concerned with the commercial outcomes of innovation**

Conventional metrics are centered on innovation as it makes its way through a set of processes to a set of products and services that make it to the market. By doing that, conventional metrics overlook a set of innovations that occur in both the formal and informal sectors, as well as innovation that takes place by users and producers as explained earlier. As well, in that context, innovation for social causes or innovation in the public sector whose products and services are presumably public goods, are marginalized in these metrics.

These types of innovations are not fully integrated in conventional metrics. Only new product development of consumer goods by producers are accounted for, whereas the development of consumer goods by end users has been overlooked.<sup>206</sup> Strictly defining innovation as what is marketed means that “an innovation developed and consumed by end users is not an innovation – even if it spreads widely among users by peer to peer diffusion – unless and until it becomes an offering to the market of a new or significantly improved product (good or service, or a mix of both).”<sup>207</sup> Moreover, as we mentioned, conventional metrics do not include social innovation within their definition of innovation. These metrics also do not include social impacts as an indicator of innovation.

The work of Von Hippel is crucial for our work in taking this research to the next level. In fact, as mentioned previously, the recent work of Von Hippel (2017) highlights the importance of free innovation. This is categorized under informal innovation in the informal sector. This is one of the four scopes of innovation we intend to cover. His work is derived through household surveys, which he carried out in six countries (developed economies) and he built an economic model describing the significant extent to which free innovation contributes to the economy. Our survey is partially based on the questions he developed, mirroring his research but in the African continent.

## **C. Conventional indicators use one yardstick to assess diverse economies**

Global macro indicators use one yardstick to measure all countries regardless of their status of development. The differing and dynamic nature of the concept of innovation, coupled with the fact that African economies lag behind other emerging and advanced economies in their development cycle means that the current indices are tailored in such a way as to magnify the innovative achievements of advanced economies, and understate those of less advanced ones such as African economies. Indicators can mean different things in different contexts. Moreover, give this context, a global comparison of economies may be entirely impossible.

Kraemer-Mbula (2009) argues that it is important to note that there is a policy divergence in how developing countries [Africa, the NEPAD-ASTII] should measure their innovative activities. In fact, most indicators that are used to measure innovation internationally do not fit the framework of developing countries, particularly in developing countries in Africa. The global innovation frontier is a

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<sup>206</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Management*.

<sup>207</sup> Ibid, 25.

different benchmark than the type of innovation occurring in developing economies and least developed countries.<sup>208</sup> This is despite the fact that innovation in frontier markets such as Africa is usually incremental, informal, and to a great extent under the technology frontier. This is generally why “incremental innovations” in emerging markets and least developed countries are not captured by the current measurement framework.<sup>209</sup>

Gault (2010) stresses the need to support survey work, case studies, and the synchronization of the work of international organizations on innovation. This development will be key to reduce the gap between advanced countries and emerging markets and facilitate international comparisons.<sup>210</sup>

Furthermore, improving macro indicators requires promoting the design of new statistical methods and interdisciplinary approaches to data collection.<sup>211</sup> Proposing innovation policies requires taking into account the characteristics of technologies, people and locations and the linkages and flows between them.<sup>212</sup> Advanced inter-disciplinary methodologies are needed to comprehend “innovative behavior, its determinants and its impacts at the level of the individual, the firm and the organization.”<sup>213</sup> Key actions to achieve this include creating interdisciplinary approaches to data collection and new units of data collection and refining the measurement of innovative activity in sophisticated business structures, organizations and networks.<sup>214</sup>

#### D. Macro indicators miss out on detail on the micro level

In general, macro-indicators tend to miss out details that are lost in aggregation. This becomes aggravated when measuring intangibles or human related variables. Micro and case studies are usually better suited in assessing such variables. This is more the case for developing countries where macro data, to start with, is not available or accurate. Micro studies, firm studies or sector specific analysis present a more accurate picture of the reality on the ground.

Micro studies on innovation can still be compatible with international comparisons. Gault (2010) adds that in the short term, there is a need to focus on micro data on innovation by 1) including data on more countries to facilitate international comparisons; 2) expanding datasets by relating them to administrative and survey data; and 3) supporting further access to confidential data, while abiding by the confidentiality rules of national statistical offices to safeguard respondent information.<sup>215</sup> This

<sup>208</sup> Kraemer-Mbula, E. (2009). Part Three: Report of the Rapporteur General. In *Innovation for Development: Converting Knowledge to Value*. Summary Report. Online. <http://unesdoc.unesco.org/images/0018/001832/183288e.pdf>.

<sup>209</sup> Ibid.

<sup>210</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Management*, 77. Available Online. <https://prd-idrc.azureedge.net/sites/default/files/openebooks/484-0/index.html>.  
<sup>211</sup> OECD (2010). *Towards a New Measurement Agenda for Innovation*. Online.

<https://www.oecd.org/site/innovationstrategy/45392693.pdf>

<sup>212</sup> Ibid.

<sup>213</sup> Ibid.

<sup>214</sup> Ibid.

<sup>215</sup> Microdata analysis stemmed out of the OECD Blue Sky II Forum and led to an OECD project, with significant finding as it tackles a number of problems. The 2009 OECD Innovation Microdata Project contained significant acumens due microdata analysis as it examined the determinants and impact of innovation and the effect of intellectual property rights on innovation (Gault, 2010). This project “used 20 indicators to compare five dimensions of innovation: technological innovation; non- technological innovation; innovation inputs; innovation outputs; and a set of policy- relevant



is very much applicable to an example such as African countries, where data on innovation activity is scarce, and is not reflective of the true innovation landscape in Africa.

Gault (2010) stresses the need to support survey work, case studies and the synchronization of the work of international organizations on innovation. This development will be key to reduce the gap between advanced countries and emerging markets and facilitate international comparisons.<sup>216</sup>

To sum up, the above four critiques can be reduced to a call for attempts to assess innovation in a way that captures what is lost in a) aggregation, and b) pre-set indicators. Such attempts, on one hand, can be located in a micro approach to studying innovation through case studies. On the other hand, attempts can be made to highlight broad factors that are dropped in the mainstream input and output measurements of innovation. These factors can build a new edifice for innovation metrics that are sensitive to the above-mentioned critiques and it is through expanding means of capturing them that we propose ways forward.

## V. Conclusions and next steps for Open AIR Research

This research will be conducted in several stages. First, we review and infiltrate current indices relevant to innovation. This paper represents the first stage of our work, where we critically assess macro and micro indices in order to complement previous studies with other dimensions to innovation activity. Accordingly, we conclude with core areas to explore. Second, we will undertake fieldwork where we will pilot and test a survey on innovation activity in one African country (Egypt). We will then expand our fieldwork to (3) other countries in Africa. Third, we will work towards developing an Index of Innovation Activity (IAI). We will input the data gathered from the surveys into our index, which we will continuously refine in order to inform policy makers and international scholarship on global innovation measurement.

From our ongoing research, we have identified three main pillars of innovation that occur in Africa and need sharper assessment: collaborative innovation, human resource development, and knowledge governance mechanisms. Furthermore, we have identified four dimensions to innovation where these three pillars occur: formal and informal innovation activities, occurring in both the formal and informal sectors in Africa. With this in mind, we will proceed to assess these previously unmeasured innovation activities using two parallel tracks: fieldwork and index development.

### A. Proposed core areas to explore

We propose exploring intangible assets and informal innovation that can take place in both the informal *and* the formal sector. Part of innovation and skill development that go unmeasured takes

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characteristics (internationalization, collaboration and intellectual property rights). The results of the analysis demonstrated considerable inhomogeneity of firms" (Gault, 2010, p. 149).

<sup>216</sup> Gault, F. (2010). *Innovation Strategies for a Global Economy: Development, Implementation, Measurement, and Management*, 77. Available Online. <https://prd-idrc.azureedge.net/sites/default/files/openbooks/484-0/index.html>

place in the formal sector: For example, innovation not funded by R&D and not seeking formal IP appropriation, informal knowledge-sharing and collaborative innovation, apprenticeships and informal training, etc.

On the input side, we recommend zooming in on human capital, skill development, and collaboration in innovation. In addition to the literature, our previous research showed significant evidence of informal skill development and collaboration in innovation in the African context for example. At this stage, we need to extract further evidence that feeds towards better articulation and assessment of this element of innovation in Africa.

On the output side, we recommend studying the governance of the knowledge output of innovation, and the organizational modes embedded in this process.<sup>217</sup> Evidence from our previous work showed that a great deal of African innovative outputs are appropriated and/or shared outside the mainstream IP regime. Based on this, our questions will aim to gauge the value of knowledge sharing and alternative mechanisms of appropriation. These include sharing technological modifications at no charge, and the use of alternative licenses.

Specifically, the three main themes we are proposing to study in order to create alternative innovation metrics are: 1) collaboration, 2) human capital development, and 3) knowledge governance.

### **Collaboration**

Based on our previous research findings, we have reason to believe that a good part of innovation happening in Africa relies on organic, spontaneous and informal collaboration as defined earlier in this paper. We pose this hypothesis based on the significant size collaborations made possible in contexts like the informal economy, the traditional knowledge production sectors, but also, in the expanding entrepreneurship scene with increasing reliance on information and communication technology.

We acknowledge that collaboration is not identical to cooperation. CIS, for example, includes questions on co-operation and joint innovation. GII assesses “innovation linkages” covering clusters, alliances, and university industry collaboration. Charmes et al. (2016) have directly enquired about “collaboration in production” and “collaboration in the cluster,” in addition to asking about “networking and information flows,” “partnership and cooperation.” Furthermore, Von Hippel’s work has created a solid ground where he identifies the organic type of collaborative innovation. We are consolidating this coverage, and using as a base for developing questions that further probe into collaborative innovation, searching for proxies that assess the linkages within the different firms/communities, among the firms/communities, between firms/communities and users, between firms/communities and universities, between firms/communities and larger firms in the market and between them and the public sector. As such, our questions aim to gauge elements, values and features of collaborative interactions in both the formal and informal sector that we hope will contribute to a more nuanced definition of collaborative innovation. For example, collaboration in firms (and/or any formal institutions) that is required, i.e. employees have to work in teams, is

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<sup>217</sup> We do not, in this phase, study demand driven innovation or the impact of innovation.

considered “formal activity in the formal sector.” Alternatively, collaboration that occurs organically, where employees or individuals help each other out and share knowledge freely, is categorized as “informal activity in the formal sector.”

### **Human capital development**

We take a closer look at what human capital development means in the African context, and its role in innovation. The realities on the ground in Africa, as we know and as documented in the literature, indicate the means of human capital development are not limited to formal education and training systems or knowledge that potentially flows through means of foreign direct investment (FDI). Other means of accumulating knowledge include, but are not limited to: learning by doing, learning by using, learning on the job, apprenticeship, vocational training, self-training, etc. While the role of formal educational and training institutions remains pertinent, it is equally important to capture these other forms of knowledge acquisition, including Indigenous learning and tacit flows of knowledge. This is documented in studies of the informal sector. As mentioned earlier, we aim to capture elements of that taking place in both the informal and formal settings of our case studies.

### **Knowledge governance**

While mainstream metrics focus on formal IP (e.g. patents, trademarks) as evidence of innovation, we set out to explore alternative forms of knowledge appropriation in Africa, guided by our previous research. We pose the hypothesis that a great deal of African innovative outputs are appropriated and/or shared outside the mainstream IP regime. Based on this, our questions will aim to gauge the value of knowledge-sharing and alternative mechanisms of appropriation, including those employed in the context of software development, especially in the case of open source software. These include sharing technological modifications at no charge, and the use of licenses such as Creative Commons. This will be highly relevant for the tech hubs theme, but also important for case studies under the themes of Indigenous knowledge and informal innovation. There is a wide spectrum of how innovators protect their innovations; ranging from simply “a feeling of ownership” to legal protection (i.e. patents). Because legal protections are time-consuming and expensive, informal innovation activity stays formally unprotected in the developing world. However, innovators protect their innovations in other ways. We attempt to identify all forms of protections, whether informal and/or formal.

### **B. Fieldwork**

To capture the above innovation dimensions, we will compile evidence from ongoing case study research within Open African Innovation Research. The purpose here is to gauge evidence, stories, anecdotes that we can use to test our hypotheses. Additionally, an expanded version of the interview is being developed into a long survey questionnaire to be conducted in partnership with the Academy of Scientific Research and Technology (ASRT). The purpose here is to get quantitative data that we can use to highlight otherwise unmeasured components of innovation. This survey is based on a compilation of questions from several surveys already conducted in previous literature along with our own specially tailored questions, to find a way in which innovation can be more accurately quantified. The survey also includes questions used in “Free Innovation” by Von Hippel (2017), as the survey results can be used for comparative research with innovation assessment in developing countries. This would be the first time such fieldwork is done in a developing country context.

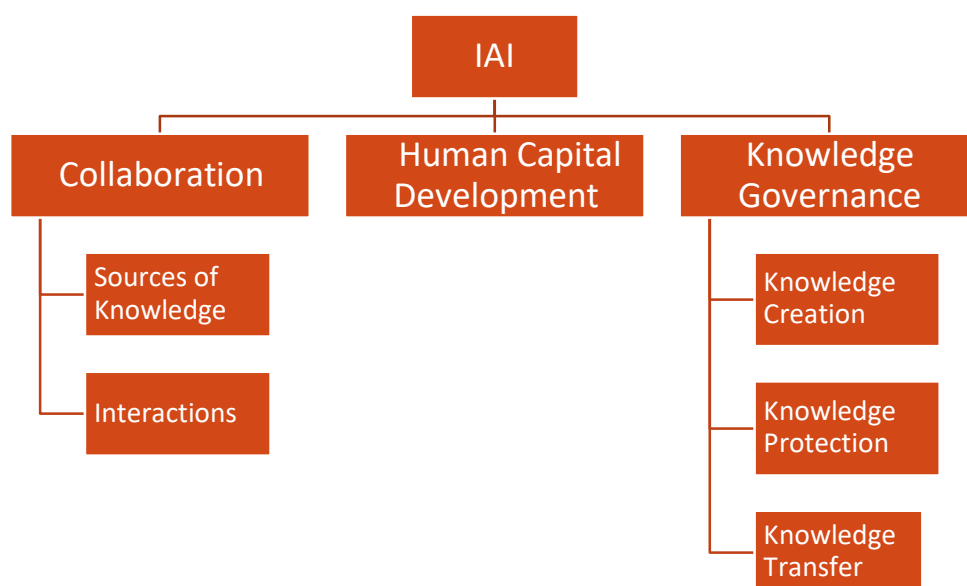
The other sources of the questions researched are the Global Innovation Index (GII), the World Bank Knowledge Assessment Methodology (KAM), the Oslo Manual's Community Innovation Survey (CIS) (2004, 2012) and the Global Competitiveness Report, all of which are discussed earlier in this document. Both GI and KAM are macro surveys that compile countrywide data, with sub components and questions that may not directly fit micro firm or community studies (e.g. asking for gross national expenditures). Nevertheless, critiquing these two indicators was highly insightful in bringing out valuable content that feeds into the articulation of our final list of field questions. As is known, CIS and its adapted versions are more useful for micro studies. We are aware of the literature on such adaptations, including Kraemer-Mbula's work on measurement of innovation in the informal sector.

Interview questions are provided in Annex VIII. The survey questionnaire is being finalized.

### C. Innovation Activity Index (IAI)

Last but not least, in parallel, we are building the structure of an index entitled "Innovation Activity Index (IAI)." This new Index encompasses three pillars: Collaboration, Human Capital Development, and Knowledge Governance. This work is informed by a study conducted by our metrics research consultant, entitled "Index Methodology Review." In this, the author reviews various mathematical approaches used in the process of index development.

The first draft of the index is illustrated below. The Collaboration pillar is divided into two sub-pillars: Sources of Knowledge and Interactions; the Human Capital Development pillar has no sub-pillars; and the Knowledge Governance pillar has three sub-pillars: Knowledge Creation, Knowledge Protection, and Knowledge Transfer. Each of the sub-pillars includes the informal and formal outlooks. Within the latter, we have the indicators, which are our survey questions transformed into a scaling procedure. This is how we bring about the unmeasured aspect of innovation activity that is unseen in conventional metrics.



## VI. A Final Word – Better metrics for better policymaking and global assessment methodologies

Our purpose in the metrics research is to assimilate those dimensions of innovation activity which have not been explicitly conveyed in innovation measurements in the previous literature. A sharper lens to capture innovation in Africa will better inform policy makers in the fields of innovation and entrepreneurship, but also in the larger realm of development planning which impacts inclusion and betterment of people's livelihood. This work can also help to inform local policy makers as to how to most effectively create an environment conducive to innovation. For example, science and technology policies could complement their focus on formal intellectual property acquisition with initiatives to encourage knowledge sharing and open business models. Intellectual property models could be encouraged if and when shown to enhance innovation in particular contexts such as the case of traditional knowledge and community shared innovation.

As well, development planning could benefit from more accurate depiction of African innovation. This would help identify new business niches and provide work opportunities, especially for marginalized groups in the informal sector. As well, a better articulation of African innovation could help formulate initiatives that capitalize on and enhance existing human resource and skill development.

Last but not least, precise gauging of African innovation can help reposition African and other developing countries on the global innovation map. This in turn can attract investors and positively impact the future of work in Africa and elsewhere in the developing world. In the end, this would help bridge the global developmental divide.

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## Annex I: Global Innovation Index Methodology<sup>218</sup>

The GII relies on seven pillars. Each pillar is divided into three sub-pillars, and each sub-pillar is composed of two to five individual indicators. Each sub-pillar score is calculated as the weighted average of its individual indicators. Each pillar score is calculated as the weighted average of its sub-pillar scores.

The GII comprises three indices and one ratio as outlined above. Country/economy rankings are provided for indicator, sub-pillar, pillar, and index scores. The Innovation Efficiency Ratio serves to highlight those economies that have achieved more with less as well as those that lag behind in terms of achieving their innovation potential.

### A. Type of Data and Scaling

82 indicators are used. They are either: 1. quantitative/objective/hard data (58 indicators), 2. composite indicators/index data (19 indicators), and 3. survey/qualitative/subjective/soft data (5 indicators). Indicators are often correlated with population, gross domestic product (GDP), or some other size-related factor such as total trade; they require scaling by some relevant size indicator for economy comparisons to be valid.

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<sup>218</sup> Lanvin, Bruno, and Sacha Wunsch-Vincent. "The Global Innovation Index 2016." WIPO.

## B. Treatment of Outliers

Outliers (excessively high or low numbers relative to the rest of the sample) need special treatment as they could polarize the entire results. Certain thresholds were identified to determine the cut-off points of the outliers that are then winsorized (econometric technique) assigning them the next highest value up to the level where skewness and/or kurtosis centred within relevant ranges (or thresholds) determined.

The formula used is on page 411:

$$\text{Ln} [ ((\text{max} \times f - 1)(\text{economy value} - \text{min}) / (\text{max} - \text{min})) + 1 ] \text{ (to the power of } n \text{).}$$

Min and max are the minimum and maximum indicator sample values. F is a given factor (not explained further... it is a particular weight).

## C. Normalization

All 82 indicators were normalized to numbers between the [0, 100] range, with higher scores representing better outcomes (in cases where the original data had higher values indicating a deterioration, the scaling/normalization inverts this for consistency purposes). Normalization occurs using min-max method, where the min and max values were given by the minimum and maximum indicator sample values respectively. The only exception to this is for index and survey data, for which the original series' range of values was kept as min and max values (for example, [1, 7] for the World Economic Forum Executive Opinion Survey questions; [0, 100] for World Bank's World Governance Indicators; [0, 10] for ITU indices, etc.). The following formula was applied:

Goods:

$$[\text{Economy Value} - \text{Min} / \text{Max} - \text{Min}] * 100$$

Bads

$$[\text{Max} - \text{Economy Value} / \text{Max} - \text{Min}] * 100$$

World Economic Forum Executive Opinion Survey questions; [0, 100] for World Bank's World Governance Indicators; [0, 10] for ITU indices, etc.).

# Annex II: Other innovation-related indicators

This Annex provides additional innovation indicators in the literature on the macro level. The indices also attempt to capture innovation based on the mainstream literature.

First, the **Technology Achievement index**<sup>219</sup> measures the ability of a country to create and diffuse technology and build a human skill base. This mirrors the aptitude to partake in the technological innovations of the network age. The main components of this index are as follows: 1) creation of technology: patents granted to residents (per million people), receipts of royalties and licence fees (US\$ per person); 2) diffusion of recent innovations (DRI): internet users (per 1000 people), high-

<sup>219</sup> Desai, M., S. Fukuda-Parr, C. Johansson and F. Sagasti (2002). Measuring the Technology Achievement of Nations and the Capacity to Participate in the Network Age. *Journal of Human Development*, Vol. 3, No. 1.

technology exports (% of index ranking manufactured exports); 3) diffusion of old innovations: telephone mainlines and cellular subscribers (per 1,000 people), electric power consumption (kWh per capita); 4) human skills: gross enrolment ratio. All levels combined (except pre-primary), gross enrolment ratio in science, engineering, manufacturing and construction.

Second, the **Networked Readiness Index<sup>220</sup> (NRI)** presented in the Global Information Technology Report 2015 measures, on a scale from 1 (worst) to 7 (best), the performance of 143 economies in employing ICT to enhance competitiveness and well-being. This index is based on several pillars and sub-pillars, which capture: 1. environment subindex: political and regulatory environment (9 indicators), and business and innovation environment (9 indicators); 2. readiness subindex: infrastructure (4 indicators), affordability (3 indicators), and skills (4 indicators); 3. usage subindex: individual usage (7 indicators), business usage (6 indicators), and government usage (3 indicators); 4. impact subindex: economic impacts (4 indicators) and social impacts (4 indicators). The table below shows the top 10 Sub-Saharan African countries that harness information technology.

There are six subcomponents of this index, which are divided as follows: first, connectivity and technology infrastructure (weighing 20% in the overall score), which contains variables such as broadband penetration, broadband quality, broadband affordability, mobile-phone penetration, mobile quality, internet user penetration, international internet bandwidth, and internet security. Second, there is the business environment category (weighing 15% in the overall score), which contains variables that capture the overall political environment, the macroeconomic environment, market opportunities (such as policies related to private enterprise), foreign investment policy, foreign trade and exchange regimes, tax regime, financing, and the labour market. The third category is the social and cultural environment (weighing 15% in the overall score), which contains variables such as school life expectancy (and other education indicators), internet literacy, technical skills of innovation, and the degree of innovation which is captured by R&D spending and generation of patents and trademarks. The fourth category is the legal environment (weighing 10% in the overall score), which contains variables such as the effectiveness of traditional legal framework, laws covering the internet, the level of censorship, and the ease of registering a new business. The fifth category is government policy and vision (weighing 15% in the overall score), which contains variables such as the e-government strategy, e-participation, government spending on ICT as a proportion of GDP, and the digital development strategy. The last category in this index is consumer and business adoption (weighing 25% in the overall score) and it contains variables such as the per capita consumer spending on ICT, the level of e-business development, the use of internet by consumers, and the use of online public services by citizens.<sup>221</sup>

Next, the **Digital Access Index** measures the overall ability of individuals in a country to access, and use, new ICTs. This index is on a scale of 0-1; 1 being the highest. It is divided into high access, upper access, medium access, and low-access countries. This index includes fixed telephone subscribers per

<sup>220</sup> Dutta, Soumitra, Thierry Geiger and Bruno Lanvin (2015). The Global Information Technology Report 2015. World Economic Forum and INSEAD.

<sup>221</sup> The Economist Intelligence Unit (2010). Digital Economy Rankings 2010: Beyond E-readiness. Online. [http://www-935.ibm.com/services/us/gbs/bus/pdf/eiu\\_digital-economy-rankings-2010\\_final\\_web.pdf](http://www-935.ibm.com/services/us/gbs/bus/pdf/eiu_digital-economy-rankings-2010_final_web.pdf)

100 inhabitants, mobile cellular subscribers per 100 inhabitants, internet access price as percentage of Gross National Income per capita, adult literacy, combined primary, secondary and tertiary school enrolment level. It also includes data on international internet bandwidth (bits) per capita, broadband subscribers per 100 inhabitant, and internet users per 100 inhabitants. The following chart displays some of the ranking of countries included in the index.<sup>222</sup>

Finally, the **ICT Development Index (IDI)**<sup>223</sup> is divided into the following three sub-indices:

- Access sub-index: This sub-index captures ICT readiness, and includes five infrastructure and access indicators (fixed telephone subscriptions, mobile-cellular telephone subscriptions, international internet bandwidth per internet user, households with a computer, and households with internet access).
- Use sub-index: This sub-index captures ICT intensity, and includes three intensity and usage indicators (individuals using the internet, fixed broadband subscriptions, and mobile- broadband subscriptions).
- Skills sub-index: This sub-index seeks to capture capabilities or skills which are important for ICTs. It includes three proxy indicators (adult literacy, gross secondary enrolment, and gross tertiary enrolment). As these are proxy indicators, rather than indicators directly measuring ICT-related skills, the skills sub-index is given less weight in the computation of the IDI than the other two sub-indices.

## Annex III: Oslo Manual: Methodology in Developing Countries<sup>224</sup>

Innovation surveys in developing countries should be based the characteristics described above to facilitate both public and private decision-making. Measurement exercises should prioritize the innovation process instead of its outputs. They should highlight the process by which capabilities, efforts and results are handled. As such, innovation activities by firms and organisations and capabilities are vital to capture.

As for interviews, they must be made in person, by trained professionals, and the questionnaires should be structures in such a way to allow different people in the firm to respond to different sections; this is crucial when it comes to obtaining information on the firm's economic stance (provided by the finance division) relative to specific questions on the actual innovation process (information available by a "plant manager" as an example). It is important to note that respondents in developing countries may not necessarily understand the concept of "innovation," therefore, the questions should include definitions. The language in which the survey is written must therefore be written carefully, and the wording of the survey should attempt to properly address the background

<sup>222</sup> International Telecommunications Union. <http://www.itu.int/ITU-D/ict/dai/>.

<sup>223</sup> The ICT Development Index (IDI): Conceptual Framework and Methodology. ITU: ICT Statistics.

<sup>224</sup> OECD and Eurostat. *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. (Paris: OECD Publications, 2005), 46.

of the “average” respondent. It may also be necessary, in some cases, to present questionnaires in more than one language to facilitate the process for respondents.

The periodicity of conducting surveys should be every three or four years, and their timing should coincide with major international innovation surveys, such as the Community Innovation Survey (CIS) rounds in Europe. This will permit having comparable data for the same time periods. Ideally, a minimum set of variables should be updated annually, if resources allow for it. The main quantitative variables should be the ones updated annually. A more cost effective strategy would be to include a short questionnaire to an existing business survey.

Obtaining reliable information on innovation in countries with underdeveloped statistical tradition is very common. Managers could be intentionally keep away information on finances, which makes qualitative information more useful than quantitative information. This is why the purpose of surveys should be clearly written and the questions clearly outlined to ensure the success of the survey. Simplified questionnaires can be designed to encourage the participation of small firms in innovation surveys.

Some crucial questions on innovation measurement in developing countries continue to be unanswered, and further research, could tackle issues such as:

- The role and attitude of entrepreneurs towards innovation.
- The intention to capture innovations in the public sector, and the determinants of innovation other than market forces.
- The adaptation of ways to measure innovation in the primary (agricultural)\_ sector.
- The development of indicators that capture sub-national (regional) innovation systems. This can lead to more experience with innovation surveys in emerging markets. Countries with better S&T statistics experience should be able to incorporate innovation surveys in their statistical programmes in addition to R&D surveys. Consolidating – and adjusting – standards, concepts, formats to better suit emerging markets should foster capacity and awareness. Efforts targeting capacity building for innovation surveys are crucial to support this work

It is of extreme importance to try to involve national statistics offices in developing countries as they bring experience in the design and application of surveys, and may facilitate a higher response rate. It should also be noted that factors that support – or act as an obstacle for – innovation are key aspects to focus on. This is why the concept of a “potentially innovative firm” is of relevance to emerging market. These are firms that fall under the bigger auspices of the innovation-active firms, but have not achieved innovation results. They are important to analyse, however, since they are enterprises that could have previously innovated, or will have the propensity to innovate in the future. It is important to note that the presence of a significant number of those potentially innovative firms may also reflect existing barriers to innovations, particularly if resources are scarce, as is the case in developing countries.



## Annex IV: Community Innovation Survey – Methodology

The enterprise represents the basic unit of measurement of the CIS, results are tallied and then percentages are calculated. Each CIS covers the preceding three-year period, the latest of which is the CIS 2012, covering activity from 2010.<sup>225</sup> The survey includes a core or ‘harmonised’ survey and then leaves room for country specific inquiries. Questions include those that require a yes/no answer, others require respondents to indicate the degree of importance and others where respondents are instructed to select all that apply.<sup>226</sup>

CIS 2012 includes 12 sections which cover general information about the enterprise, followed by six sections covering different aspects of product innovation, process innovation including questions on sources of information (whether it is internal, or from market sources or institutional sources) for innovation activities, impact of innovation (whether it allowed them to enter new markets, increase their range goods and services offered), factors hampering innovation activities (access to finance, knowledge-related constraints, such as the lack of qualified personnel), in addition to other IP-related questions. Sections 8 to 10 tackle organizational, marketing and public sector innovation. Sections 11 and 12 cover strategies and obstacles for achieving firm goals as well as economic information about the enterprise.<sup>227</sup>

## Annex V: Informal Sector Surveys – Methodology

Charmes et al. (2016)<sup>228</sup> suggest methods for conducting surveys in the informal sector. The questionnaire is comprised of several modules with the aim of collecting information on entrepreneurial dynamics and innovation.

1. The modules on employment and workers collect data on skills development, received and required (needed) by the operators, as well as in-service training for the employees.
2. The module on business expenditures collects information on cost of licenses issued, advertising costs, product innovation, process innovation and social responsibility.
3. The module on access to information and amenities includes access to electricity, telephone, computer services.
4. The module on business income and seasonal variations includes a section on Product, Process and Marketing Innovation with 4 questions which resemble CIS type innovation surveys:

<sup>225</sup> “EuroStat,” *Community Innovation Survey*.

<sup>226</sup> CIS 2012 ‘Harmonized core survey’ is available at

<http://ec.europa.eu/eurostat/documents/203647/203701/Harmonised+survey+questionnaire+2012/164dfdfd-7f97-4b98-b7b5-80d4e32e73ee>.

<sup>227</sup> Ibid.

<sup>228</sup> Charmes et al. (2016). *Measuring Innovation in the Informal Economy – Formulating an Agenda*.

- a. During the period 2009 to 2013, did you introduce new or significantly improved goods or services, Yes/No
  - b. During the period 2009 to 2013, did you introduce new or significantly improved methods of manufacturing or producing goods or services
  - c. During the period 2009 to 2013, did you implement a new marketing method involving significant changes in product design or packaging, product placement, promotion or pricing?
  - d. Please estimate the total turnover in 2013 of goods and services innovations introduced in 2013.
5. The module on capital and technology comprises 6 questions also surveying the amount and sources of initial and additional capital, the types of equipment, the type and sources of technological advice and support, and the use of information and communication technologies.
  6. The module on business organisation and marketing comprises 7 specific questions on marketing relating to how prices are set, information on buyers, sub-contracting, and questions which relate to marketing innovation (advertising, etc.), and finally customer feedback mechanisms.

Based on the above, Charmes et al. (2016)<sup>229</sup> believe that “four to five innovation survey questions can be formulated and surveyed through combined surveys in a more systematic manner and in more countries. The African Observatory for Science, Technology and Innovation (AOSTI) could be asked to review the results of the resulting country initiatives and to convene meetings to review what is working in more than one country and which could give rise to an African-wide measurement initiative.”

Three non-probability sampling techniques are often used in informal surveys: (i) purposive, (ii) snowball, and (iii) quota sampling methods. In “purposive sampling, a sample is selected purposively from available lists or association members, for example (e.g. a list of registered Traditional Herbal Medicine Practitioners in Ghana obtained from the Traditional Medicine Practice Council (TMPC) in the case of Essegbey et al. (2016)).<sup>230</sup> In this case the judgment of the researcher comes in when selecting the units that are being targeted.”

The “snowball interview technique,” is normally used to identify rare populations where registers do not exist. “Starting with some recommended interviewees, the subsequent interviewees are selected by referral. In the case of the South African study, for instance, an initial set of nine companies was identified in collaboration with two technology incubators and two business incubators.”

Cautiousness must be exercised using these two methods to ensure a proper gender distribution, hierarchical levels (master versus apprentice), and types of actors in the informal sub-sector.

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<sup>229</sup> Ibid.

<sup>230</sup> Essegbey, G. and Awuni, S. (2016). Herbal Medicine in the Informal Sector of Ghana. In E. Kraemer-Mbula and S. Wunsch-Vincent (Eds.), *The Informal Economy in Developing Nations: Hidden Engine of Innovation?* (Intellectual Property, Innovation and Economic Development, pp. 194-231). Cambridge: Cambridge University Press.

In the case of the “quota sampling method,” initial knowledge about the population to be surveyed should exist. “Quota sampling then consists of selecting an equal and small number a various pre-determined fractions of the population in terms of gender, age, activity, etc. and proceeding to the selection by the method of ‘itineraries.’ Here an itinerary is defined in the area to be surveyed; on this itinerary, all units are surveyed until a fraction is completed. Once this fraction is completed, all units which fall within this fraction are not surveyed anymore; the process continues until all fractions are completed.” In all three methods, bilateral interviews are sometimes replaced by focus group discussions.

Rigorous interview guidelines and formats must be set out at the outset and followed throughout the survey deployment. Interview templates include both open and closed questions to allow capturing unexpected phenomena and personal experiences that would inform the study. All interviews should be recorded and transcribed, and questions should be simplified even more in the informal sector relative to the formal one.

The annex from Charmes et al. (2016)<sup>231</sup> contains examples of surveys that contain questions on the type of the firm, their main consumers, supplies, their competitors pricing strategies, reasons undertaking the activities they are doing in the firm, obstacles in the production process, use of type of technology, its purpose, type of products produced, how or why it is made, collaboration efforts, whether or not they considered acquisition of IPRs, and questions on the innovation process itself such as

1. Have you originated a new product since you started working as a ...? Yes/no
2. Have you changed the production process since you started working in the cluster?  
Yes/no
3. Who assisted you in the origination of the product?
4. Did you receive support from any of the following (and then provide a list) of institutions in technology upgrading?
5. Do you collaborate with other xxx who produce similar products?
6. How do you modify the design (of the product)?
7. Why do you modify the design?

## Annex VI: Lesser tracked aspects of innovation

In product and process innovation that constitute the prevalent description of innovation as relayed above, there is account in the measurement process to different layers of process and product innovation at firms level, be it in the formal or the informal sector.

For example, *communication innovation* is the implementation of a new method of promoting the organisation or its services and goods, or new methods to influence the behaviour of individuals or others. These must differ significantly from existing communication methods in an organisation.<sup>232</sup>

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<sup>231</sup> Ibid.

<sup>232</sup> Bloch, Carter and Bugge (2013). “Public Sector Innovation-From theory to measurement.” Structural Change and Economic Dynamics, 2013, vol. 27, issue C.

Manzini (2015) also discusses *organizational innovation*, which may be considered as “any organisational restructuring process, including downsizing.”<sup>233</sup> A *business model innovation* focuses on “systemic changes to the value proposition offered by a product or service, and to the cost structure incurred by the firm offering it.”<sup>234</sup> Amazon is provided as an example of business model innovation, as it “involves changes to the product... distribution ... price ... and promotion.”<sup>235</sup>

There is also *drastic innovation*<sup>236</sup> or *revolutionary innovation*,<sup>237</sup> which renders existing products obsolete. Chandy and Prabhu, (2012) cite electronic calculators rendering slide rules obsolete. A *radical innovation* is a rare type of innovation as it “employs substantially new technology and offers substantially higher customer or user benefits relative to existing products, services, or processes.”<sup>238</sup>

Chandy and Prabhu (2012) define *component innovation* as a new product, service, or process that employs new parts, but depends on the original technology as other existing products. They highlight magnetic tapes and floppy disks in the field of data recording as examples; the two used different components and materials, but were both based on “the core technology of magnetic recording.”<sup>239</sup> Henderson and Clark (1990) discuss *architectural innovation*<sup>240</sup> which reconfigures component layout but uses the same core technology as other existing products. Once again, Chandy and Prabhu (2012) use the example of floppy disks and how their size grew smaller over time as an example of design innovation; the same applies for cellular phones, laptops, and other equipment.

*Frugal innovation* is a type of innovation that occurs in response to scarcity of resources, financial, institutional, or material and transforms these constraints into opportunities.<sup>241</sup> “Through minimising the use of resources in development, production and delivery, or by leveraging them in new ways, frugal innovation results in dramatically lower-cost products and services.”<sup>242</sup> *Frugal Innovation* is usually linked to emerging economies with sizeable groups of consumers with unmet needs and is an area that has been garnering attention in a lot of work, not only for emerging markets, but also for

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<sup>233</sup> Manzini, Sibusiso. (2015) “Measurement of Innovation in South Africa: An Analysis of Survey Metrics and Recommendations.” South Africa Journal of Science.

<sup>234</sup> Chandy, R. and J. Prabhu (2012). Innovation Typologies. Online.  
<http://faculty.london.edu/rchandy/innovation%20typologies.pdf>.

<sup>235</sup> Ibid.

<sup>236</sup> Reinganum, Jennifer F. (1985), “Innovation and Industry Evolution,” Quarterly Journal of Economics, 100 (1), 81-99.

<sup>237</sup> Caselli, Francesco (1999), “Technological Revolutions,” American Economic Review, 89 (1), 78-102.

<sup>238</sup> Chandy, R. and J. Prabhu (2012). Innovation Typologies. Online.  
<http://faculty.london.edu/rchandy/innovation%20typologies.pdf>.

<sup>239</sup> Ibid.

<sup>240</sup> Henderson, R., and K. Clark (1990), “Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms,” 35 (1), 81-112.

<sup>241</sup> NESTA (2008). The New Inventors. How Users are Changing the Rules of Innovation. Online.  
[https://www.nesta.org.uk/sites/default/files/new\\_inventors\\_report.pdf](https://www.nesta.org.uk/sites/default/files/new_inventors_report.pdf)

<sup>242</sup> Ibid.

advanced economies.<sup>243</sup> Yet, theoretical underpinnings of frugal innovation remain largely unclear. Frugal innovation was originally detected in Emerging Asia (China and India).<sup>244</sup>

*Soft innovation* is innovation that occurs across every sector of an economy. Soft innovation, also referred to as “artistic innovation,” is a driving force behind the art scene as well as other creative industries, such as film and television, contribute significantly to both a country’s formal and informal economies.<sup>245</sup> In traditional sectors that are based on R&D, soft innovation has significant value added for “product design, packaging and other aesthetic value additions.”<sup>246</sup> However, soft innovation seems to be overlooked in the existing innovation metrics as it does not necessarily lead to a new or meaningfully enhanced product. Yet, soft innovation “may add significant economic value to products and services.”<sup>247</sup>

Moreover, *disruptive innovation* “describes a process whereby a smaller company with fewer resources is able to successfully challenge established incumbent businesses.” Disruptive entrants successfully focus on “overlooked segments, gaining a foothold by delivering more-suitable functionality frequently at a lower price.” They can also create “a market where none existed.”<sup>248</sup>

## Annex VII: Free Innovation Survey by Eric Von Hippel<sup>249</sup>

### Section A

A02. First, **creating computer software** by programming original code. Within the past three years, did you ever use your leisure time to create your own computer software?

1: yes 2: no  
if A02>1 Go to A12

A03. Did you do this primarily for your employer or business?

1: yes 2: no  
if A03 = 1 Go to A12

<sup>243</sup> Bound, Kristen and Thornton, (2012). “Our Frugal Future: Lessons From India’s Innovation System.” NESTA.

Radjou, Navi and Prabhu, (2015). *Frugal Innovation: How to do more with less*. The Economist.

Ramdorai, Aditi and Herstatt (2015). *Frugal Innovation in Healthcare*.

<sup>244</sup> Tiwari, R. L. Fischer, and K. Kalogerakis. (2016). Frugal Innovation in Scholarly and Social Discourse: An Assessment of Trends and Potential Societal Implications. Online. [http://www.global-innovation.net/publications/PDF/Tiwari et al 2016 Frugal Innovation BMBF ITA.pdf](http://www.global-innovation.net/publications/PDF/Tiwari%20et%20al%202016%20Frugal%20Innovation%20BMBF%20ITA.pdf).

<sup>245</sup> Manzini, S. (2015). Measurement of innovation in South Africa: An AUTHOR: analysis of survey metrics and recommendations. Pp. 4. Online. [http://sajs.co.za/sites/default/files/publications/pdf/SAJS%20111\\_11-12\\_Manzini\\_Research%20article.pdf](http://sajs.co.za/sites/default/files/publications/pdf/SAJS%20111_11-12_Manzini_Research%20article.pdf).

<sup>246</sup> Ibid.

<sup>247</sup> Ibid.

<sup>248</sup> Christensen, C. M. E. Raynor, and R. McDonald. (2015). What is Disruptive Innovation? Online.

<https://hbr.org/2015/12/what-is-disruptive-innovation>.

<sup>249</sup> Eric Von Hippel, *Free Innovation* (Cambridge, MA: The MIT Press, 2017).



A04. At the time you developed it, could you have bought ready-made similar software on the market?

1: yes 2: no

if A04 = 1 Go to A12

A05. Did you primarily create it to sell, to use yourself, or for some other reason?

1: to sell 2: to use myself 3: other, please specify...

If A05 = 1 Go to A12

A06a. What kind of software did you create? [open answer]

A06b. What was new about this software? [open answer]

(Repeat the sequence of questions shown above for each of the following cues)

A12. The second example is **household fixtures and furnishing**, such as kitchen- and cookware, cleaning devices, lighting, furniture, and more. In the past three years, did you ever use your leisure time to create your own household fixtures or furnishing?

1: yes 2: no

A22. Next, you may have developed **transport or vehicle-related products**, such as cars, bicycles, scooters or anything related. In the past three years, did you ever use your leisure time to create your own transport or vehicle-related products or parts?

1: yes 2: no

A32. **Tools and equipment, such as utensils, molds, gardening tools**, mechanical or electrical devices, and so on. In the past three years, did you ever use your leisure time to create your own tools or equipment?

1: yes 2: no

A42. **Sports-, hobby- and entertainment products**, such as sports devices or games. In the past three years, did you ever use your leisure time to create your own sports-, hobby- or entertainment products?

1: yes 2: no

A52. **Children- and education-related products**, such as toys and tutorials. In the past three years, did you ever use your leisure time to create your own children- or education-related products?

1: yes 2: no

A62. **Help-, care- or medical-related products**. In the past three years, did you ever use your leisure time to create your own help-, care- or medical-related products?

1: yes 2: no

A72. Finally, in the past three years, did you ever use your leisure time to create or modify any other types of products?

1: yes 2: no

(follow-up questions and routing A13-A16b, A23-A26b, etc., see A03-A06b)

If number of valid innovations (A05, A15, ... , A75 > 1) = 0 Go to End

If number of valid innovation = 1 Go to B01

A99. You just mentioned a number of creations. Which one do you consider most significant?

1: computer software

2: household or furnishing product

3: transport or vehicle-related product

4: tool or piece of equipment

5: sports-, hobby- or entertainment product

6: children or education-related product

7: help-, care- or medical-related product

8: other product or application

## Section B

**My next questions are concerned with this specific [insert name of innovation that respondent identified in A99 as “most significant”] that you created. I will refer to it as the “innovation.”**

B01. Why did you develop this innovation? I will give you a list of reasons.

Please indicate their importance by assigning zero to 100 points

to each reason. The total number of points for all reasons together must add up to 100.

B01a: I personally needed it \_\_\_\_points

B01b: I wanted to sell it/make money \_\_\_\_points

B01c: I wanted to learn/develop my skills \_\_\_\_points

B01d: I was helping other people \_\_\_\_points

B01e: I did it for the fun of doing it \_\_\_\_points

B02a. Did you work with other people to develop this? innovation?

1: yes 2: no

If B02a = 2 Go to B03

B02b. How many others contributed to developing this innovation? ...persons

B03. Can you estimate how much time you invested developing

this specific innovation? .... hours/days/weeks during ... days/weeks/  
months

B04a. Did you spend any money on this innovation?

1: yes 2: no

If B04a = 2 Go to B05

B04b. Can you estimate how much? ....Euros

B05. Did you use any methods to protect this innovation? (For example  
patents, trademarks, copyrights, confidentiality agreements)

1: yes 2: no

B06. Supposing that other people would be interested, would you be  
willing to FREELY share what you know about your innovation?

1: yes, with anyone 2: yes, but only selectively 3: no

B07. Supposing that other people would offer some kind of COMPENSATION,  
would you be willing to share your innovation?

1: yes, with anyone 2: yes, but only selectively 3: no

B08. Did you do anything to inform other people or businesses about  
your innovation? (For example: Showing it off, communicating about  
it, posting its design on the Web)

1: yes 2: no

B09a. To the best of your knowledge, have any other people adopted  
your innovation for personal use?

1: yes 2: no

If B09a = 1 Go to B10a

B09b. Do you intend to contact other people who may adopt your  
innovation for personal use?

1: yes 2: no

B10a. Do you, alone or with others, currently own a business you help  
manage, or are you self-employed?

1: yes 2: no

If B10a = 2 Go to B11a

B10b. Did you commercialize your innovation via your business? Or do  
you intend to do this?

1: yes, I commercialized it 2: yes, I intend to do so 3: no

Go to B12

B11a. Are you currently, alone or with others, trying to start a new business?

1: yes 2: no

If B11a = 2 Go to B12

B11b. Do you intend to commercialize your innovation with this start-up?

1: yes 2: no

B12a. Finally, commercial businesses like your employer or any other organization may be interested in your innovation. Did any commercial business adopt your innovation for general sale?

1: yes 2: no

If B12a = 1 Go to End

B12b. Do you intend to contact commercial businesses to adopt your innovation for general sale?

1: yes 2: no

## Annex VIII: Interview Questions on Innovation Metrics for Open AIR case study research

**In Search of Empirical Evidence of Unmeasured Wealth:  
Collaboration, Skill Development and Knowledge Appropriation –**

***Examples, Stories, Anecdotes from Open AIR Field Research***  
*Interview Questions for Case Study Research (Draft)*

*Access to Knowledge for Development Center*  
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The purpose of these interview questions is to gain a deeper understanding about 1) collaboration 2) human resource development and 3) knowledge appropriation and sharing that take place on the ground in Africa.

Our hypothesis is that those three areas in particular, witness and contribute to innovation that takes place in Africa in a way that goes unmeasured. The following questions attempt to capture evidence

that supports (or refutes?) our hypothesis. Examples of innovation in any or all of these three areas, especially of the type that does not show in mainstream metrics, will support our argument.<sup>250</sup>

These questions are based on extensive research of questions asked and/or statistics compiled for sub components or prior indices – mainstream and others that sought to go beyond them. Please see the appendix that includes a compilation of questions and statistics sought in other studies covering the three components of interest to us.

## A. Collaboration

This section searches for the linkages, interactions, and sources of knowledge that are unmeasured and yet integral for the innovation process. The purpose is to document evidence of collaboration that leads to innovation.

1. Can you provide examples/anecdotes you documented or witnessed of collaboration that you feel are not characterized as formal interactions with organized institutions (such as research centers, NGOs, incubators, etc.), but are rather informal (within the community, kinship ties, informal spaces, peers in the informal, but also possibly in the formal sector etc.)

1.1. If so, please provide examples/evidence of how valuable (or not) these collaborations are/were to your innovation.

OR

2. Consider the linkages/interactions/collaborations that you have with formal and informal entities, how, if at all, does each type of collaboration add value to your innovation?

2.1. What is most useful and challenging about formal and informal mechanisms for diffusion, transfer or exchange relatively more useful for your process?

2.2. Please illustrate your points with examples.

OR

3. Have you interacted with any of the below for setting up your activities, and if so,

Peer firms (competitors, suppliers)

Users/customers

Family

Friends or other members of the community

Other: \_\_\_\_\_

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<sup>250</sup> While the aim is to extract the wealth of knowledge and processes that have not been measured, the below questions do not seek to lead interviewees to stories that show informal innovation is important, but rather remain open-ended and probe parts of anecdotes that could be relevant to our research.



If so: How?

3.1. At what stage (inception, piloting, production, marketing, distribution)?

3.2. What was the nature of this interaction?

3.3. How does/did it benefit your work and how do you benefit them?

OR

4. Do you see that collaboration adds to the value of your innovation?

4.1. Which type of collaboration and how? Formal or informal? Provide examples.

4.2. Have you faced any drawbacks of your collaboration affecting the value of your innovation? Provide examples.

## **B. Human Capital & Skill Development**

This section explores how human capital development in Africa is not limited to formal education and training systems. It tries to capture the role of alternatives means such as learning by doing, learning by using, learning on the job, internships and apprenticeship. Aspects related to gender and to knowledge tacit in older members of the community are relevant here and can be explored.

1. Please consider all types of training/skills development you provide for your team/workers.
  - 1.1. Can you give us instances of how learning processes that are not “formal” (tactic learning, on the job training, cooperative learning, apprenticeships) or how knowledge gained from products of informal innovation enhance your innovation?
  - 1.2. Do you find such training more/less/equally useful for innovation compared to formal (degree) education? How? Please explain.

OR

2. Can you provide evidence of the value of investing in interns, apprenticeships contribute to the overall process of innovation long and short term?
  - 2.1. Would you explain/provide examples of how training/internships/apprenticeships contribute to the overall process of innovation?
  - 2.2. Is there a difference between formal and informal training (tactic learning, on the job training, cooperative learning, apprenticeships)?

### C. Knowledge Appropriation & Sharing

This section sets out to explore alternative forms of knowledge appropriation in Africa, and assess the ways in which a great portion of African innovative outputs are appropriated and/or shared outside the mainstream IP regime.

1. Do you have your own brand?

1.1. Is this product or service your own design? What kind of help did you seek to go about creating?

1.2. Do you feel you own this service or product?

1.3. Have you patented this product or service? If not, what other means of protecting your innovation have you used?

OR

2. Please provide examples of how, if at all, knowledge sharing contributes to the value of your innovation.

OR

3. Do you assign a budget for knowledge acquisition or appropriation? If so, what kind of acquisitions do you make and how much do you spend on it?

OR

4. Do you think about intellectual property rights when exchanging or collaborating with others? If yes, what prompts you to think about it?

Economic gains

Moral recognition

Both

Other: \_\_\_\_\_

OR

5. Have you ever contested the copying of your innovation or part of it by another market player? If yes, say why and how, and if not, explain why.

OR

6. What, if any, is the share in total innovation, of innovation that is not commercialized or protected by formal intellectual property protection?



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Open African Innovation Research (Open AIR) is a unique collaborative network of researchers investigating how intellectual property (IP) systems can be harnessed in open, participatory ways that have the potential to maximise knowledge access, innovation, and the sharing of benefits from innovation inclusively.

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