MIT Lab for Innovation Science and Policy

WORKING PAPER

A systematic MIT approach for assessing ‘innovation-driven entrepreneurship’ in ecosystems (iEcosystems)

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'Innovation' and entrepreneurship are now much sought after, but not always well-defined, and even less often well measured. This Working Paper draws upon our MIT approach to innovation, entrepreneurship and the powerful combination of 'innovation-driven entrepreneurship' to suggest a method to capture a set of globally-available metrics to assess these and the ecosystems in which they flourish.

Our MIT approach is guided by a few critical insights that derive from our research-informed framework and our experience of working with a large number of decision-makers who seek comparable metrics that make sense and yet are not overly complex:

- Our metrics are designed to capture both innovation and entrepreneurship which we identify in successful ecosystems and highlight the special blend of 'innovation-driven entrepreneurship';
- In such ecosystems, there are four key elements in our framework to measure: foundational institutions, separate innovation and entrepreneurship capacities, comparative advantage, and impact;
- Starting with foundational institutions, we seek globally-available metrics that allow for maximum comparability, both over time as well as in comparison to other ecosystems, with the caveat that these are typically available on a national not a sub-national 'regional' level.
- Emphasizing metrics for both innovation and entrepreneurship capacities, we then focus on the key inputs into these two distinctive capacities – measured in 5 areas: human capital, funding, infrastructure, demand and culture/incentives;
- Building on the inputs into innovation and entrepreneurship capacities, we then include metrics that capture intermediate outputs (that in turn can lead to longer term regional 'comparative advantage' and ultimately 'impact');

Our Working Paper is informed by our work with many colleagues but most especially with our fellow faculty members, Scott Stern and Bill Aulet. We continue to be guided by our experience with decision-makers who often assess and analyze the relative strengths of chosen innovation ecosystems and thus need a set of basic metrics to guide them. As such, we present this Working Paper to capture what we have learned so far, and to seek further feedback from researchers, practitioners and decision-makers.

Many stakeholders are assessing their ecosystems, and using a variety of names to describe them. Though a range of labels is widely used (including by MIT) and should be respected, references in our Working Paper should be considered as being to the fuller (if not pithy) 'innovation-driven entrepreneurship ecosystems' ('*iEcosystems*').[1] What matters is that we are all trying to understand the same basic phenomena.

Governments and Universities, for example, may define their 'home' ecosystems from an innovation perspective, and undertake assessment of eg how they compare to other benchmark regions. On the other hand, Corporates, Capital investors or even mobile Entrepreneurs may be comparing a number of ecosystems – and defining them in a variety of ways - to make a decision as to a possible location for specific innovation activity, entrepreneurship ventures and/or collaboration.

As with any such analysis, there are already many approaches, 'ecosystem' definitions and data sources that are relevant (and we review the most widely used and relevant of these here). Indeed, in recent years, a number of organizations have sought to create metrics and indices to rank locations on both innovation and/or entrepreneurship dimensions, and in doing so have provided orderings of cities, regions or countries. This is, at one level, a welcome step forwards beyond just looking at say R&D for 'innovation' or the number of new enterprises for 'entrepreneurship'.

This explosion of information, however, has not always been accompanied by greater clarity, nor has it facilitated decision-making because these approaches are often hard to decipher or are based on a collection of measures that are not clearly defined. Many do not have global coverage (but are limited to the EU or US), whereas others do not differentiate 'innovation' and 'entrepreneurship'. From our MIT perspective, they often also conflate the 'inputs' for innovation and entrepreneurship (and fail to specify what are intermediate 'outputs'), so do not provide a clear guide for decision-makers.

Our approach, as outlined in this Working Paper, is to develop a simple but comprehensive measurement approach, informed by our MIT theory of innovation-driven entrepreneurship and the ecosystems ('*iEcosystems*') in which it flourishes. Where our approach adds value is providing a clear framework for analyzing such ecosystems – our 'theory' if you will - and then selecting measures accordingly.

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[1] MIT itself and its faculty are associated with a variety of such 'ecosystem' names: eg "**Entrepreneurial Ecosystems**" (https://portal.scotlandeuropa.com/event-listings/view/36); "**iEcosystems"** (https://innovation.mit.edu/event/mit-iecosystem-symposium/); "**Innovation ecosystems**"(https://executive.mit.edu/openenrollment/program/innovation-ecosystems-a-new-approach-to-accelerating-corporate-innovation-and-entrepreneurship/#.Wb1uFq3MxE4).

Within our framework, it is the key differentiation between the ‘innovation’ and ‘entrepreneurship’ capacities, and among ‘inputs’ and ‘outputs’, that places this apart from most other methods.

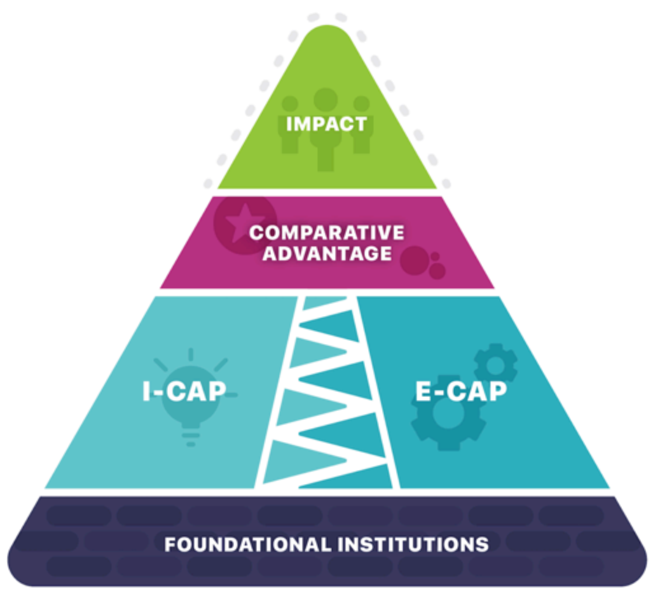
With our framework as a starting point, we engage in a deep assessment of the most widely available and useful measures and indices. Building on the data foundations built by others, we suggest a range of basic metrics that allow for global comparison of more consistently available national data.

Subsequent work will address other elements of our MIT framework, most importantly the range of ‘impact’ measures that can be most appropriately used to track the progress of an ‘iEcosystem’. This includes identifying and analyzing comparable regional and local data, which are often harder to collate than the high-level national data, and yet are important to assessing regional impact. In some ways, the data for specific ‘policy and/or program interventions’ (PPIs) might be easier to collect and then assess, but this should be done with an eye to the basic national-level metrics, and what can be found at the regional and local levels.

1. A Framework for analyzing 'innovation Ecosystems'

To define the phenomena of what are commonly described as 'innovation ecosystems' or 'entrepreneurship ecosystems' (*iEcosystems*), we draw on our own analysis of 'innovation-driven entrepreneurship' and that of our MIT colleagues with whom we have collaborated on much of this material.[2] We are also guided by lessons learned from teaching this framework in a range of global settings and with decision-makers from different stakeholder groups, but especially from government and corporates.[3]

While not the place to explore all the intellectual foundations of the MIT iEcosystem framework, the approach here emphasizes a more comprehensive understanding of the 'system' that underpins innovation-driven entrepreneurship in these ecosystems. For simplicity, we break the 'system' down into four core elements (see Figure below). Taken together, these elements lead to 'comparative advantage' and ultimately (to a greater or lesser extent) 'impact' within an iEcosystem.



-- Fig. One: the 'system' for innovation-driven entrepreneurship --

[2] We particularly recognize the work that we have done in collaboration with our MIT colleagues – Professor Scott Stern and Professor of Practice Bill Aulet.
[3] Teaching has raised and refined this material in a number of settings, both in custom and Exec Ed settings, and also in formal courses: 'Innovation-Driven Entrepreneurial Advantage' (IDEA, 2011+), 'Regional Entrepreneurship Acceleration Lab' (REAL, 2012+), 'Regional Entrepreneurship Acceleration Program' (REAP, 2012+), 'Innovation diplomats' (2014+) and 'Innovation Ecosystems' (2016+).

Working from the bottom of the system up, we explore each of these elements in turn.

Foundational institutions are those institutions, rules, practices and norms that are often taken for granted, but ensure that investments in a wide variety of capacities and assets can be effectively protected and leveraged to the benefit of the economy. At the core, they include rule of law (and conversely lack of corruption), protection of property rights (especially for intellectual property), financial institutions, freedom for new ideas (including scientific openness), and general ease of doing business.

The two 'capacities' are the twin engines of the 'system', resting on the foundational institutions and combining distinctive 'inputs' to ultimately drive impact, often in the form of 'innovation-driven enterprises' (IDEs), rather than standard 'small/medium-sized enterprises' (SMEs).[4] A key contribution from MIT's work on innovation, entrepreneurship and ecosystems is to separate out these two capacities:[5]

- **Innovation Capacity (I-Cap)** is, in our definition, the capacity of a place – a city, a region or a nation – to develop 'new-to-the-world' ideas and to take them from 'inception to impact' (whether this be to economic, social and/or environmental impact). In other words, innovation capacity covers not only the development of basic science and research but also the translation of their 'solutions' into useful products, technologies and/or services that truly solve problems.

- **Entrepreneurship Capacity (E-Cap)** emphasizes a subset of the more general entrepreneurial capability and conditions for forming enterprises: the latter supports all types of entrepreneurship (leading mostly to SMEs rather than 'IDEs').[6] The aspects of 'E-Cap' most interest to innovation are the ones supporting this 'innovation-driven' side of entrepreneurship capacity, tailored to support the growth of IDEs in a specific place – such as a city, region or nation.

Building on foundational institutions, it is the combination of (and linkages between) innovation and entrepreneurship capacities within a city, region or nation that drives impact. However, innovation- and entrepreneurial-capacity are not always general assets developed in a regional context: they are more likely to be specialized around areas of expertise, which we think of as a broader form of comparative advantage.

[4] This distinction between SMEs and 'Innovation-Driven Enterprises' (IDEs) highlights the distinctive set of start-ups that are entrepreneurial but also have a source of advantage grounded in innovation (see Aulet & Murray 2012).
[5] For this key and recent insight of separate capacities, we are grateful to Professor Scott Stern and Professor Fiona Murray. This builds on the ground-breaking work by Porter, Furman and Stern (1999) on 'innovative capacity'.
[6] See our draft 'Typology on Enterprises' working paper, which looks at the range of these in various globally-available definitions, from micro- to 'small and medium-sized enterprises (SMEs).

Comparative Advantage of any region's economy is based on specific areas of strength that differentiate it from others around it, increasingly globally.[7] For 'innovation-driven entrepreneurship ecosystems' (iEcosystems), such 'comparative advantage' is shaped by underlying strengths in both innovation and entrepreneurship capacities but is also distinctive. A region's comparative advantage will often find expression in geographical clusters or industrial sectors - as agglomeration and specialization remain factors even in this latest phase of the industrial revolution – whether they be clusters in the life sciences, IT services or education.

We have also found that comparative advantage can be usefully expressed not only in backward reflection upon existing, well-defined clusters, but in forward-leaning areas of expertise and specialization e.g. 'Oceans', Smart City Infrastructure, etc. In the case of a region like Greater Boston, for example, this 'comparative advantage' is in life sciences, and, recently, clean energy and hardware. For Pittsburgh, it is robotics: for Singapore, maybe 'smart city infrastructure'. In countries such as Chile and Morocco, potential sources of comparative advantage for the ecosystem are likely focused on mining - its safety, water and energy needs, and new uses for specific minerals.

The resulting **'impact'** comes from the combination of innovation- and entrepreneurial-capacities, when combined with core comparative advantage and often taking specific actions through 'program and policy interventions' (PPIs). Such PPIs can be measured in a variety of different ways, and such measurement is key to their evaluation. The key 'impact' metrics are, in part, a matter of choice and prioritisation on the part of the decision-makers and iEcosystem stakeholders. It should be recognized that even the most profound interventions in the system will only drive measurable changes in impact over the longer run.

At the highest level, impact can be captured in the form of economic or social progress indicators. For economic progress, the most commonly used metric is GDP per capita: this is not without its problems, but it is widely used. For social progress, indicators such as the Social Progress Index (SPI) or UN Sustainable Development Goals (SGDs) may be more appropriate.[8]

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[7] In his Wealth of Nations (1776), Adam Smith introduced the concept of "absolute advantage" which David Ricardo developed into what has since been known as "comparative advantage" from his Principles of Political economy and Taxation (1817). The regionalized geographical dimension was introduced by Alfred Marshall in his treatment of "industrial districts" in his Principles of Economics (1890), and developed by Michael Porter with 'clusters' in his Competitive Advantage of Nations (1990). Likewise, the notion of flexible specialization (Piore and Sabel) as well as the 'varieties of capitalism' literature also focused attention on particular regional expertise.

[8] SPI (https://www.socialprogressindex.com) and UN SDGs (https://sustainabledevelopment.un.org).

Other decision-makers will define ‘impact’ differently – such as qualitative changes e.g. in local attitudes towards such entrepreneurship – and therefore measure it with different (often survey-based) metrics, tailored to the strategies and aspirations of key stakeholders.

At a more granular level, impact can be captured in terms of the types of start-ups that are being created and grow within the ecosystem – eg the level of job creation and levels of valuation. One novel metric of particular interest is the rise in the number and quality of ‘innovation-driven enterprises’ (IDEs) - enterprises that blend innovation and entrepreneurship, and in doing so have the potential for extraordinary job creation and the potential to develop solutions to important problems (at a scale that is more significant than traditional small/medium-sized enterprise (SME) start-ups).[9]

In the even shorter run, it is possible to measure the impact of specific PPI interventions in an ecosystem that take place at the regional (or national) level, where ‘impact’ might be most easily targeted and evaluated. In those cases, the metrics required to evaluate the intervention – whether it be a policy or a program – require a well-designed set of metrics to capture early impact.

[9] These IDEs are a subset of all start-ups, many of which will be on the trajectory of less exponential growth. As such, they are a critical vehicle for advancing new solutions to important problems, for long run job creation, and ultimately for economic growth and social progress. Approaches to measuring and mapping such IDEs along an “Entrepreneurial Quality Index” (EQI) – from high levels of potential based on innovation, to much lower levels, are under development by Professor Scott Stern and Jorge Guzman. See, for example, http://www.startupmaps.us/

2. Common Indices of Innovation and Rankings for Entrepreneurship

In our experience, a challenge for most decision-makers, and for all those working within complex innovation ecosystems, is to develop a simple set of metrics to evaluate the current '*as-is'* state of their ecosystem, to assess its performance relative to other benchmark locations, to inform choices and then to track progress and evaluate impact.

These challenges arise for a number of different reasons:

- First, 'innovation' and 'entrepreneurship' are hard to assess, as is the 'impact' resulting from choices: in cases where 'innovation-driven enterprises' are the sign of success, they can be complex to measure in and of themselves, especially as they take time to emerge, even after system-level changes and efforts.

- Second, 'impact' arises from a complex underlying 'system' so that there is no singular metric that can capture the state of that ecosystem, and so instead we need measures of various system elements.

- Third, I-Cap and E-Cap are the result of multiple inputs (as well as of effective transformation of these into 'outputs' for 'comparative advantage' and 'impact') leading to the need for a basket of input measures for each capacity.

- Fourth, there is widespread disagreement and a lack on clarity in the sorts of measures that are useful, leading to a proliferation of measures and indices, with various 'rankings' placing nations and regions in a pecking order without the underlying assumptions (and calculations) always being so clear.

The rise in popularity of innovation 'indices' and entrepreneurship 'rankings' means that decision-makers are presented with ever more information on which to base decisions, but with less guidance on how to assess these or determine the most appropriate measures for their ecosystem or program/policy interventions.

Before turning to our own proposed series of metrics, we review (and provide limited commentary on) a range of the most commonly used indices – and their baskets of measures - so as to be able to compare our approach to these existing ones, and show why we see the need for additional contributions (such as our own) in this already crowded field! What follows is a brief summary of the most widely-used rankings and indices: further details on these (and their underlying data) are set out in Appendix A.

First, we explore innovation-oriented indices and measures including the Global Competitiveness Index (GCI, which is broader than innovation), Bloomberg Innovation Index (BII), Global Innovation Index (GII), and the European Innovation Scorecard (EIS).

The Global Competitiveness Index (GCI) has been published every year since 2004, by the World Economic Forum (WEF). It looks at the sets of institutions, policies, and factors that determine the level of productivity of a country. The Index was developed by Prof Sala-i-Martin and Prof. Artadi and integrated the Growth Development Index by Prof Sachs and Business Competitiveness Index by Prof Porter. GCI relies heavily on the WEF's Executive Opinion Surveys and structures itself onto 12 pillars that make up a region's competitiveness, ranging from Institutions to Good Market Efficiencies. The GCI's Innovation Pillar correlates most closely with the I-Cap 'demand' component of the MIT Framework. Given its scope, GCI also provides information that is usefully linked to our analysis of "Foundations" and less relevant for I-Cap and E-Cap although several of the measures in the GCI do allow us to explore concepts for which survey-based opinions are relevant and often the only means of measurement.

More narrowly focused on innovation, the Bloomberg Innovation Index (BII) has been published by the Bloomberg Group since 2012. It ranks the top 50 most innovative countries that are rated against 6-7 parameters. These parameters focus only on innovation but are a good measure of innovation and the selection of variables makes the index robust and rather straightforward. However, its strength is also its weakness: by focusing solely on so few parameters, it misses a scope of information needed to assess the innovation-capacity. Moreover, several of the index variables e.g. patents, are elements we would deem to be outputs of innovation capacity (at least outputs along the path to strong I-Cap) and so mix inputs and outputs in a way that make the levers of change hard to identify.

Global Innovation Index (GII) is published by Cornell, INSEAD, and the WIPO, and ranks countries by their capacity for, and success in, innovation. The report has been published annually since 2007. GII ranks countries based on a collection of over 80 various singular and composed indicators to study the innovation and its environment. GII is one of the closest indexes to the MIT Framework, as a number of these individual variables overlapping, but it does not address E-Cap with precision.

The European Innovation Scoreboard (EIS) is an annual publication by the European Commission, prepared by Maastricht University. It provides a comparative analysis of innovation performance in EU and other European countries and regional neighbors. The earliest edition in a consolidated state is from 2010, although earlier editions (with a slightly different set of parameters) going back to 2007 are available. The Regional Innovation Scoreboard is a regional extension of the EIS, published every two years. The EIS collects a number of parameters that fit into the MIT framework, but its scope is limited to Europe and its surroundings.

With respect to entrepreneurship-focused rankings, we have reviewed three indices: the Global Entrepreneurship Monitor (GEM), the Global Entrepreneurship Index (GEI) and the Global Startup Ecosystem Report.

The Global Entrepreneurship Monitor (GEM) is developed by a consortium of corporations, universities, top research institutions and government laboratories that annually publishes studies on the state of entrepreneurship in over 70 countries. It conducts the research through a series of interviews and surveys: an annual survey and interviews of a representative sample of the population (the Adult Survey Population) and a survey of the experts in the country (the National Expert Survey). This GEM serves as a primary source for many other entrepreneurial indices. We will draw upon some of its measures of entrepreneurial culture/incentives as the best, and most comparative, measures of the underlying attitudes towards entrepreneurship.

The Global Entrepreneurship Index (GEI) was created by the Global Entrepreneurship and Development Institute (GEDI), developed by Imperial College London, the London School of Economics, the University of Pecs and George Mason University. It creates a framework to study individual and institutional factors that lead to entrepreneurial activities. The Index focuses on studying the entrepreneurship environment and its outputs, looking at a number of parameters to define attitudes, abilities, and aspirations of individuals, and institutional factors affecting those.

Often, these 'individual-institutional' factors are further paired, e.g. perception of entrepreneurship as a career choice and corruption index into a single variable, lowering the resolution of the study. T nonetheless a useful index for E-Cap, albeit one with many different elements, again mixing inputs and outputs in a way that makes it challenging to identify levers of change.[10]

Global Startup Ecosystem Report is a new study from 2017 by Startup Genome that looks into a number of selected tech Ecosystems. It looks in great detail at the demographics, performing, funding and infrastructure. A particular focus is on talent

[10] This framework is further extended to a Female Entrepreneurship Index, and a Regional Entrepreneurship Index for the European Union.

and other resource attraction for selected areas, however, this scope is also the limit of the study.

Lastly we explore the range of unique sources of data that provide many of the key data inputs into the indices defined above, and which serve as the bedrock of our approach to systematically measuring innovation ecosystems (at the national level). These include the World Bank, UNESCO, and OECD.

The World Bank (WB) World Development Indicators (WDI) is the Bank's primary collection of metrics, collected from official sources from around the world. It covers over 1500 variables. The data is available for 1990 (for selected countries) until 2015 (latest to date) and is comprehensive in its coverage including up to 264 countries for some measures in some years. It covers a wealth of detailed data about the structure of the national economy, agriculture, energy and education.

UNESCO's Institute for Statistics (UIS) is a particularly robust source for R&D data, which is collected through the Institute's survey on R&D statistics (in collaboration with the OECD) and available from 1996 until the current year. The UIS also works in collaboration with the Latin American Network on Science and Technology indicators and the African Union. Its coverage is for over 70 countries for data available annually or bi-annually. It is used to track progress on the UN SDGs especially for Target 9.5 which asks countries to "Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending." Its more recent innovation data collection emphasizes the types and origins of innovation (e.g. product, process, organizational or market) as well as where innovation takes place (in universities, contractors, firms etc.) It provides new insights into innovation capacity beyond R&D spending.

The OECD provides comprehensive innovation data but only for the subset of OECD countries that it engages. As the developer of the Oslo Manual, it provides critical guidance on the collection of innovation data and statistics from industry. OECD increasingly gathers data on entrepreneurship as well as innovation.

3. MIT's Approach to 'Innovation-driven Entrepreneurship' Metrics

Given the many indices and plethora of data outlined above, we have chosen an alternative approach that starts with our definition of the 'system', then breaks each part into a limited series of relevant metrics. In line with our model of the 'system', we therefore select metrics for each of the core components, as follows**:**

i. Innovation-driven entrepreneurship 'impact'
ii. Comparative Advantage of regions
iii. Innovation and Entrepreneurship Capacities
iv. Foundational Institutions

In selecting the specific measures, we are guided by the following simple criteria:

1. Measures that are simple, self-explanatory and as close to the underlying phenomena as possible;
2. Measures that capture distinctive elements of the system with as little duplication or overlap as possible, so as to be parsimonious;
3. Measures that are widely available across countries around the world (not just the OECD, EU or US) while recognizing that these measures are not always available at the sub-national regional level;
4. Measures that might be replicated or measured with simplicity by countries who do not have existing coverage;
5. Measures that are objective given preference over those that are subjective, expect where those measures are not available;
6. Measures that are directly captured rather than those that contain multiple elements.

In this Working Paper, we start by setting out metrics for the base of the ecosystem pyramid – its Foundational Institutions. We then turn to the core of our work – the selection of a small basket for metrics which are the critical 'inputs' into both the innovation and entrepreneurship capacities of the system. We then address the intermediate 'outputs' from these capacities, and the 'comparative advantage' (including regional clusters) which is shaped by these capacities.

Further work will examine and discuss a range of different approaches to capturing the 'impact' desired for specific ecosystems.

3a. Measuring 'Foundational Institutions'

Many organizations and scholars have explored the importance of foundational institutions that serve to support broader economic development in a nation, which has an obvious read-across to the establishment of a vibrant innovation ecosystem within it. Below we have selected a short list of metrics from these rankings that capture some of the key foundational institutions. Of course, these indices provide much greater depth which may be relevant for some decision-makers versus others and in some specific contexts. For our 'innovation' purposes, we consider a handful of measures that capture our conception of foundational institutions (and the strength of these), including rule of law, property rights, ease of doing business, and levels of corruption.

From the World Bank Group's (WB) Doing Business (DB)[11] site, we look at headline 'Ease of doing business' (DB) rankings but also to a number of its constituent innovation-related metrics (eg 'Topics' like starting a business, resolving insolvency, etc) and their 'Distance to frontier' (DF). From the Heritage Foundation's Index of Economic Freedom[12] (IEF), we look below the headline 'overall score' and within its four key categories for particular areas of institutional concern (eg property rights). Finally, from Transparency International (TI), the headline figures from its Corruption Perceptions Index provide a useful benchmark for countries (by perception) and the overall trends.

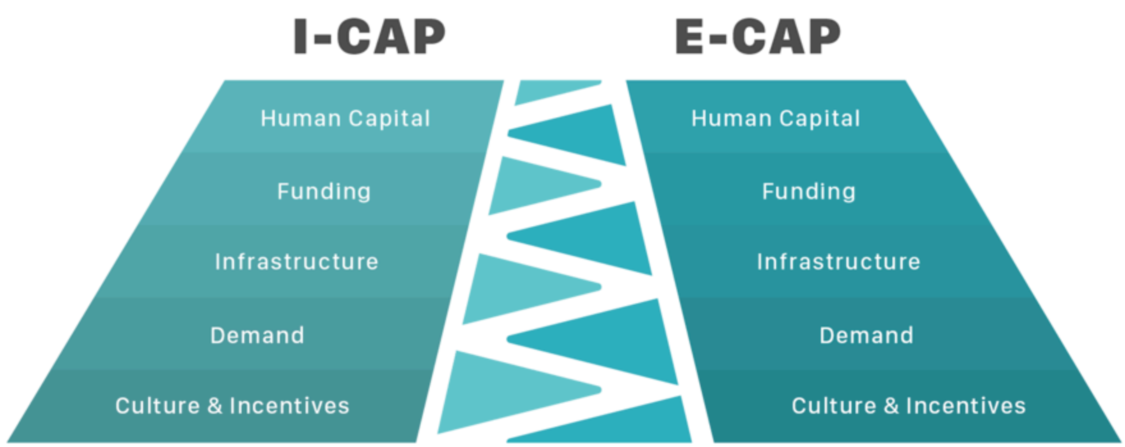
Ease of doing business (WB)	Composite country ranking from the World Bank across 10 topics relevant to ease of operating private-sector firms.
Starting a business (WB)	Ranking of the simplicity of starting a new business for entrepreneurs incorporating and registering a new firm.
Paying taxes (WB)	Ranking level of tax rates and administrative burden in tax payment for typical medium-size firms.
Resolving Insolvency (WB)	Ranking level of weaknesses in insolvency law and main bottlenecks in the process.
Enforcing contracts (WB)	Ranking level of time/cost for resolving a commercial dispute including degree of good practices in the court system.
Property Rights (IEF)	Score across the strength of laws allowing individuals to accumulate five types of property rights (including IPRs).
Government Integrity (IEF)	Score capturing levels of trust, transparency and absence of corruption.
Labor Freedom (IEF)	Score capturing flexibility and efficiency of a country's labor market including hindrance to hiring etc.
Trade freedom (IEF)	Score capturing tariff and non-tariff barriers to imports and exports.
Corruption Perceptions Index (TI)	Overall ranking of countries in their composite level of perceived corruption (high ranking implies high corruption).

[11] http://www.doingbusiness.org
[12] http://www.heritage.org/index/

3b. Measuring Innovation and Entrepreneurship Capacities

Together, I-Cap and E-Cap capture the sense that a system is capable of two particular activities: innovation and entrepreneurship respectively. As a starting point, we usefully think of a 'capacity' as a sort of 'production function' - i.e. a way of relating a series of well-defined inputs to the outputs, in this case of entrepreneurial or innovative capacity outputs. Through a decision-making lens, it is critical that the inputs into the production function be defined and then optimized for - or at least made as appropriate as possible for – innovation (moving ideas from inception e.g. in the lab through to impact in a variety of organizational settings not just in start-up enterprises) and entrepreneurship (the creation of start-ups and the scale-up of all new enterprises).

We consider five critical inputs into the I-Cap and E-Cap production functions, based on MIT research about the drivers of 'innovation-driven entrepreneurship' in a variety of locations – some within the United States but also from regions worldwide (including Singapore, Tokyo, Finland, Scotland, London, Israel, etc.).



-- Figure 2: MIT I-Cap/E-Cap framework –

This simplified framework allows decision-makers to determine their systems' greatest points of weakness and thus identify the points of leverage. These five components are:

- **Human Capital** (people) – the appropriate human talent (from within a region, or attracted into a region) with relevant education, training and experience for either innovation or entrepreneurship (or both).

- **Funding** – a variety of types of capital (from the public and private sectors) that support innovation and entrepreneurship both at their origins but also throughout the journey from idea to impact, or start-up to scale-up.

- **Infrastructure** – the physical infrastructure that is necessary to support innovation and entrepreneurship at their different stages – including space as well as equipment required for discovery, production and supply chains, etc.

- **Demand** – the level and nature of specialized demand for the outputs of innovation and entrepreneurial capacities supplied by different organizations in the system.

- **Culture & incentives** – the nature of role models and individuals who are celebrated, the social norms ('culture') that shape acceptable career choices and the incentives that shape individual and team behaviors.

For each of the different inputs into I-Cap and E-Cap, we select a basket of measures that captures the strength of these specific elements (without being too repetitive and overlapping). Starting below we outline each of these in turn.

3b.i. Measuring Innovation Capacity (I-Cap) Inputs

Human Capital: The number and quality of innovations that move from idea to impact are critically dependent on who is trained in the various skills that are essential to the innovation process and the availability of such high-quality human talent in the region of study. Human capital depends on the quality of education, the level of educational attainment and employment in their fields. We include five elements in measuring human capital as an input into I-Cap.

Funding: Research and Development (R&D) as well as the later stages of innovation is an expensive and risky process that requires a lot of financial support. Countries vary in the degree they provide for R&D, with some dedicating a larger portion of public funding, others leaving it to the business sectors. We include four elements representing funding as an input into I-Cap.

Infrastructure: Infrastructure to support I-Cap spans the range from highly specialized technological support to information access support e.g. the availability of good telephony and Internet connections. Infrastructure to support the later stages of innovation also comes through sophisticated production processes that can serve to produce innovations at a large scale. We include four elements in measuring both hard and soft infrastructure as an input into I-Cap.

Demand: Demand for innovation can be intrinsic and/or extrinsic. Here we study the interaction among innovators in different sectors, as well as buyers and their willingness to adopt new innovations. We use three elements to measure demand.

Culture & Incentives: Culture and Incentives to pursue innovation are an important factor in how much I-Cap a country has. Is there cultural support for the pursuit of technological innovations? How popular is science and engineering as a course of study in your young population and how do they view innovation? While hard to evaluate, for now, we include two elements in measuring culture and incentives as inputs into I-Cap.

Innovation Capacity (I-Cap) Inputs

HUMAN CAPITAL

Quality of STEM education (GCI)	Higher quality of Science, Technology, Engineering and Math (STEM) education leads to a higher rate of more advanced technological breakthroughs made
STEM Graduates per capita (OECD)	Are there enough graduates trained in the country to sustain the innovative work?
New PhD graduates per capita (EIS)	Are there enough graduates trained in research for the analytical work behind the R&D?
Availability of Scientists & Engineers (GCI)	Are there enough scientific and engineers staff available to be engaged in scientific work?
Researchers/Professionals engaged in R&D per million population (GII)	R&D cannot be done with the specialized trained staff in employment directly in R&D. Are there enough researchers engaged?

FUNDING

R&D expenditure as a % GDP (UNESCO)	How much funding does R&D receive in your country as a percentage of GDP?
R&D expenditure in '000 current PPP$ (UNESCO)	How much funding does R&D receive in your country in absolute terms?
Public R&D Expenditure as % of total R&D expenditure (UNESCO)	How much R&D is supported by the government through grants or education?
Business Expenditure as % of total R&D expenditure (UNESCO)	How much R&D financial support is carried out by private sector?

INFRASTRUCTURE

ICT access (GII)	Is it easy to have access to internet and communications technologies?
Internet Bandwidth (GCI)	Could the innovation pace be hampered by the internet speed? That could limit communication variety and speed.
Production Process Sophistication (GCI)	Is the work mostly done using labor-intensive methods and previous generations of process technology, or is it done using leading and most efficient processing technology?
Availability of latest technologies (GCI)	Technological progress requires more and more sophisticated scientific and other equipment. Not having access to these advancements may be a disadvantage to a region's capacity to conduct research.

DEMAND

Government procurement of advanced technology (GCI)	Governments can create demand for technologies, e.g. via military or civil contracts, that support innovation in direct or indirect ways.
University-industry research collaborations (GII)	Industries that are working close to universities can create demand for the direction of research conducted in academia. What is the degree of such collaborations in your region?
Trade, Competition & Market scale (GII)	Is there a domestic market large enough for new innovations? Is the access to international markets easy? How large are the barriers to entry for new innovation?

CULTURE & INCENTIVES

Quality of scientific research institutions (GCI)	High prestige and high quality of scientific research institutions can attract talent from the country and the international scope
Graduates in science & engineering (%) (GII)	How alluring is it to be choosing a degree in science and engineering?

3b.ii. Measuring Entrepreneurship Capacity (E-Cap) Inputs

Human Capital: Human Capital for E-Cap is more complex to measure but conceptually it refers to the number of people in a region/nation with the relevant skills and knowledge to build an enterprise from start-up through to growth and scale. It may be derived from relevant education, training, and experience. Given that it challenging to capture human capital for entrepreneurship, we include two elements in measuring human capital as an input into E-Cap.

Funding: A new enterprise often requires investment in the form of external 'risk capital', ranging from angel equity funding or then Venture Capital (VC), through to debt finance and credit arrangements. (As such 'risk capital' is defined as funding for seed and start-up finance as well as later rounds requiring the capital for expansion and replacement. In our analysis of inputs into E-Cap, we attempt to capture how accessible such funding is. The guiding questions are how transparent and efficient is the credit system and how available and common is the VC funding. We therefore include five elements in measuring funding as an input into E-Cap.

Infrastructure: Infrastructure for E-Cap is more basic than that which might be relevant for I-Cap, however it includes a number of different elements. We look at the infrastructure for telecommunications and for goods transfer, which could be crucial for the life expectancy of a start-up, the number of Internet users (as a measure of access to on-line products and services), and logistics so as to explore the delivery of products from suppliers and to customers. We include three elements to measure infrastructure.

Demand: Demand for new products and services could be predicted, to a certain extent, by the size of the domestic market (at least as a starting point). Is the domestic market attractive enough for the products/services of a new enterprise? The demand could also be affected by the sensitivity of customer to price or quality of the product. What is the share of men declaring that they would rather take a risk and start a new business than work for someone else? We include two elements to capture demand.

Culture & Incentives: Culture is widely regarded as an important factor that may support or inhibit the success of any entrepreneurial. In our index we wish to explore how culturally accepted entrepreneurship is: Are the winners celebrated sufficiently and if a business is a failure, how accepting is the society? Do the surrounding policies make it easier or harder? Furthermore, what are the positive or negative incentives in your area? If the business was a failure, does it affect one's chances for starting a new enterprise? We therefore include a total of eight elements in measuring culture and incentives as an input into E-Cap!

Entrepreneurial Capacity (E-Cap) Inputs

HUMAN CAPITAL

% school grads in tertiary education (GII)	Relevant education refers to the level of education population receives. What is the proportion of people with completed secondary education how are enrolled in universities or their equivalents?
Entrepreneurship perceived capabilities (GEM)	What share of the adult population who believe they have the required skills and knowledge to start a business?

FUNDING

Easy Access to Loans (GCI)	How easy is it for businesses to obtain a bank loan?
Ease of Credit (GII)	How easy is to take credit in terms of legal rights and credit information? Are the legal rights strong enough, and is the lending facilitated enough?
Venture capital (VC) availability (GCI)	How easy is it for start-up entrepreneurs with innovative but risky projects to obtain equity funding? Often, for enterprises that are developing or using new technologies, VC is the only available capital.
VC investment (EIS)	What is the share of VC investment to your country's GDP?
VC deals (GII)	As an index, how common is VC in the location? How many deals take place per year?

INFRASTRUCTURE

Electricity & telephony infrastructure (GCI)	Is the electricity supply sufficiently stable? How many telephones are there per inhabitants? What about the mobile telephone subscriptions?
Number of internet users (UN)	What is the share of Internet users in a region? Internet can be used via a computer, mobile phone, personal digital assistant etc.
Logistics performance (World Bank)	How well developed is the logistics performance? This includes the efficiency of clearance process by customs, trade and transportation infrastructure; and reliance on timely delivery of shipments.

DEMAND

Buyer sophistication (GCI)	On what basis do buyers make purchase decisions, price or performance?
Domestic Market Scale (GII)	How large is the domestic market size?

CULTURE & INCENTIVES

Entrepreneurial intention (GEM)	How many people have intentions to start a new business within the next three years?
Attitudes towards Entrepreneurial Risk (OECD)	What is the share of individuals declaring that they would rather take a risk and start a new business than work for someone else?
Male Attitudes towards Entrepreneurial Risk (OECD)	What is the share of men declaring that they would rather take a risk and start a new business than work for someone else?
Female Attitudes towards Entrepreneurial Risk (OECD)	What is the share of women declaring that they would rather take a risk and start a new business than work for someone else?
Fear of failure (GEM)	What share of the adult population who indicate that fear of failure would prevent them from setting up a business?
Entrepreneurship as a Good Career choice (GEM)	What share of the adult population agrees with the statement that most people consider starting a business as a desirable career choice?
High Status to Successful Entrepreneurs (GEM)	What share of population agrees with the statement that in their country successful entrepreneurs receive high status?
Business Freedom (Heritage Foundation)	How limited is an individual's ability to establish and run an enterprise without undue interference from the state? This parameter is an important dis/incentive for entrepreneurship.

3b.iii. Measuring Innovation and Entrepreneurship Capacities' Outputs

While innovation- and entrepreneurship-capacities can be thought of as having a range of inputs (that fit into five distinctive categories), there are also some easy to measure (though incomplete) outputs of both innovation- and entrepreneurship-capacities.

These simple outputs are not adequate to capture the (ever-changing) impact of an 'innovation-driven entrepreneurship' ecosystem. They are still useful, however, as intermediate outputs with which to evaluate the effectiveness of the twin engines of the innovation and entrepreneurship capacities:

- Innovation Capacity (I-Cap) Outputs include, at the simplest level, the number of research publications produced each year by a country, and (though an incomplete way of measuring innovation) the number of patent applications filed and/or granted each year. Obviously, all the usual caveats about the limitations of using publications and patents as measures of innovation apply, but they remain useful output (rather than impact) measures, especially when considered over time or against other nations.

- Entrepreneurial Capacity (E-Cap) Outputs include, in the most simplistic fashion, the number of new start-up enterprises established each year. This is a good measure of basic entrepreneurship capacity output that can be further refined when we consider 'impact' measures to consider the entrepreneurial quality (or potential) of these start-ups, and their outcomes eg. venture fund raising, job creation, public listing, etc.

All of these measures can be considered in terms of population and GDP. These two different denominators allow the outputs of I-Cap and E-Cap to be compared more globally against a baseline of either population or economic scale.

By establishing some simple benchmarks for the effectiveness of the engines of I-Cap and E-Capacity, it is possible to develop an understanding of where a country of interest lies within one of the four I-Cap/E-Cap quadrants:

- high I-Cap/high E-Cap (for example Israel and parts of the United States),
- high I-Cap/low E-Cap (for example countries such as South Korea);
- low I-Cap/high E-Cap (for example Thailand, Nigeria etc.); and finally
- low I-Cap/low E-Cap (though this is rare).

3c. Measuring the 'Comparative Advantage' of Regions

As we noted in our introduction, the 'comparative advantage' of a region is based on specific areas of strength that differentiate it from others around it – locally or globally. In some instances, such advantage arises within a country having that region be the most successful in the nation. For example, Bangalore is India's most successful region for information technology, Cambridge is such a region for life sciences in the United Kingdom, and Berlin for creative media in Germany.

On the other hand, some regions have comparative advantage that is global in stature – in other words, the region is unique on the global stage. Silicon Valley is the most obvious example, having global comparative advantage in a range of sectors including B2C and B2B software and much hardware. Similarly, Boston's Kendall Square has emerged as the leading global location with a comparative advantage in the life science.

Comparative advantage can most easily be measured through an assessment of the existing economic 'clusters' in a given region – which identifies the relative strengths in that place. The relative national or international standing are often more difficult to measure, although this can be done at a national scale. Such 'cluster' analysis has been undertaken for the United States, Europe and other selected nations.[13] As such, it can provide a useful starting point for regions that are so covered to investigate their 'as is' competitive state. Some regions find themselves seeking competitive advantage in a 'cluster' that is not part of the traditional list, such as 'oceans' for several bordering the north Atlantic which have recently identified it as their cluster focus of choice.

As well as exploring strong clusters, it is also useful to find measures that capture the collection of specialized assets, critical talent and unique challenges that might be crafted into 'comparative advantage' in a more forward-looking fashion. For example, in Chile, the obvious strengths in the mining cluster are being fused with challenges in mining-related health, environment and energy so as to provide a platform for a new generation of innovation-driven entrepreneurial startups. London's emergence as a "TechCity" built on creative talent in media and arts, from software talent unleashed from the financial sector in 2008, and the presence of many multi-national headquarters in the city.

[13] The most fully developed measures of economic clusters have been developed by Delgado, Porter and Stern as part of the US Cluster Mapping Project. And by the European Cluster observatory.

Of course, measuring such comparative advantage or even the foundations of advantage is not simple. And it is not likely to be suitable for the development and application of standard metrics in the vein of other elements of our framework. We therefore recommend that regions work with their stakeholders to explore different perspectives and opinions on the current sources of comparative advantage e.g. existing strong sectors, and future sources of comparative advantage such as potentially powerful future opportunities based on key assets, talent and challenges.

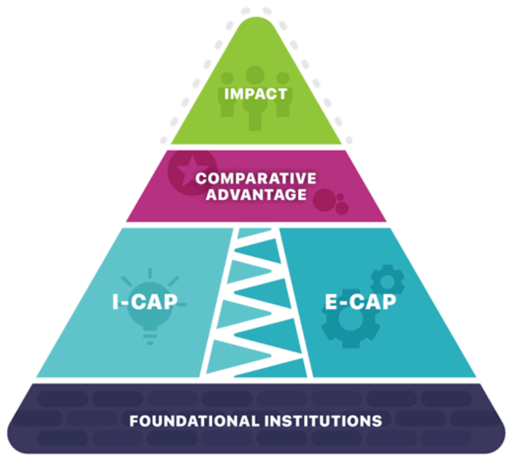
In all this work, it is critical to consider the degree to which any cluster, asset or talent is national, continental, or global. This often requires an honest and clear-eyed assessment: as an example, at one period in time, over 40 of the states in the US claimed to be ‘in the top three’ life science clusters. On the other hand, a region such as south Wales (in the UK) had noted its national comparative advantage in compound semi-conductors, while in fact it was actually global in its degree of advantage. The validity of claims to ‘global advantage’ is likely to be rare because, given the natural nature of agglomeration, only a small number of regions will rise to truly global significance in any given economic arena.

From a measurement perspective, we would therefore advise developing a simple collection of measures and metrics:

Leading current economic clusters	Ranking the three to four strongest economic sectors or clusters in the region, with additional ranking information on the degree of competitiveness of those sectors/clusters at the international level.
Leading assets	Ranking of the three most important assets in the region e.g. physical assets.
Leading areas of expertise and talent	Ranking of the three most important areas of expertise and talent in the region e.g. AI, creative arts etc. with ranking information on the degree of competitiveness at the international level.
Critical problems/ challenges	Ranking of the three most critical challenges for the region e.g. water shortages, defense security, that might be of broader relevance to other markets.

4. Conclusions

Our approach to measuring 'innovation-driven entrepreneurship' in an ecosystem is grounded in a clear framework for understanding this as a 'system' in which a range of inputs are combined, on the (more or less strong) bedrock of institutional foundations.



As the foundations for the whole system, the underlying 'institutions' are important, even though they might not be amenable to major change in the short term. Despite this, it is important to be honest and clear-eyed about them, but then turn to how to proceed in the circumstances, given the challenges – or perhaps even the opportunities – which they provide.

For both analytical and decision-making purposes, the innovation capacity (I-Cap) and entrepreneurship capacity (E-Cap) can be usefully separated into the 'twin engines' of the system, each with a separate series of inputs to fuel them. Either or both of these engines can be stronger or weaker in any given country, contributing to an ecosystem, and this assessment can be captured in a series of simple output metrics.

These then feed into 'comparative advantage' at the regional level (including clusters), which is a useful intermediate prism through which to consider the outputs of both entrepreneurship and innovation capacities.

Beyond that, the health of innovation-driven entrepreneurship in an ecosystem – as a snapshot in time, or over time - must be captured through a series of higher-level impact measures that are appropriate for the particular circumstances.

As a starting point, we have provided decision-makers with a framework to understand the innovation-driven entrepreneurship in their iEcosystem and some simple measures that capture the institutional foundations, and both innovation and entrepreneurship capacities. While not as satisfying as a singular index, we find this approach to be more intellectually robust and more useful in terms of guiding subsequent actions of decision-makers – be they within government, corporations, universities or other stakeholders.

In future work, we will expand upon our discussion of 'impact' with a variety of measures from high-level national ones (such as GDP, SPI or the UN’s SDGs) through more regional ones (such as EQI for the ‘IDEs’) to more targeted evaluations of region-specific ‘policy and program interventions’ (PPIs).

In the meantime, we present this Working Paper to capture what we have learned so far, and to seek further feedback from researchers, practitioners and decision-makers.

Appendix A: Data Sources & Indices

Taken together, our data our drawn from a range of sources. Below we present each of these sources in turn.

Bloomberg Innovation Index (BII)

The index ranks 50 countries that came top according to the following six parameters: R&D, Manufacturing, Number of High-Tech Companies, Post-Secondary education enrolment, Number of Research personnel and Number of Patents. The Bloomberg Innovation Index is available from 2012, and the index matches the MIT framework on the Human Capita, Funding, Infrastructure and Performance (see Table 1)

Table 1, Bloomberg Innovation Index's structure and indicators, and tis links to the MIT Framework (in brackets)

R&D (FUNDING)	R&D expenditure as %GDP
Manufacturing (INFRASTRUCTURE)	Manufacturing value added per capita
High Tech Companies (IDE PERFORMANCE)	# domestic high tech public companies as a share of total global # high-tech companies
Post Secondary Education (HUMAN CAPITAL)	% school graduates enrolled in post-secondary institutions, % workforce with tertiary degrees; annual science/eng grads as %
Research Personnel (HUMAN CAPITAL)	Professionals (including PhD Students) engaged in R&D per 1 million people
Patents (I-Cap PERFORMANCE)	Resident patent filings per 1M people; utility patents granted as percentage of world total.

Global Innovation Index (GII)

The Index, published by Cornell, the World Intellectual Property Organization (WIPO) and INSEAD among others, has some of the closest overlaps with the MIT approach. It covers 128 economies and focuses on innovation-oriented metrics. The largest overlap with the MIT Framework is on the iCap side, excluding the Culture & Inventive parts (see Table 2)

Table 2, Global Innovation Index structure and components and their mapping to the MIT Framework. PPL is human talent, $ is funding, INF is infrastructure, INS is institutions, IDE = Innovation-driven Enterprise performance, DMD is demand and PLC is policy.

HUMAN CAPITAL & RESEARCH	**Education**	**PPL.**	Expenditure on education, % GDP; Gov't expenditure/pupil (% GDP/cap); School life expectancy (years); PISA scales in reading, math & science; Pupil-teacher ratio in secondary education
	Tertiary education	**PPL.**	Tertiary enrolment, % gross; Graduates in science & engineering, %, Tertiary inbound mobility, %
	Research & development	**PPL. $**	Researchers, FTE/mn pop; ERD, $GDP; Global R&D Companies, avg. expend. Top 3, mln $US, QS university ranking, avr. score top 3
KNOWLEDGE & TECHNOLOGY OUTPUTS	**Knowledge creation**	**PPL.**	Patents by origin/nl PPP$ GDP; PCT patent applications/bn PPP$; Utility models by origin/bn PPP$; Scientific & technical articles/bn PPP$ GDP, Citable documents, H index
	Knowledge Impact	**IDE. INF.**	Growth rate of PPP$'; New businesses/th pop 15-64; Computer software spending, %GDP, ISO 9001 quality certificates, /bln PPP$ GDP, High- # medium-high-tech manufactures, %
	Knowledge Diffusion	**PPL. FND.**	Intellectual property receipts, % total trade, High-tech exports less re-exports, % total trade; ICT services exports, % total trade; FDI net outflows, % GDP
CREATIVE OUTPUTS	**Intangible Assets**	**PPL. INF.**	Trademarks by origin/bb PPP$ GDP; Industrial designs by origin/bln PPP$ GDP; ICTs & business model creation; ICTs & organizational model creation
	Creative goods & services	**IDE.**	Culture & creative services exports, % of total trade, National feature films/mn pop 15-69, Global ent. & media market/th pop 15-69, Printing & publishing manufactures, %; Creative goods exports, % total trade

	Online creativity	**INF.**	Generic top-level domains (TLDs)/th pop. 15-69; Country-code TLDs/th pop 15-69; Wikipedia edits/mln pop. 15-69; Video uploads on YouTube/pop 15-69
BUSINESS SOPHISTI-CATION	**Knowledge workers**	**IDE. $**	Knowledge-intensive employment, %; firms offering formal training, % of firms; GERD performed by businesses, % of GDP; GERD financed by business, %; females employed with advanced degrees, % total
	Innovation linkages	**DMD. IDE.**	University/Industry research collaboration; State of cluster development; GERD financed by abroad, %; JV-strategic alliance deals/bln PPP$ GDP; Patent families 2+ offices/bln PPP$ GDP
	Knowledge absorption	**IDE PPL.**	Intellectual property payments, % total trade; High-tech imports less re-imports, % total trade; ICT services imports, % total trade; FDI net inflows, % GDP; Research talent, % in business enterprise
INSTITUTIONS	**Political environment**	**INS.**	Political stability & safety; Government effectiveness
	Regulatory environment	**INS.**	Regulatory quality; Rule of law; Cost of redundancy dismissal, salary weeks
	Business Environment	**INS.**	Ease of Starting a business; Ease of Resolving insolvency; Ease of Paying taxes
INFRA-STRUCTURE	**ICTs**	**INF.**	ICT access; ICT use; Gov't's online service; E-participation
	General Infrastructure	**INF.**	Electricity output; Logistics performance; Gross Cap. Formation
	Ecological Sustainability	**INS.**	GDP/unit of energy use; Environmental performance; ISO 14001 environmental certificates/bn PPP$ GDP
MARKET SOPHISTI-CATION	**Credit**	**$**	Ease of getting credit; Domestic credit to private sector, %GDP; Microfinance gross loans, %GDP
	Investment	**INS. $**	Ease of protecting minority investors; Market capitalization, %GDP; Total value of stocks traded, %GDP; Venture Capital deals/bn PPP$ GDP
	Trade, Competition & Market Scale	**PLC.**	Applied tariff rate, %; Intensity of local competition; Domestic market scale/bn PPP$

Global Competitiveness Report (GCR, by WEF)

The global competitiveness report (GCR) is published by the World Economic Forum (WEF) in Davos. Most of its indicators are coming from the Executive Opinion Surveys, but the others include UN (UNESCO) statistics, International Telecommunications Union, World Trade Organization and the International Monetary Fund. The Report covers 138 economics, with separate Africa report to cover all African countries. It has a strong overlap with the MIT Framework, particularly on the foundations, infrastructure and funding (see Table 3). However, it does not have any comparable overlap on the culture and incentives.

Table 3, Global Competitiveness Report structure and mapping to the MIT Framework. PPL is human talent, $ is funding, INF is infrastructure, INS is institutions, IDE = Innovation-driven Enterprise performance, DMD is demand and PLC is policy.

1	**Institutions**	**INS.**	Property rights, Intellectual property protection, Diversion of public funds, Public trust in politicians, Irregular payments and bribes, Judicial independence, Favoritism in decisions of government officials, Wastefulness of government spending, Burden of government regulation, Efficiency of legal framework in settling dispute Efficiency of legal framework in challenging regs, Business costs of terrorism, Business costs of crime and violence, Organized crime, Reliability of police services, Ethical behavior of firms, Strength of auditing and reporting standard, Efficacy of corporate boards, Protection of minority shareholders' interests Strength of investor protection
2	**Infrastructure**	**INF.**	Quality of overall infrastructure, Quality of roads, Quality of railroad infrastructure, Quality of port infrastructure, Quality of air transport infrastructure, Available airline seat km/week, millions Quality of electricity supply, Fixed telephone lines/100 pop. Mobile telephone subscriptions/100 pop.
3	**Macroeconomic environment**	**FND.**	Quality of electricity supply; Fixed telephone lines/100 pop; Mobile telephone subscriptions/100 pop; Government budget balance, % GDP; Gross national savings, % GDP* Inflation, annual % change; General government debt, % GDP; Country credit rating
4	**Health and primary education**	**PPL.**	Malaria cases/100,000 pop. Business impact of malaria, Tuberculosis cases/100,000 pop. Business impact of tuberculosis, HIV prevalence, % adult pop. Business impact of HIV/AIDS, Infant mortality, deaths/1,000 live births Life expectancy, years Quality of primary education, Primary education enrollment, net %
5	**Higher education & training**	**PPL.**	2° education enrollment, gross %; 3°education enrollment, gross % Quality of the education system, Quality of math and science education, Quality of management schools, Internet access in schools, Availability of research and training services, Extent of staff training, Intensity of local competition

6	**Goods market efficiency**	**FND DMD..**	Intensity of local competition, Extent of market dominance, Effectiveness of anti-monopoly policy, Effect of taxation on incentives to invest, Total tax rate, % profits, No. procedures to start a business No. days to start a business Agricultural policy costs, Prevalence of trade barriers, Trade tariffs, % duty Prevalence of foreign ownership, Business impact of rules on FDI, Burden of customs procedures, Imports as a percentage of GDP Degree of customer orientation, Buyer sophistication
7	**Labor market efficiency**	**DMD.**	Cooperation in labor-employer relations, Flexibility of wage determination, Hiring and firing practices, Redundancy costs, weeks of salary Effect of taxation on incentives to work, Pay and productivity, Reliance on professional management, Country capacity to retain talent, Country capacity to attract talent, Women in labor force, ratio to men
8	**Financial market development**	**$**	Financial services meeting business needs, Affordability of financial services, Financing through local equity market, Ease of access to loans, Venture capital availability, Soundness of banks, Regulation of securities exchanges, Legal rights index
9	**Technological readiness**	**INF.**	Availability of latest technologies; Firm-level technology absorption; FDI and technology transfer, Individuals using Internet, % Fixed broadband Internet subscriptions/100 pop. Int'l Internet bandwidth, kb/s per user; Mobile broadband subscriptions/100 pop.
10	**Market size**	**DMD.**	Domestic market size index, Foreign market size index, GDP (PPP$ billions) Exports as a percentage of GDP
11	**Business sophistication**	**INF.**	Local supplier quantity, Local supplier quality, State of cluster development, Nature of competitive advantage, Value chain breadth, Control of international distribution, Production process sophistication, Extent of marketing, Willingness to delegate authority
12	**Innovation**	**IDE.**	Capacity for innovation, Quality of scientific research institutions, Company spending on R&D, University-industry collaboration in R&D, Gov't procurement of advanced tech products, Availability of scientists and engineers, PCT patents, applications/million pop.

European Innovation Scoreboard (EIS)

The European Innovation Scoreboard (EIS) was originally conducted using the methodology developed with the OECD, called the Oslo Manual in the early 2000. Rather deep in detail and with many elements mapping to the MIT Framework (mostly i-Cap) (see Table 4), its coverage is limited to the EU states and neighboring countries.

Table 4, European Innovation Scoreboard structure. PPL is human talent, $ is funding, INF is infrastructure, INS is institutions, IDE = Innovation-driven Enterprise performance, DMD is demand and PLC is policy.

FRAMEWORK CONDITIONS	**Human resources**	**PPL.**	New doctorate graduates, Population completed tertiary education, Lifelong learning
	Attractive research systems	**PPL.**	International scientific co-publications, Scientific publications among top 10% most cited, Foreign doctorate students
	Innovation-friendly environment	**INF.**	Broadband penetration, Opportunity-driven entrepreneurship
INVESTMENTS	**Finance and support**	**$.**	R&D expenditure in the public sector, Venture capital investments
	Firm investments	**$, PPL.**	R&D expenditure in the business sector, Non-R&D innovation expenditure, Enterprises providing ICT training
INNOVATION ACTIVITIES	**Innovators**	**IDE.**	SMEs with product or process innovations, SMEs with marketing or organisational innovations, SMEs innovating in-house
	Linkages	**IDE.**	Innovative SMEs collaborating with others, Public-private co-publications, Private co-funding of public R&D expenditures
	Intellectual assets	**PPL.**	PCT patent applications, Trademark applications, Design applications
IMPACTS	**Employment impacts**	**IDE.**	Employment in knowledge-intensive activities, Employment fast-growing firms innovative sectors
	Economic effects	**DMD. IDE.**	Medium & high tech product exports, Knowledge-intensive services exports, Sales of new-to-market and new-to-firm innovations

Global Entrepreneurship Index (GEI, from GEDI)

The Global Entrepreneurship Index (GEI) looks at factors impacting entrepreneurship, but studying both individual level and institutional level parameters. Table 5 below gives an overview of its structure and how it overlaps with the MIT Framework.

Table 5 Global Entrepreneurship Index structure and linkages to the MIT Framework.. PPL is human talent, $ is funding, INF is infrastructure, INS is institutions, IDE = Innovation-driven Enterprise performance, DMD is demand and PLC is policy.

ATTITUDES	Opportunity Perception	**PPL.**	Opportunity recognition
			Freedom (Economic freedom * Property rights)
	Start-up Skills	**PPL.**	Skill Perception
			Education (Tertiary education * quality of education)
	Risk Acceptance	**PPL.**	Risk Perception
			Country Risk
	Networking	**PPL. INF.**	Know Entrepreneurs
			Agglomeration (Urbanization * infrastructure)
	Cultural Support	**PPL. INS.**	Career status
			Corruption
ABILITIES	Opportunity Start-up	**PPL. INS.**	Opportunity motivation
			Governance (Taxation * Good governance)
	Technology Absorption	**INF. PPL.**	Technology Level
			Technology absorption
	Human Capital	**PPL.**	Educational Level
			Labor Market (Staff Training * Labour freedom)
	Competition	**IDE. DMD**	Competitors
			Competitiveness (Market dominance * Regulation)
ASPIRATION	Product Innovation	**IDE.**	New Product
			Tech Transfer
	Process Innovation	**IDE. $, INS.**	New Technology
			Science (GERD*(Average quality of scientific institutions and Availability of Scientists and Engineers)
	High Growth	**IDE. $**	Gazelle
			Finance and Strategy (Venture Capital * Business Sophistication)
	Internationalization	**IDE. PLC.**	Export
			Economic Complexity
	Risk Capital	**$ PLC.**	Informal Investment
			Depth of Capital Market

Global Entrepreneurship Monitor (GEM)

The GEM is a consortium of corporations, universities, top research institutions and government laboratories that annually publishes a study on the state of entrepreneurship in over 70 countries. It conducts the research through a series of interviews and surveys, an annual survey and interviews, of the population (the Adult Survey Population) and the experts in the country (the National Expert Survey). This GEM serves as a primary source for many other entrepreneurial indices. It is one of the few to provide data on the Culture & Incentives part of the MIT Framework (see Table 6 below).

Table 6, Global Entrepreneurship Monitor structure and linkages to the MIT Framework.. PPL is human talent, $ is funding, INF is infrastructure, INS is institutions, IDE = Innovation-driven Enterprise performance, DMD is demand and PLC is policy.

Self-Perceptions About Entrepreneurship (PEOPLE)	Perceived opportunities, perceived capabilities, undeterred by fear of failure
Activity (IDE PERFORMANCE)	Total Early-Stage Entrepreneurship Activity, Established business ownership rate, Entrepreneurial Employee Activity
Motivational Index (CULTURE&INCENTIVES)	Improvement-Driven Opportunity/Necessity Motive
Gender Equality (PEOPLE, CULTURE&INCENTIVES)	Female/Male Ratio, Female/Male Opportunity Ratio
Entrepreneurship Impact (IDE PERFORMANCE)	Job expectations, Innovation, Industry (% in Business Services Sector)
Societal Value about Entrepreneurship (CULTURE&INCENTIVES)	High status to entrepreneurs, entrepreneurship a good career choice