ADAPTING TO THE NEW TRANSFORMATION OF THE ECONOMY
BY VICTOR MULAS

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EXECUTIVE SUMMARY

Increasing signs suggest that the economy is in the process of a significant restructuring process.

Technology-led transformations are no longer limited to technology-related sectors and are beginning to impact structural sectors, including manufacturing, retailing, transportation, and construction. Disruptions of business models are surging from an atomized mesh network of entrepreneurs and innovators. Cognitive skills are increasingly being substituted by technology-led productivity, affecting labor supply in both developing and developed countries. In turn, creativity and social skills are becoming more important and valuable than ever before.

This change has potentially significant implications for the competitiveness of countries, business, and people. Countries are facing changes in their traditional sources of competitiveness based on a global market composed primarily of physical goods and services. Business organizations are struggling to adapt to new structures that require both leaner organizations and open innovation processes to cope with disruptive changes in their sectors. On the labor side, workers are encountering a stagnant or decreasing offering from the traditional base of physical and basic cognitive skills employment.

Some countries are starting to react to these economic changes in order to maintain their competitiveness. Most of these countries, however, are developed countries, including the United States and some European Union (EU) countries. This has significant implications for developing countries, because 70 to 80 percent of the productivity gap between developed and developing countries today can be explained by the lag in transitioning to technology-led changes from previous economic restructuring processes (for example, the 18th-century and 20th-century industrial revolutions).

Policies to respond to these technology-driven economic trends have focused on four key areas:

(i) adapting education to provide practical skills for a predominately knowledge-based economy, (ii) promoting the development of local innovation ecosystems, (iii) fostering entrepreneurship that creates new sectors and businesses, and (iv) creating innovation networks and collaborative environments (for example, innovation labs) for existing core and traditional industries to remain competitive. Countries that have applied these policies are starting to witness preliminary results as they begin to adapt their economies to the new sources of growth, particularly led by new business models and innovations.

If developing countries want to remain competitive, they will also need to adapt to these economic trends. The policy areas of focus and the examples presented below, although not prescriptive, can help these countries to shape and design their policy responses to these challenges.
Technology-led changes are transforming the economic structure

Technology-led transformation has significant impact on the structure of the economy. Both industrial revolutions, in the 18th and 20th centuries, reshaped the global economy.

The first industrial revolution ushered in changes that are still present today. In less than 150 years, the world went from being a rural-dominated economy—with less than 5 percent of the population living in cities1—centered on the agricultural sector, which employed more than 75 percent of the workforce in nearly every country, to a city-centered economy based on manufacturing and services.2 This shift led to the highest increase in productivity, output, and population in world history; however, it also caused major social disruptions and inequality, as society and the labor force coped to adapt to this new reality.3 This first technology-led transformation of the world economy reshaped countries’ competitiveness and positioned those countries that embraced new technologies faster (for example, the United Kingdom, Germany, and the United States) at the forefront of economic progress, while widening the gap with laggard countries at a dramatic scale.4 At the beginning of that industrial revolution, the difference in living standards between richest and poorest countries was about 2 to 1. Today that difference has risen to a ratio of between 30 and 40 to 1.5 The gaps in competitiveness and in living standards were further magnified by the second industrial revolution, in the 20th century.

Today, there are strong signs that the impact from digital technologies is reaching an inflection point that can produce a similar transformational impact on economy. The Internet has enabled information access, knowledge sharing, and collaboration in ways not seen before. Crowdsourcing communities create new products, solve complex problems, produce knowledge repositories (for example, Wikipedia), offer a platform for entrepreneurship in digital goods (for example, mobile apps),6 and provide funding to millions of entrepreneurs through crowdfunding platforms (for example, Kickstarter)7. Not only is this trend increasing, it is expanding and affecting the physical world. There are already more things connected to the Internet than there are humans; this number is expected to grow more than four times by 2020.8 Data analytics allow for finding trends and predicting outcomes in almost real time, thereby automating processes and responses.9 The costs of manufacturing have been reduced dramatically: automation has decreased costs relative to labor by 40 to 50 percent since 1990.10 3D printing11 is changing production processes in manufacturing, blurring the need for a physical location.12 Today, pieces of equipment can be produced with an Internet connection and a 3D printer, as this technology is turning “bits” into things, digitizing large parts of the manufacturing process.13 Automation is also reducing cognitive labor beyond traditional substitution of physical labor and, more significantly, it will dramatically impact transport and logistics.14 This can have significant consequences for the structure of the economy, most notably via manufacturing and transportation. These effects will expand into other sectors (for example, agriculture, construction, and medicine).15

Manufacturing processing is at the center of this new inflection point. It is easy to imagine the future of manufacturing and transportation in two to five years. Production facilities will be located close to demand (that is, within cities) and will be fully or semi-fully automatized. They will need few laborers—most, as few as 5 to 10 people—and will be able to produce, 3D print, and assemble in less than a day customized products on demand sent by consumers via digital order.16 This new production dynamic will impact supply chains, reshaping their current configuration based on production costs to one based
on the value added in this new environment (for example, proximity to demand, design, and innovation centers). Production through a semiautomatic delivery system will become the new norm in delivery of manufacturing in consumer and business markets.\textsuperscript{17} Transportation will increasingly become more automatized, with semiautomatic vehicles being first deployed for short-range travel distances and then longer ones. Maintenance of fleets and machinery will change dramatically, with just-in-time production of pieces and predictive maintenance for machinery reshaping supply chains and skills in these tasks.\textsuperscript{18}

Technology-driven changes have already started to produce a structural transformation in the economy and employment. Some authors have suggested that the economic structure is undergoing a major change of similar proportion to that of the first Industrial Revolution.\textsuperscript{19} If in that revolution physical work was substituted by technology, then in this instance, cognitive work is being substituted by technology at a more rapid pace—first affecting routine work, then expanding to other cognitive tasks. This expansion would have major implications to countries’ economic structures, affecting labor, industry competitiveness, and asset allocation, among other things. Recent studies show that technology is behind the separation of growth and gain in the United States, called “decoupling,” where productivity growth has continued but employment has stalled or declined as technology has reduced labor needs.\textsuperscript{20} Similar conditions were found in the United Kingdom.\textsuperscript{21} This situation is impacting labor markets beyond the traditional substitution of physical jobs. Routine cognitive jobs are being eliminated in the economy and substituted by technology and automation of tasks, not only in developed but also in developing countries.\textsuperscript{22} A recent study shows labor share of income has steadily declined in the economy across both developed and developing countries, including labor-intense countries (for example, China, India, and Mexico which is being substituted by capital investment in technology).\textsuperscript{23}

Changes in countries’ competitiveness and trade patterns will affect labor-intensive and developing countries the most. Countries less prepared to adapt to these structural changes will suffer in their competitiveness. Seventy to 80 percent of the productivity gap between developed and developing countries that we still see today can be explained by the lag in transitioning to technology-led changes from previous economic restructuring processes (for example, the 18th- and 20th-century industrial revolutions).\textsuperscript{24} If these technology-led trends continue and expand, then developing countries’ recent competitive gains from lower labor costs will decrease. Knowledge-intensive flows of trade are already growing 1.3 times faster than capital- and labor-intensive trade flows.\textsuperscript{25} Supply chain reshaping and relocation of manufacturing closer to consumption and demand will also impact recent gains in industrialization and foreign direct investment (FDI) that developing countries have achieved.\textsuperscript{26} If routine cognitive labor diminishes its value to global production and services, then developing countries may see less job opportunities, increased poverty and inequality, and a decrease in economic gains achieved over the past decades. Trade patterns will also be impacted, as logistics costs increase the importance of product customization and rapid delivery to consumers. This—combined with the diminished comparative advantage of low-cost labor—decreases the return on investment of disaggregated international supply chains that have fueled growth in developing countries. Trade will shift gradually from the current structure of trade in goods and services to a mixed structure where networking of knowledge will be more preeminent, increasingly resembling the patterns of the flow of digital goods.\textsuperscript{27} This would have major implications for global trade and sources of income for developing countries, particularly those with less sophisticated and/or smaller consumer markets.
Countries need to take action to adapt to this new environment. Similar to what happened in prior technology-led economic transformations, countries that embrace and adapt to the transforming economic structure will be more prepared to increase their productivity and competitiveness more than those that do not. Some countries are starting to react to the new economic changes, but most of them are developed countries, including the United States and some EU countries. If other countries want to remain competitive, they will also need to proactively adapt their economies to a predominately knowledge-based economy, where innovation and networks of open collaboration multiply economic effects.

The main policy areas, which leading countries are focusing on, are the following:

- Adapting education to provide practical skills for a predominately knowledge-based economy
- Promoting the development of local innovation ecosystems
- Fostering entrepreneurship that creates new sectors and businesses
- Creating innovation networks and collaborative environments (for example, innovation labs) for existing core and traditional industries to remain competitive.

Infrastructure to support these policies will also be critical, as broadband connectivity becomes an enabler of the digital economy. However, these four policy areas can be addressed even with limited nationwide infrastructure, as long as there is enough connectivity to knowledge and open collaboration networks in key hubs (box 1). In the following paragraphs, this paper describes these policy areas and the emerging trends and policies adopted in each of them.

B/ Policies to prepare for the technology-led transformation in the economy

A/ ADAPTING EDUCATION TO PROVIDE PRACTICAL SKILLS FOR A PREDOMINATELY KNOWLEDGE-BASED ECONOMY

Preparing the population for skills that will be demanded by the new industry environment will be critical for employability and competitiveness. In the 19th century, introducing mandatory basic education helped reallocate labor from agriculture to industry after the 18th-century industrial revolution. The new labor force will now need to gain the skills for an environment where cognitive tasks are substituted by technology. Adapting educational curricula to provide what are called “21st-century skills” (for example, critical thinking, problem solving, teamwork and collaboration, communication, creativity, and innovation) will help toward this end. However, a major revamp of education is needed to achieve this goal. Many national educational programs are still based on 19th-century dynamics, where teachers lecture students and memorization is the primary method of learning. Teachers need to become facilitators who allow the acquisition of 21st-century skills by students. STEM (science, technology, engineering, and math) education and skills such as coding and 3D printing, along with creativity will become more important. Some countries—including the United Kingdom, Israel, Denmark, and New Zealand—are already moving in this direction, adapting their national curriculum to this new paradigm and including mandatory subjects (for example, coding) in schools. STEAM programs, which add arts to STEM education, are also starting to gain importance.

As technology-driven changes reshape existing industries, new skills will be constantly required.
Technology start-up communities have surged in many countries in Africa. South Africa, Ghana, Nigeria, Kenya, and Tanzania are some of the countries where technology start-ups have been emerging, forming communities of entrepreneurs. This transformation has occurred despite the level of available broadband and connectivity, which differs substantially from that of European countries or the United States, for instance. In many of these African countries, there is no abundance of broadband, quality is low, and Internet access is expensive relative to what developed countries pay. One of the most successful examples of technology innovation ecosystems in Africa is Nairobi, which has grown into one of the largest and most active ecosystems in Africa, with more than 200 active start-ups, 14 accelerators and incubators, 3 collaboration/community management spaces, and several tech-community regional events. Although Nairobi has enjoyed a substantial increase in international capacity through submarine cables, which have provided a base for broadband availability through mobile (99 percent of Internet subscribers access the Internet through mobile devices), 80 percent of mobile subscriptions are second generation (2G) with no Internet access. This limits possible technology innovations; however, it also presents opportunities to address markets that have been ignored by other entrepreneurs and multinationals because they are based on 2G technologies, using SMS and USSD apps, targeting local use-cases, which are different from those of developed countries. These markets today are not only restricted to Africa but also exist in many other countries in South Asia, East Asia, and Latin America. It is not by chance that two of the most innovative platforms used in 2G environments—M-PESA, the world’s largest platform of mobile payments, and Usahidi, which serves to crowdsource data from users to monitor election processes and help disaster recovery—come from Nairobi. This has led to multinational companies, such as Facebook, to set labs in developing countries to emulate the technology conditions of countries like Kenya in order to adapt their products to these markets.

Preparing the workforce for learning these new skills and adapting to the changed environment will be critical for existing industries to compete. Companies face a skills gap: to remain competitive in a rapidly changing environment, their specific needs must be met with an adaptable workforce. Education and training will need to be more flexible to changing corporate needs. Real-time experience is critical for education systems to remain practical, relevant, and useful in this new environment. For example, apprentices systems, such as those implemented in Germany and Austria, and university-industry platforms, which match industry projects with students to pair training with real-work experience to address the gap between academic education and corporate needs, Demola, which started in Finland and has expanded to five other countries, and Cornell NYC Tech’s program of engineering, which was specifically designed to support the New York start-up culture, are examples of these university-industry project platforms.

Vocational education and rapid training programs of technology- and creativity-related skills will also become important for the existing workforce in order to access the new job opportunities created by technological innovation. Despite the common perception that technology- and creativity-related jobs require advanced education, many of these jobs require just basic skills training (for example, Web development, which can be learned quickly with no previous training). Further, many tech jobs require only on-the-job training, either short- or long-term. For instance, almost half of the jobs of New York’s tech start-up system, one of the largest in the world, do not require a bachelor’s degree. Creating rapid skills training (for example, the coding and entrepreneurship bootcamps provided by General Assembly in New York, London, and other locations; the Ateneus de Fabricació in Barcelona; and other similar initiatives in other cities) and introducing basic tech and creativity skills in vocational training lets existing workers recycle their skills and access new job opportunities. Initial results from coding bootcamps programs that target the unskilled and poor populations, such as the Coalition for Queens in New York, confirm that rapid skills training with mentorship results in employability and rapid reskill of workers.

Cities are becoming the new ground for organic innovation. The reduction of costs and the availability of resources provided by digital technologies are allowing innovators to surge all around the world, taking advantage of the agglomeration effects provided by cities. Most of today’s start-ups do not need large investments of hardware or office space. A technolo-
gy-based start-up can develop a functioning prototype with as little as US$3,000, six weeks of work, and a working Internet connection. The focus is now on sources of networks of knowledge; mentors; interdisciplinary, cumulative learning; and talent. Cities are most suited to offer all of this, as they provide diversity and allow for constant interaction, creation of networks of knowledge, and collaboration. These dynamics are driving the urbanization of organic innovation ecosystems, not only in the United States and Europe but also in developing cities (for example, Mumbai, Buenos Aires, Nairobi, and Cape Town). Contrary to the model of suburban science and research parks prevalent in the 1990s—which was centered in large research projects requiring high investments and facilities, and where collaboration was bounded to research projects’ partners—the city innovation model is easily available to developed and developing countries alike. This presents a great opportunity for developing countries to forge organic innovation ecosystems and generate a base of innovators and entrepreneurs to support the creation of new sectors, businesses, and skills. Developing sustainable and scalable locally grown innovation ecosystems require action. Not all cities are growing their innovation and start-up communities at the same pace. Some are growing faster by actively supporting local innovation. New York, London, Amsterdam, and Barcelona are actively fostering the creation of collaboration spaces, (for example, coworking spaces, maker spaces, living labs, fab-labs, urban labs, or innovation hubs) and supporting networks of entrepreneurs through incubators and accelerators (see annex). Cities also host competitions to solve urban problems, involving the tech sector in urban life and attaching these entrepreneurs to real-life problems. New York and Barcelona serve as platforms for innovation, seeking the active involvement of the entrepreneurial community, and as laboratories for innovators to test their solutions.

**BOX 2**/ The creation of the second-largest U.S. tech innovation ecosystem

New York City has experienced one of the largest growths in the development of a technology-based innovation ecosystem in the world. From 2006, when the technology-led ecosystem was almost anecdotic in the city, to 2013, the city has become the second-largest technology-based innovation ecosystem in the United States, with almost US$2.5 million of venture capital (VC) investment. The New York ecosystem grew by 3.5 times in VC investments in start-ups and almost tripled the number of exits above US$0.5 billion. This also has implications in job creation, where the city technology ecosystem is estimated to generate more than half a million jobs, of which half of them are generated directly.

The surge of New York City’s tech innovation ecosystem is not random; it has been the result of the active support of city hall, with targeted strategy and policy actions. New York consciously followed this strategy to create new sources of income and competitiveness at the time the financial crisis occurred. Despite the size and significance of New York, the challenges faced by the city to develop a technology-based innovation ecosystem were very similar to those facing many other cities, including (i) lack of technology-specialized talent, (ii) insufficient sources of seed capital for start-ups, (iii) lack of physical space for entrepreneurs, and (iv) a limited and uncoordinated community of tech-led innovators and entrepreneurs.  

New York addressed these challenges through a strategic program with targeted policies, including (i) promoting collaborator spaces linked to mentor networks and incubators, (ii) fostering entrepreneurial fund to attract VCs into New York start-ups, (iii) attracting engineering schools to develop programs in the city and providing basic skills training and access to open hardware tools in public spaces (for example, libraries), and (iv) energizing the community through competitions and challenges. This last strategy is accomplished by opening data, developing mentorship networks for tech entrepreneurs, and promotion of the tech community by the city, including promotion campaigns, support of high-ranking city officials, and public awards. These actions were conducted in partnership with the community and private sector, thereby providing incentives to the latter. The focus on community development and collaboration spaces and mentorship networks proved to be a success, attracting a community that is self-sustainable and continues to grow.

The success in developing a sustainable technology-led innovation ecosystem presents lessons for cities around the world, in both developed and developing countries. As its ecosystem grew, New York also actively engaged poor neighborhoods through training and integration into new employment opportunities generated by the ecosystem. Almost half of the jobs generated in the New York tech ecosystem do not require a bachelor’s degree. Further, al-
As a result, knowledge, technology, and innovations, such as large capital investment or technology, longer are important to determine access to resources, petitiveness of existing industries and businesses, or businesses out of daily challenges, improve competitiveness of existing businesses and businesses, or create pioneering new business models applicable to the innovations and businesses they create directly apply to the local reality, providing a competitive edge at the start and solving local problems at the same time. As the cases of New York and Nairobi show, city innovation ecosystems can create new businesses out of daily challenges, improve competitiveness of existing industries and businesses, or create pioneering new business models applicable to existing business or industries. Simply developing these innovation ecosystems alone is not sufficient for the benefits to occur. Other actions are needed to support the conversion of ideas and start-up projects in viable entrepreneurship, and the absorption of innovation by existing industries to adapt and transform their business models, as described in the following paragraphs. However, without the base of local innovation ecosystems generated in cities, the impact of innovative transformations in the industries and the economy of a country will be severely diminished.

C/ FOSTERING ENTREPRENEURSHIP THAT CREATES NEW SECTORS AND BUSINESSES

Local entrepreneurs will be critical to create new employment and increase competitiveness of existing industry. Entrepreneurs translate innovation into new market categories locally, creating new employment opportunities for themselves and others. High- expectation entrepreneurs (HEE), where high ambition and disruptive technologies meet, drive new employment. Decreases in technology costs and global reach to markets through Internet-based open platforms have reduced barriers for entrepreneurship globally, resulting in the rise of microentrepreneurs and HEE. In this new environment, location is no longer as important to determine access to resources, such as large capital investment or technology. As a result, knowledge, technology, and innovation are growing in many developing countries where these resources are not available locally. However, as discussed later, access to knowledge, collaboration, and interdisciplinary creativity are still important. For this reason, fostering openness—creation of networks of knowledge, common spaces, and mentor networks where entrepreneurs, academia, government, and users can interact with other stakeholders and form ecosystems of innovation—will become increasingly more important. Although such initiative is necessary, in order to convert ideas and projects into sustainable start-ups and scalable businesses, it alone will not suffice. Access to capital, particularly seed investment, will remain an important determining factor for entrepreneurship. Angel investor networks—with their focus on very early stages—and accelerator programs—with their focus on early-stage capacity building and network creation while providing initial seed funding—will become more important to support the pipeline of entrepreneurs coming from nascent innovation ecosystems. New developments, such as crowdfunding platforms, could help the development of micro-entrepreneurs globally and provide access to seed financing as equity investments start being developed.

Entrepreneurship does not happen in a vacuum; it requires a conducive environment. Bottom-up innovation and co-creation of services and products with users—where solutions to real problems and rapid prototyping can be adjusted to adoption—is becoming more important for entrepreneurship. However, such co-creation is often fostered by engagement platforms of commons, where developers of ideas and users can interact. The most effective engagement platforms require a leader who conducts the platform and drives co-creation dynamics. Some countries are developing and facilitating these platforms by providing resources, such as data, thereby creating local challenges and developing virtual and physical spaces for the coordination and cooperation of diverse actors and users. The United States and EU countries are using open data and launching challenges to foster entrepreneurship locally, and they are supporting the creation of collaboration spaces, including co-working spaces, accelerators, living labs, and fablabs, where multiple stakeholders
are intertwined and where networks of open domestic and international innovation can be interlinked. In the European Union, living labs and manufacturing institutes are evolving and increasingly incorporating fablab methodologies to expand collaboration to manufacturing processes and other industries. In the United States, the federal government is financing the expansion of fablabs through TechShops across the country. In the United Kingdom, the government is carrying a nationwide initiative, “Make Things, Do Stuff,” to raise awareness and introduce the population to creating new digital technologies and applying them to practical innovation. These initiatives are paired with programs that offer access to capital and strengthening of entrepreneurship skills.

**D/ CREATING INNOVATION NETWORKS AND COLLABORATIVE ENVIRONMENTS (FOR EXAMPLE, INNOVATION LABS) FOR EXISTING CORE AND TRADITIONAL INDUSTRIES TO REMAIN COMPETITIVE**

Innovation requires ecosystems where multiple players interact and reinforce each other. Innovation is shifting from large Research and Development (R&D) facilities, traditionally hosted by governments or large corporations, to ecosystems where collaboration and cumulative inventions thrive and rapid prototyping and adoption happens. The following are crucially needed to foster and strengthen the formation of these ecosystems: hubs connecting multiple stakeholders; networks of innovation; dynamics creating interdisciplinary approaches; and environments for rapid testing, prototyping, and adoption. Moreover, these assets increase the return on innovation. Companies have been adapting to this shift, and many have adopted open innovation practices. A recent survey of almost 3,000 firms with revenues over US$250 million in the United States and Europe found that almost 80 percent of them are using some kind of open innovation. Some companies are integrating tech shops into their facilities to develop internal open innovation and rapid prototyping. However, most of these practices are internal and are more prevalent among large companies and technology-driven sectors. Traditional industries are slower to adapt to the new models of ecosystem innovation, and there is a slow rate of collaboration with multiple players and broader ecosystems.

If existing and traditional industries do not move toward an open collaboration environment in order to generate and incorporate innovation, they will lose competitiveness. Governments can help foster an environment for open collaboration and create organic networks of innovation. Some countries are supporting collaboration networks through spaces (for example, industry innovation labs) that combine companies, academia, entrepreneurs, users, and government to build networks, share knowledge, and produce shared inventions. These initiatives also help produce rapid prototyping, iterate and test rapidly in real environments to share results in real time with the innovation stakeholders. This results in cumulative and advanced innovation and formation of stronger links between innovation, design, and production, which shapes new knowledge-based supply chains. By creating networks that link these labs, the collaboration community is enlarged and diversified, increasing the results on innovation and adoption. For example, the United States has launched an initiative to create a network of advanced manufacturing innovation institutes with these premises, including the digital manufacturing lab in Chicago, which comprises a network of universities, companies, and government with a creative commons approach focused on manufacturing. In Europe, there is a network of living labs that are evolving organically toward a more connected ecosystem structure with universities, companies, government, and civil society. This network of living labs introduces collaborative commons approaches, providing a platform to build connected innovation ecosystems.
# ANNEX – Collaboration and Community Promotion Spaces

## Collaboration Space

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<th>Coworking spaces</th>
<th>Description</th>
<th>Examples</th>
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| Coworking spaces  | Coworking spaces are open spaces that usually provide broadband connectivity and a few other amenities (for example, a cafeteria and a workspace). Typically coworking spaces tend to be an open floor with shared desks for members, though some offer closed-door offices. The three main characteristics of coworking spaces are that they offer interaction with other people, flexible working hours, and an environment for serendipitous discoveries. Coworking spaces have multiple models: some are owned by companies and no external members are allowed (usually aligned with a corporation’s open innovation strategy); some are independently operated and open to the public (some of which create communities of interest); and others are publicly owned (for example, by city governments). Many coworking spaces have evolved into techinnovation community management centers that also provide links with, or include in the same space, networks of mentors, skills training courses, accelerators, and incubators. | WeWork, New York [https://www.wework.com](https://www.wework.com)  
Alt City, Beirut [http://www.altcity.me/](http://www.altcity.me/) |
|                   | Accelerator programs, or accelerators, can be virtual, but most of them are attached to a physical space, where a cohort of start-ups work together to develop their projects for a limited period of time. An accelerator can be part of a broader coworking space or incubator, or a space on its own. Accelerators support entrepreneurs and start-ups in early stages of development, and they are often comprised of the following features: (i) a highly competitive and open application process for entrepreneurs; (ii) provision of small amounts of seed investment; (iii) focus on small teams rather than individual founders; (iv) intensive support for a limited period of time (usually 3–6 months), with active mentorship and networking; and (v) collaborative work among start-ups through a cohort or classes of startups. | Tech Starts, Boulder, New York, and other locations [http://www.techstars.com/](http://www.techstars.com/)  
### Collaboration Space

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<th>Collaboration Space</th>
<th>Description</th>
<th>Examples</th>
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| **Maker Spaces**    | Maker spaces are community centers or co-working spaces, typically independently owned, that provide access to a series of tools and light equipment for fabrication—most significantly, 3D printers and open-source hardware board toolkits and technology (for example, Arduino boards). Maker spaces can be more sophisticated, offering more advanced tools and materials for textiles or for metal- and woodworking. Some of these spaces also provide mentors and a community of interest around the “makers movement” or DIY (do-it-yourself) fabrication and prototyping. | Santiago Maker Space, Santiago de Chile  
http://www.stgomakerspace.com/  
Maker Space, Madrid  
http://makespacemadrid.org/  
GearBox, Nairobi  
http://gearbox.co.ke/ |
| **Fabrication Labs (fablabs)** | Fablabs are similar to maker spaces, though they have standard requirements, including a minimum set of tools for fabrication and an accreditation program for fablab managers. Fablabs are small-scale workshops that were originally designed as prototyping platforms for local entrepreneurship but have expanded to universities and higher education facilities to provide complimentary hands-on training. Fablabs are part of the fablab program from the Massachusetts Institute of Technology (MIT). Fablabs have to subscribe to the fablab charter and have to offer public access to their facilities. The fablab program has a fablab academy to train and accredit its managers and a network of collaboration (global fablab network). | Fab Lab Barcelona  
http://www.fablabbcn.org/  
Fab Lab Lisboa  
http://fablablisboa.pt/  
Fab Lab South Africa  
http://www.fablab.co.za/ |
| **Techshop**        | Techshop is an example of a sustainable business model of the concept of fablab and maker space, where access to the fabrication equipment and mentorship is offered for a fee. Techshop has developed partnerships with universities, such as Arizona State University, or companies, such as Ford Motor Company, to develop ad hoc facilities for internal R&D. | Techshop, multiple locations  
http://www.techshop.ws/ |
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<th>Collaboration Space</th>
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| **Living Labs**     | Living labs are environments where the user-centric design methodology is applied to test prototypes developed by entrepreneurs, companies, universities, or the public in general. The basic principle of the living lab is to form collaborative environments among different actors and to help developing products through interactive user-centric design. Living labs have flexible approaches and have been employed for academic purposes in universities and/or city governments to form local communities of innovation, companies to develop products, etc. Although there are no specific requirements, the common minimum elements of a living lab are (i) a methodology for product development through user-centric design, (ii) space, (iii) a community of users, and (iv) a vacillator/management structure. There is an international network of living labs, which originated in the European Union and is managed by the ENoLL council. | Waag Society, Amsterdam [https://waag.org/en](https://waag.org/en)  
| **Urban Labs**      | Urban labs is a concept that has been implemented by some cities (for example, Barcelona) to provide companies with a platform to test products and services in the real environment within the city. The city can provide a specific area for testing or allow companies to request real-life testing environments. The selection of companies to test their products and services usually follows an open call, and product testing lasts for a limited period of time. | Urban Lab, Barcelona [http://www.22barcelona.com/content/view/698/897/lang.en/](http://www.22barcelona.com/content/view/698/897/lang.en/)  
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| **Industry Innovation Labs**| Industry Innovation Labs provide a platform connecting industries with other stakeholders in the ecosystem, particularly entrepreneurs and universities, to create open innovation and commons environments for existing industries and business. Innovation labs include living lab concepts of rapid prototyping and iteration, and are similar to innovation hubs in providing a platform coordinating a community of diverse stakeholders. | U+I Labs, Chicago  
http://www.uitlads.org/                                                                                                                   |
| **Innovation hub**          | Although there is no common definition of an innovation hub, this concept can be applied to define the evolution of collaboration spaces into community managers that coordinate or integrate many of the other functions of collaboration spaces defined above, including coworking, maker spaces, fablabs, accelerators, living labs, and urban labs. Innovation hubs' main function is to coordinate all actors of the ecosystem and help manage the community of tech-innovators and entrepreneurs to grow sustainably. Many of these innovation hubs enjoy the participation of the most relevant actors of the technology innovation ecosystem, including entrepreneurs, universities, private sector, collaboration spaces, accelerators, incubators, other providers of seed capital, community managers, and government—particularly city government. Some of these innovation hubs have collaboration spaces in their facilities, such as coworking and maker spaces, while others coordinate their functions with those spaces. Typically, these hubs will phase out their other functions when there are enough offerings for the community provided by third parties. For a detailed description of how this concept of innovation hub can be applied to develop and strengthen a technology-led innovation ecosystem, see description of the Lebanon Mobile Innovation Ecosystem Project at http://www.mie-p.org | NUMA, Paris  
http://en.numa.paris/                                                                                                                      |
|                             |                                                                                                                                                                                                              | Forum Virium, Helsinki  
http://www.forumvirium.fi/en                                                                                                               |
|                             |                                                                                                                                                                                                              | Ruta N, Medellin  
http://rutamedellin.org/                                                                                                                   |
|                             |                                                                                                                                                                                                              | iHub, Nairobi  
http://www.impacthub.net/                                                                                                                  |

2. As an example, in Europe, urban population almost doubled from 8.2 percent in the year 1700 to 15 percent in 1870. The increase was higher in Northern Europe, which further absorbed technologies from the industrial revolution, going from 13 percent to almost 28 percent. See Malanima and Volckart. For agriculture data, see Grigg, David. 1987 “The Industrial Revolution and Land Transformation.” In Land Transformation in Agriculture, ed. by M.G. Wolman and F.G.A. Fournier, Chapter 4. John Wiley & Sons. http://dge.stanford.edu/SCOPE/SCOPE_32/SCOPE_32_14_Chapter4_79-109.pdf.


6. Digitalization is creating online platforms that facilitate production and cross-border exchanges, eliminating barriers and reducing costs for small and micro-companies. Digitalization also allows access, distribution, and production costs at marginal, near zero, costs. Online platforms such as eBay, or applications platforms (Apple IOS, Google Play, or Android platforms), access a global market from almost any location in the world. See Manyika, James, Jacques Bughin, Susan Lund, Olivia Nottebohm, David Poulter, Sebastian Jauch, and Sree Ramaswamy. 2014. “Global Flows in a Digital Age: How Trade, Finance, People, and Data Connect the World Economy.” McKinsey Global Institute. http://www.mckinsey.com/insights/globalization/global_flows_in_a_digital_age.


11. 3D printing is also known as additive manufacturing, a technology that allows users to fabricate physical objects by the deposition and/or fusing of material layer by layer. See Kilkenny, Maureen. 2014. “3D Printing: Economic and Public Policy Implications.” Entreprenorskaps Forum.


31. See GSMA.
34. See, for instance, http://www.safaricom.co.ke/personal/m-pesa.
37. See Economist Intelligence Unit.
43. See http://demola.net/ and http://nyc.cornell.edu/.
45. See https://generalassembl.ly/ and http://ateneusdefabricacio.barcelona.cat/xarxa-de-ateneus-de-fabricacio/.
46. Coalition for Queens (http://www.c4q.nyc/) provides targeted skills training programs of three to six months, with mentorship, for unskilled and poor populations. Out of the first batch of 20 graduates, 70 percent obtained full-time employment, 15 percent became entrepreneurs, and the rest entered formal education programs. Interview with Jukay Hsu, Coalition for Queens (August 2014).
48. If in the 1990s an entrepreneur needed US$2 million and months of work to develop a minimum viable prototype, today she would need less than US$50,000 and six weeks of work (in some cases, these costs can be as low as US$3,000). See, for instance, Center for an Urban Future. 2012. “New Tech City.”


54. HR & A.

55. Interview with Dmytro Pokhylko, Director, Vice President, New York City Economic Development Corporation (October 2014).

56. Interview with Dmytro Pokhylko, Director, Vice President, New York City Economic Development Corporation (October 2014) and Rachel Haot, former Chief Digital Officer, New York City (September 2014).

57. HR & A.; and Center for Urban Future.


60. High-expectation entrepreneurs (HEE) are defined as those entrepreneurs who expect to employ 20 employees or more within five years. HEE are a major source of employment among entrepreneurs (between 40 percent to 70 percent of jobs created, depending on surveys). See Morris, Rhett. 2011. "2011 High-Impact Entrepreneurship Global Report." Center for High-Impact Entrepreneurship. http://www.gemconsortium.org/docs/download/295.

61. See Economist Intelligence Unit.


66.See Prahalad and Ramaswamy, and Reuters.


Curley and Salmein.


Miller and Bound.

Open-source hardware refers to hardware whose design is made publicly available and can be freely modified, made, distributed, and sold. Arduino boards are the most prominent open-source hardware. See http://www.oshwa.org/definition/ and http://www.arduino.cc/.

Fablabs’ minimum equipment includes “a laser cutter that makes 2D and 3D structures, a sign cutter that plots in copper to make antennas and flex circuits, a high-resolution NC milling machine that makes circuit boards and precision parts, a large wood router for building furniture and housing, and a suite of electronic components and programming tools for low-cost, high-speed microcontrollers for on-site rapid circuit prototyping.” See http://fab.cba.mit.edu/about/faq/ and http://www.fabfoundation.org/fab-labs/.

See http://www.fabfoundation.org/fab-labs/fab-lab-criteria/.

See http://www.techshop.ws/.

For Arizona State University, see http://techshop.ws/ts_chandler.html; for Keegan.

See http://www.openlivinglabs.eu/.

For Barcelona example, see http://www.22barcelona.com/content/view/698/897/lang,en/.

See, for instance, U+I Labs’ description at http://www.uilabs.org/#about.