Article

WTR 2016;5:19-29 http://dx.doi.org/10.7165/wtr2016.5.1.19

OPEN ACCESS

Technological Innovation and Entrepreneurship: Education, Social Good and Economic Development

Ramón Emilio Fernández[1]*, David L. Ferguson[2], Komal Magsi[3]

[1] Assistant Professor, Department of Mathematics, Dyson College of Arts and Sciences, Pace University, USA

[2] Distinguished Service Professor and Chair, Associate Provost for Diversity and Inclusion, Department of Technology and Society, College of Engineering and Applied Sciences, Stony Brook University, USA

[3] Faculty, Department of Technology and Society, College of Engineering and Applied Sciences, Stony Brook University, USA

Abstract

The innovation ecosystem provides benefits and challenges for multiple institutional actors like universities, industry, government, NGOs, and private funding agencies, as well as individuals in a rapidly evolving and dynamic environment. First, we describe the changing role of universities—whereby, the support of innovation and entrepreneurship is developing into a core mission of universities. We then describe strategies within the United States and globally to help students learn about innovation and entrepreneurship. Finally, we explore the benefits and challenges of technological innovation for economic development, emphasizing how such development relates to the global problem of underprivileged communities, both in developed and developing countries, and the special concerns of economic development for developing countries.

Keywords

Social good, Experiential learning, The third mission, Innovation, Entrepreneurship, Innovation spaces, Internships, Competition, Economic development, Developing countries

1. INTRODUCTION

1.1 Innovation Ecosystem: Evolving Roles for Universities

The world's ecosystem allows us to contextualize a very complicated system, namely the innovation ecosystem. The Diccionario de la Real Academia Española, (RAE) defines ecosystem as a compound word that emerged from the words "eco" and "system". In the English language, the word "eco" signifies ecological, something we associate with naturalness. In Spanish, this word carries two connotations: ecologic, and echo, as in repetition. Hence, according to the RAE, an ecosystem is a "community of living organism whose vital processes are interrelated among each other and that develop as a function of physical factors of a same environment" (Real Academia Española, 2015). In this paper, we position the Innovation Ecosystem in a global context. We view the innovation ecosystem as a community of self-organized entities which at times work jointly but that mostly work independently to provide knowledge that when put together by other community members, can serve the entire community in a very efficient, quickly, and affordable manner. The University is a pivotal member of the innovation ecosystem. The University comprises two intertwined but fundamentally differentiated economies: the knowledge economy, whose bedrock is fundamental

*Correspondence to : Ramón Emilio Fernández
Assistant Professor, Department of Mathematics, Dyson College of Arts and Sciences, Pace University, Pleasantville, NY 10570, United States
E-mail: rfernandez@pace.edu

World Technopolis Review
Copyright©World Technopolis Association

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License(http://creativecommons.org/licenses/by-nc/3.0) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited

WTR 2016;5:19-29 http://dx.doi.org/10.7165/wtr2016.5.1.19

research, which is fueled by the university's human capital[1]; and the commercial economy[2], which is driven by technological innovations, professionals' formation, and degree values. We frame the role of the University in the innovation ecosystem as that of an actor containing various resources that facilitate the inclusion of material resources (e.g., laboratories, lecture halls, economic capital, science parks and connections in national laboratories) and human capital (researcher scientists and engineers, research and instructional faculty, students, staff) with the potential to become catalyst of innovation ecosystems (Ferguson and Fernández, 2015).

Nowadays, the University's third mission is gaining recognition and its significance becomes more apparent. The University's capacity be a producer of the human capital that fuels the innovation ecosystem earns it a vital role within the innovation ecosystem. The university, as we know today, is fairly young. When the first European university was founded in 1088, The University of Bologna, its primary mission was to disseminate religious knowledge. At their beginning, universities served primarily to train clerics, lawyers, civil servants, and medical doctors (Rudy, 1984). Today's university model emerged at the turn of the 19th century and was grounded on the idea that a synergy between teaching and research could lead to impartial truth. This model, called the Humboldtian ideal, is charged with having influenced American universities as we know them today. While the Humboldtian ideal started with the University of Berlin in 1810, research as we know it today was recognized as a vital tool for society by the 20th century when its contributions to industry, the military, social welfare and partnership growth were undeniable. By then, research was recognized as a collaborative rather than an isolated or individual effort (Anderson, 2010). That is how the third mission of the university gained recognition, and today, carries a greater presence in civil society.

1.2 The Emergence of the Third Mission in the United States

The strengths of the United States' public research universities can be traced to the year of 1862 when the Morrill Act was passed by Congress on July 2nd. The Act granted each state 30,000 acres of public land so that they could sell them and use the revenues to fund public colleges. We highlight the following three colleges among the sixty-nine founded by these land grants: Cornell University, the Massachusetts Institute of Technology, and the University of Wisconsin at Madison (The Library of Congress, 2015). Historically, universities were involved in community outreach, engagement, and public service mostly indirectly; it was the passage of the Morrill Act that expanded university functions in the aforementioned areas and formalized the university's Third Mission (Beere et al., 2011). It has been argued that the third mission gained prominence in the early 1960s when the UNESCO published the report, "The development of higher education in Africa: Report of the Conference on the Development of Higher Education in Africa" in 1963 (Mugabi, 2014). This report outlines the importance of the role of the university in helping to develop the overall well-being of developing counties. The report highlights the significance of higher education in the formal and informal training of public servants, economic development, and the well-being of the people (UNESCO, 1963). As an example, scholars have made the case that, quantitative literacy, while not sufficient, is a necessary condition to help citizens make informed decisions based on logic rather than fanaticism and that quantitative illiteracy in the public sector is a recipe for bad public decisions (Steen and Madison, 2011). It is imperative for academic, industrial, governmental, and non-governmental communities to realize and understand that higher education's essential aim is to help students develop reasoning grounded on economic, sociological (UNESCO, 1963), cultural (Bourdieu, 1986) and quantitative reasoning (Adelman, 1999; Steen and Madison, 2011) so that they can see most, if not all, aspects of current and emerging societal challenges and problems to develop the necessary tools to implement short as well as sustainable solutions to current and emerging social challenges.

We have been taking about the third mission of the university informally. We now switch our attention to provide a more formal definition of the University's third mission. Since its origins, as we know it today in the 21stcentury, the University's mission was to teach about, and train on, the current state of knowledge so that those taught and trained could then disseminate such information (Laredo, 2007). However, as re-

[1] In relation to the knowledge economy, a university's human capital consists primarily of research faculty who manage labs, grants, research groups, or all and also reproduces the university's human capital by training students at all stages of education but especially at the doctoral level.

[2] A university's commercial economy varies depending on many factors. Big research universities often are partners with industries and philanthropists and therefore tend to have a stronger commercial economy.

2016 Copyright©World Technopolis Association

Table 1. Expansion of the university's mission

Expansion of university mission		
Teaching	Research	Entrepreneurial
Preservation and dissemination of knowledge	First academic revolution	Second academic revolution
New mission generates conflict of interest controversies	Two missions: teaching and research	Third mission: economic and social development; old missions continued

Source: Etzkowitz (2003)

search gained societal recognition, primarily through its contribution to the world wars, the development of space shuttles, and the expansion of local markets into global markets, it became apparent that university service, in the form of research, was paramount to national development. Laredo (2007) affirms that the third mission indeed emerged from research activities and notes that, public investment in research is imperative as the likelihood of a private actor to make an investment without clear assurance of profit is unlikely. Thus fundamental research is highly dependent on public funds. At the fundamental level, there have been many theories about what the mission of the university is or ought to be. For example, Etzkowitz (2003) argues that the research university parallels a startup and has become highly entrepreneurial. The article presents a compelling narrative as to how universities have undergone revolutions that led them to become the entrepreneurial university which is where the third mission lies (Etzkowitz, 2003).

The table above depicts the history of the research university and how it has evolved over the years. It could be argued that the evolution of the university parallels that of humans and their needs. The Business/Higher Education Round Table (BHERT), a not-for-profit organization that seeks to galvanize the relations between business, industries and universities, states that universities have three missions, calling the third "communities engagement" (B-HERT, 2006). Universities have transitioned from being a knowledge incubator and disseminator into artifacts of economic and social development. The latter is an example of how the university has taken on the role that Etzkowitz calls entrepreneurial (Etzkowitz, 2003), with a big innovative role. Such role became apparent post World War II, when various sectors of civil society began to see or recognize how optimizing innovation as a sequential process could lead to a more efficient and quicker innovation process (Laredo, 2007). At this moment, we make the case that there is no one single or unique definition of the third mission of the University. We know, however, that the third mission is of utmost importance in addressing various societal needs, be it by providing human, social, cultural, or economic capital, to name a few. Also, the third mission provides nations with the opportunity of creating socio-economic models that benefit all parties involved. The third mission establishes, expands, and solidifies ties between universities and communities, public and private sector agencies, as well as local communities (Mugabi, 2014). Whether defined abstractly, or by means of practical action, the third mission of the university has the potential to expand, re-shape, or re-define innovation and collaborative learning spaces: It is an important path for students to learn about innovation and entrepreneurship.

2. UNIVERSITY INNOVATION ECOSYSTEMS WITHIN THE UNITED STATES

2.1 University Innovation Ecosystem

Conceptually, the university innovation ecosystem is frequently exchanged at an academic level without a critical understanding of the values that this space can offer. In a recent NSF report by Thomas Peterson, innovative ecosystems were defined as having direct outputs that consisted of a quantifiable economic benefit (a product, process, practice, service, social change). The report highlights the following, among other, essential components of innovation ecosystems: institutional entrepreneurship and innovation culture, strength of university leadership, university research capability, local or

2016 Copyright©World Technopolis Association

WTR 2016;5:19-29 http://dx.doi.org/10.7165/wtr2016.5.1.19

regional quality of life, regional or government support, effective institutional strategy and powerful student-led entrepreneurship drive, as common factors found among academic institutions that have leading innovation ecosystems (Peterson, n.d.).

Most individuals are familiar with modern-day centers of university-based innovation and entrepreneurship such as those found at the Massachusetts Institute of Technology (MIT) and at Stanford University. However, over the last decade, an unprecedented number of universities, community colleges, Historically Black Colleges and Universities (HCBU), and regional state colleges have embraced innovation and entrepreneurship as critical to their overall mission (Office of Innovation & Entrepreneurship, 2013). In 2011, 142 major research universities and associations submitted a letter to the Secretary of Commerce renewing their commitment to innovation and entrepreneurship on their campuses and communities; they requested that the federal government continue to work with them in these areas. This report is the next step in a two-year effort by the U.S. Department of Commerce and the National Advisory Council on Innovation and Entrepreneurship (NACIE) to understand exactly what America's colleges and universities are doing programmatically and strategically to nurture innovation, commercialization, and entrepreneurship among students, faculty, alumni, and within their respective communities (Office of Innovation & Entrepreneurship, 2013). Through this collective effort, formal programs in innovation and entrepreneurship are growing, experiential learning centers are bringing a renewed meaning to university innovation centers, and new methods to bridge the gap between industry and academia are being discovered.

2.2 Formal Programs in Innovation and Entrepreneurship

Accreditation and standards for formal programs in entrepreneurship and innovation remain under development. Many academic innovators anticipate that, in the coming years, leading accreditation agencies together with state education agencies and the U.S. Departments of Labor and Education will come together to address accreditation concerns, and that this efforts will eventually lead to a great expansion of formal programs in this space (Office of Innovation and Entrepreneurship, 2013). Universities are investing both in formal programs as well as in extra-curricular activities to channel student interest in solving global problems through entrepreneurship. Examples of formal programs include degrees and certificates in entrepreneurship, while examples of extra-curricular activities include business plan contests, entrepreneurship clubs, and startup internships.

The University of Colorado at Colorado Springs (UCCS), located at the Colorado Springs campus, offer an Innovation and Entrepreneur degree program; this is one of the few programs in innovation offered at the undergraduate level. In this particular program, students receive a Bachelor's degree in Innovation (B.I.) that provides a unique multi-disciplinary team approach. UCCS's Bachelor's degree in Innovation emphasizes entrepreneurship and creative communications and globalization. For example, students completing a B.I. degree in Computer Science are required, in addition to completing classes in computer science, to develop strong team skills, to study innovation, to engage in entrepreneurship, to practice proposal writing, and to learn about business and intellectual property laws (Office of Innovation & Entrepreneurship, 2013). Multidisciplinary innovation teams working on projects for real companies are a major component of the program. The strong multi-disciplinary nature of the B.I. program provides students with critical experience working across all fields and a positive and diverse social network for them to draw upon.

Clarkson University also offers a Bachelor's degree in Innovation and Entrepreneurship. This degree is designed to leverage existing strengths in Innovation and Entrepreneurship by offering a cross-disciplinary flexible program that provides students with the knowledge and skills to: *i.* develop and manage innovation processes, *ii.* plan and commercialize innovations, *iii.* evaluate and manage innovation opportunities, *iv.* participate in, and manage, ideation and new product development processes, *v.* understand the legal and policy issues associated with new ventures, and *vi.* stimulate and manage the creation of new business enterprises both within existing corporate structures and start-up enterprises.

2.3 Experiential Learning

Experiential learning enriches traditional lecture-based classroom instruction by actively engaging students in innovative and entrepreneurial activities through workshops, conferences, internships, hands-on experience, and real world projects. In other words, experiential learning provides students with a straightforward access to active learning, as described by (Freeman et al., 2014). The following are some examples of Experiential Learning Opportunities provided by American Universities:

2016 Copyright©World Technopolis Association

i. University of Illinois' Patent Clinic provides law students with the opportunity to draft patent applications for student inventors. Student-innovators with potentially patentable inventions are referred to the Patent Clinic by the Technology Entrepreneur Center (TEC) at the College of Engineering. The Patent Clinic then reviews the innovations, searches for relevant prior work, and selects one innovation for each law student. Each law student then proceeds to work with the inventors to draft a patent application on their innovation in consultation with an instructor; *ii. The University of Wisconsin-Madison's "Entrepreneurial Deli"* borrows a food court metaphor to help students meet and learn from experienced young entrepreneurs. Using the tag line "Grab 'n Go Entrepreneurship" and a speed-dating-like format, the workshops encourage students to learn first-hand about solutions to different problems that confront startup ventures from experienced entrepreneurs; *iii. Washington University in St. Louis' student internship program* offers 25 paid internships per summer for students to work in a start-up company four days a week and attend experience learning workshops one day a week; *iv. The University of California at San Diego's Rady School of Business* requires its management students to take a course entitled "lab to market." In Lab to Market, MBAs create new products or services and go through the commercialization process, with advice from faculty and business mentors; *v. Stony Brook University (SUNY)* offers an introduction to technological design course in the Department of Technology and Society, where students have the opportunity to create a product utilizing design thinking and pitch their ideas at the end of the semester in front of a panel of both industry and academic professionals. After identifying a community and their needs, students form interdisciplinary groups to successfully create initial prototypes and business plans.

2.4 Competitions

Competitions provide a unique space for students to exercise both creativity and theory. This exciting platform also allows students to learn practical skills, such as how to craft a business plan, access venture funding, and pitch ideas. Sequential competitions build upon project ideas, ultimately leading to completed business plans that are ready for possible funding from investors. Stony Brook University has developed an Entrepreneurial Challenge where student teams from various backgrounds develop a product and a viable business plan over the course of one semester and pitch their business plan in front of industry professionals. Similar competitions exist across the United States including but not limited to: *i. Florida Atlantic University (FAU)* provides the winner of their business plan competition with free space in the incubator for half a year; *ii. Michigan Technology University's* business plan competition winners are rewarded with a monetary prize that goes directly to their business, instead of to the individual. The following year, the winners will highlight their business milestones that have resulted from the funding; *iii. University of Washington* has a stage-gated business plan competition comprised of different competitions throughout the school year in combination with seminars, courses, and mentorship to assist in advancing student ideas to the next level. The competitions range across disciplines and industries, bringing students together from different departments; *iv. University of Oregon's Venture Launch Pathway* program, student teams pick from technologies from many sources included federal labs, companies, universities and technologies from other countries. The technologies that look most promising are advanced by student teams, with backgrounds in law, business, and sciences, into the international business competition circuit. *v. The University of Wisconsin* has a 100-hour challenge in which students must purchase a product, change it, and create a public URL for outreach. They are then tested on many different aspects of entrepreneurship; *vi. University of Louisiana—Lafayette* hosts the Innovation Lafayette program. This eight day, community-wide program includes specific activities centered on the importance of innovation. Some activities are focused on the environment, entrepreneurship, and the arts.

2.5 Innovation Collaboration Spaces

Physical innovation spaces are crucial to the development of a product, for holding user testing sessions, and to create, strengthen, and improve general collaborations. Different takes on living and learning spaces are sprouting across the United States; some examples include: *i. Stony Brook University Innovation Lab* is a facility where a community of innovators from the College of Business, Research Technologies, College of Engineering and Applied Sciences, College of Arts and Sciences, and other Stony Brook departments, faculty and students can collaborate to develop ideas into actual products. The facility will be a place where ideas/concepts become tangible prototypes and creativity flows amongst members. Members can utilize the tools provided by the Innovation Lab for academic projects and personal growth. *ii. University of Florida's Infinity Hall* is a new, live-and-learn community lo-

2016 Copyright©World Technopolis Association

WTR 2016;5:19-29 http://dx.doi.org/10.7165/wtr2016.5.1.19

cated within Innovation Square, only two blocks from the University of Florida and the Florida Innovation Hub. This space (which is still under development) will offer the nation's first entrepreneurial-based academic residential community. By living and learning within the Innovation Square environment, undergraduate students can interact throughout their academic program with other like-minded people: fellow students, leading researchers, distinguished faculty, successful business professionals, and innovative entrepreneurs. Residing in an innovation-rich culture, these students dedicate themselves to the pursuit of the next breakthrough and developing their talents to bringing ideas from mind to market. *iii. Purdue University has an Entrepreneurship and Innovation Learning Community (ELC)* that is made up of students interested in new business ventures that live together in Harrison Hall, many of whom also participate in the entrepreneurship certificate program.

2.6 University-Industry Collaborations

Building effective university-industry collaborations is crucial to the creation of effective entrepreneurial ecosystems where faculty and students are directly linked to emerging and relevant industry. Supporting startup companies continues to be a main concern for universities and building and expanding strong bridges with established companies that have traditionally been their licensing partners also remains a top priority. To facilitate greater collaboration and innovation, universities are opening up their facilities, and are making their faculty and students available to businesses in the hopes of establishing greater economic value. By creating strong partnerships with companies, offering internships and externships, sharing facilities with startups, such as accelerators, and creating venture funds and incentive programs funded by industry, there is an increased output in product development by university students, faculty, and staff. Some of the most effective practices include:

i. Clemson University's International Center for Automotive Research (CU-ICAR) is an advanced-technology research campus where university, industry, and government organizations collaborate. Clemson provides the "Partnership Office" on the campus focused solely on connecting all the exceptional elements so as to ensure unparalleled economic development benefits. The Partnership Office team consists of business development, real estate, marketing, and partnership management functions all dedicated to a) making connections between automotive companies within the CU-ICAR and or State automotive ecosystem and also b) programmatically linking automotive companies to Clemson University's faculty and research expertise.

Deep Orange is a vehicle prototype program offered at CU-ICAR that immerses graduate automotive engineering students into the world of an OEM. Working collaboratively, students, multi-disciplinary faculty, and participating industry partners produce a new vehicle prototype each year. Each project integrates breakthrough product innovations and new processes – providing the automotive engineering students with hands-on experience in vehicle design, engineering, prototyping and production from the time they enter into the academic program until graduation.

ii. University of Minnesota's Industrial Partnership for Research in Interfacial and Materials Engineering (IPrime) – This is a university-industry partnership based on two-way knowledge transfer. The partnership is a consortium of more than 40 companies supporting fundamental and collaborative research on materials. Participation in IPrime affords companies the chance to scan a wide range of scientific and technological developments. IPrime's basic value statement is in providing member companies the chance to delve into the fundamental science that undergirds their products. On of iPrime's main goals is to engage industrial scientists and engineers in a pre-competitive, nonproprietary and collaborative environment. This structure promotes hands-on participation by visiting industrial scientists with IPrime faculty, students and post-doctoral associates. Industrial partners also benefit from equipment, staff and special-user rates in various supporting facilities including the Characterization Facility, Polymer Characterization Facility, University Imaging Centers, and X-Ray Computed Tomography Lab.

iii. University of Delaware's Office of Economic Innovation & Partnership (OEIP) – This program has established partnerships with the College of Engineering and the Lerner College of Business to establish a program entitled Spin In™. The program works with local entrepreneurs who 'spin in' a technology, patent, or product that needs further technical development.

iv. Georgia Institute of Technology (Georgia Tech) **Flashpoint** – This is a startup accelerator that offers entrepreneurial education and access to experienced mentors, experts,

2016 Copyright©World Technopolis Association

and investors in an immersive, shared-learning, open workspace.

v. State University of New York's Strategic Partnership for Industrial Resurgence (SPIR) – Since 1994, New York State has funded engineering programs in the State University of New York System to support industry and university/college partnerships aimed at enhancing the economy through the use of technical knowledge and the development of new technologies. As an example of impact, since 1994, SPIR at the College of Engineering and Applied Sciences (CEAS) at Stony Brook University has provided technical assistance to over 480 New York State companies. Faculty, professional staff, graduate students and undergraduate students at Stony Brook University have successfully completed hundreds of applied projects.

University-Industry collaborations are spreading across the globe. In the European Union, for example, there are a number of programs that aim at increasing students' awareness of innovation, entrepreneurship, and the importance of developing those skills prior to entering into the labor-market. France has what they describe as "Doctoral research, Business thinking". The French Ministry of Higher Education and Research funds the Industrial Agreement of Training through Research, *Conventions Industrielles de Formation par la Recherche, (CIFRE)* scholarship. CIFRE scholars receive a 3-year contract to undertake Ph.D. studies at a French company with an average salary of €28,000[3]. The primary job of fellows at the company is their research thesis. They are supervised by both an academic thesis supervisor and a company's monitor. The French company usually has a contract with a French National Laboratory. In most cases, these collaborations benefit all parties. Companies are training potential future employees, yet their payroll expenses are much lower for a student than it would be for a full time employee with the same academic expertise; by training new Ph.D.s, academic laboratories are expanding their research goals while directly supplying some important demands of the industry; students gain valuable hands on experience while developing their Ph.D. and can potentially be hired by their host industry (CIFRE, 2014). Programs like CIFRE establish innovation spaces where most parties benefit in the short and long run. Students in these types of programs are at the center of technological innovation and gain a deep understanding of the R&D needs of industries, national laboratories, and the private sector.

3. UNIVERSITY LED- SOCIAL GOOD

Nowadays, several other universities across the United States, including Ashoka University, Brown University, as well as universities across the European Union, are part of a growing movement in higher education to make the social impact of their graduates a central institutional priority.

i. Changemaker Campus Consortium. One of the main organizations pushing this trend is Ashoka University, which has created the Changemaker Campus Consortium to recognize and support universities at the leading edge of this change. The purpose of the Changemaker Campus designation is to recognize colleges and universities that have embedded social innovation as a core value and showcase the ways in which they have built supportive environments for changemaking across the entire institution – from admissions to curriculum, career services, and community and alumni engagement. Through the Changemaker Campus designation Ashoka University highlights innovative models and strategies of university-based social innovation at the most advanced institutions.

ii. The Social Innovation Fellowship at Brown University provides undergraduate students with funding, training, and mentoring to support their efforts to develop and assess new approaches to advancing social change. The Fellowship provides 15-20 students with up to $4,000 each to support an intensive summer immersion project grounded in the entrepreneurial principles of innovation, impact and sustainability. In the year following their summer immersion, Fellows may apply for up to $2,000 in matching funds to support continued efforts to deepen the project's impact and the student's learning experience.

iii. Entrepreneurial Leaders Program taught by Portland State University's business school faculty offers business

[3] This datum reflects the policy as of the year of 2012.

2016 Copyright©World Technopolis Association

WTR 2016;5:19-29 http://dx.doi.org/10.7165/wtr2016.5.1.19

training in business fundamentals, social innovation, and leadership effectiveness to more than 100 emerging social enterprise leaders from Mercy Corps, Digital Divide Data, Save the Children, World Vision, and other organizations. ELP equips these leaders with the skills they need to improve their organization's financial, social and environmental performance. In Indonesia, one participant adapted an ELP module to train 30 local youth, from which three new social businesses emerged. In Zimbabwe, a participant used ELP tools to develop a program that has now issued 51 grants to help more than 500 children with disabilities get health care and assistive devices.

iv. Changemaker Central is a student-led university-based initiative with co-working spaces at all four Arizona State University (ASU) campuses. Changemaker Central supports students in community service, entrepreneurship, service learning, and high impact careers. Their social entrepreneurship programs include: a) 10,000 Solutions, a collaborative online platform where students and community members can submit solutions for challenges they have identified and b) the ASU Innovation Challenge that supports students in developing their idea, forming a team, identifying a mentor, creating a business plan, and pitching their idea to a panel of judges. The grand-prize winner receives $10,000 to implement his or her project.

v. The European Commission hosts a number of programs that aim at re-defining the way in which higher education is delivered to various audiences, particularly audiences who seek a higher education by means of non-traditional schooling. The Lifelong Learning Programme (LLP) is Europe's flagship education and training funding program. It is divided into four sectorial sub-programmes, each of which focuses on different educational and training stages:

- Comenius for schools
- Erasmus for higher education
- Leonardo da Vinci for vocational education and training
- Grundtvig for adult education (European Commision, 2013).

After the LLP and other similar programs expired in 2013, the European Commission launched the Erasmus+ programme to provide grants for a wide range of actions and activities in the fields of education, training, and sports (European Commission, 2015). Through this programme, many master students are able to complete master degrees across participating European Union universities. This program creates an innovation space that provides students with a more global network in their respective fields.

4. TECHNOLOGICAL INNOVATION FOR SOCIAL GOOD

Technological Innovations play significant roles in society. They have the capacity to create and propel social goods in ways that are often not easily recognized. In the last decades a number of organizations and institutions have committed to broadening the access of technology to places that otherwise may face the 21st century with 19st and early 20st century technologies. One such example is the United Nations Educational, Scientific and Cultural Organization's (UNESCO) partnership with the World Technopolis Association (WTA). The UNESCO has been involved in the promotion of international collaborations by means of science, technology, innovation, and economic development, particularly in countries of high economic needs. UNESCO's ability to bring together universities and the private sector to further research for industrial innovation has been paramount (Nur and Oh, 2010). The WTA is a Non-Governmental Organization (NGO) based on Daejeon, Republic of Korea that was established in 1998 with the aim of advancing regional development by using advancements of science and technology. The WTA is a multinational multi-space of collaboration hosting a variety of initiatives that aim to lead and increase the foundation of sustainable growth and development. The following are three of their many information channels and platforms: 1) the Daejeon Global Innovation Forum provides an international platform that creates open discussions between actors who believe that sustainable growth in evolving economies is attainable by creating innovations capable of connecting science and technologies to culture and the environment. These actors understand that Higher Education and Research Institutes and industries can utilize their innovative capacity to collaborate with central and local governments, who act as facilitators of channels, to advance basic science and fundamental technologies. 2) The General Assembly, a space that creates and provides environments suitable for the discussion of how sustainable development and networking with leading experts in STEM ranging from researchers to entrepreneurs can lead discussions about the establishment and sustenance of creative economies. 3)

2016 Copyright©World Technopolis Association

The World Technopolis Review, which is a multidisciplinary peer-reviewed journal that seeks to lay the foundation for the sustainable development of Science, Technology, and Research Parks, Technopolis, as well as the incorporation of planning and decision making policies leading the creation of the latter (World Technopolis Association, 2015).

The UNESCO and WTA have been working together for some years rendering assistance to one another to create a synergy that better promotes science and technology for sustainable development. The UNESCO and the WTA provide various actors and stakeholders with spaces that can help them achieve sustainable goals in their technological innovation and implementation goals. The Science Parks provide capacity building in the form of human capital as explained by (Bourdieu, 1986). Tech Business Incubators are economic platforms that provide startups and small business owners with needed resources and support that have the potential to speed their growth and development. Their goals are centered on five primary areas of cooperation:

1. Capacity building: conducting training, workshops, seminars and conferences for science park and technology business incubator stakeholders.
2. Technical assistance: providing developing countries with technical advice in science park and technology business incubator governance.
3. Sharing experiences: promoting knowledge transfer between the public and private sectors.
4. Networking: facilitating regional and international network development, as well as collaborative research and development (R&D).
5. Pilot project: supporting the development of science parks to be used as regional case studies (Nur and Oh, 2010).

5. TECHNOLOGICAL INNOVATION AND ECONOMIC DEVELOPMENT IN DEVELOPING COUNTRIES

We introduced this report by providing a brief history of the third mission of the university and its evolution. We now turn our attention to how the third mission of the University serves as a tool for the technological innovation and economic development of third world countries. The University, as we know it today, dates back to the middles ages, when its primary role was to maintain and to disseminate information; nowadays, universities, research universities in particular, are central providers of global knowledge that produce both basic and applied research. Research universities are scarce in developing countries; nonetheless, the few that exist provide developing countries with economic and social progress (Altbach, 2007). Technological innovations range from online education, including Massive Open Online Courses (MOOCs) to water filled wheels that allow individuals to carry heavy loads of water by means of human force only. MOOCs are playing pivotal roles in enabling education access around the world. In Africa and South Africa, for example, many in favor of MOOCs highlight the following out of many positive views of MOOCs:

1. Academics view them as a tool to expand access to affordable education.
2. They have the capacity to enhance global good by means of joint collaborations in the development of courses for and with local institutions.
3. They provide an opportunity to integrate digital technology into the education mainstream for everyone's benefit.
4. They have the potential to play a pivotal role in the socio-economic development of Africa as one year of extra schooling for African students could result in an estimated growth of 12.2% in GDP (Friedenthal, 2014).

There are many opportunities and challenges ahead of leaders, entrepreneurs, and stakeholders in developing countries. MOOCs are a fairly new innovation that needs support in infrastructure, just to name one. Nonetheless, big challenges bring about big and exciting opportunities for growth and development. Many actors are taking the lead in implementing technological innovations and economic development in developing countries. Danish universities, for example, have started collaborations with developing countries to build stronger university initiatives and collaborations in four scientific areas of which we highlight: 1) Platform for Growth and Employment and 2) Platform for Environment and Climate; the first Platform addresses the needs of promoting growth and employment in developing countries by means of capacity building in three research areas: management and leadership, economic development, and agribusiness. This is done in conjunction with the African Commission. The cluster of Economic Development seeks to (i) establish a better understanding of the critical constrains and drivers of development and (ii) get more fully to grip with the many intricate links between eco-

2016 Copyright©World Technopolis Association

WTR 2016;5:19-29 http://dx.doi.org/10.7165/wtr2016.5.1.19

systems and human well-being. The cluster of Agribusiness seeks to provide a framework to address the agricultural needs of developing countries. In this Platform, both policy and technological frameworks come with the support of industries to address such needs. The second Platform seeks to develop networks of holistic and cross-disciplinary approaches to capacity development in research and research-based education, applied research, their diffusion and applications. Some of the primary pillars of platform two are: ambitious global targets for sustainable development; increased access to sustainable energy such as renewable energy systems, bio-energy and refineries; and limiting the humanitarian consequences of natural disasters (Hansen et al., 2011).

On a lesser complex scale, technological innovations can make a difference in addressing urgent developmental challenges such as the delivery of education and water and the eradication of disease and hunger. A good example of how technological innovations address the delivery of education is the "The Thomas Food Project: Feeding Mind, Body and Spirits in Thomas Haiti". Supported by the United Methodist Church and volunteers from the California-Nevada Conference, this program provides both a hot lunch and education to children of high needs. This program uses a host of technological innovations to keep running. They use a solar system to generate electricity, hence minimizing and eventually eliminating the cost of energy production. Their solar system powers the entire school, including the computer labs. They also use low-power consumption computers in an effort to be energy efficient and provide computer services all day (Waugaman, 2014).

6. CONCLUDING REMARKS

The evolution and vitality in knowledge development, new product and service development, and the interconnections of nations and industries have put innovation and entrepreneurship at the global forefront. Innovation and entrepreneurship are forcing world leaders to consider educational values (especially as they relate to social good), and economic development—in both developed and developing countries. With these considerations in mind, in this report, we have explored several dimensions on the innovation ecosystem, with an emphasis on the human dimensions. First, we explored the evolving roles for universities, including the growing interconnections between universities and industry. Secondly, we examined the many ways in which universities—often in collaboration with government and industry—are offered new and often applied opportunities that place students in the role of practitioners—capable of creating new jobs for themselves, their fellow students and new generations. Thirdly, we explored how this fervor for innovation calls into question our basic values—especially as those values relate to the type of technology that is developed and the role of technology in addressing human problems. Finally, we turned to the broad issue of innovation, entrepreneurship, and economic development. In this macro view, especially as it related to developing countries, we sought to better understand the potential benefits of existing technological systems and the future for new socio-technological systems that might support the building of infrastructures to enhance economic development.

REFERENCES

Adelman, C. (1999) *Answers in the tool box: Academic intensity, attendance patterns, and bachelor's degree attainment*, Washington, DC: U.S. Dept. of Education, Office of Educational Research and Improvement.

Altbach, P. A. (2007) "Peripheries and centres: Research universities in developing countries", *Higher Education Management and Policy* 19(2): 1682-3451.

Anderson, R. (2010, March 01) *History and Policy: Policy papers*. Retrieved July 09, 2015, from The 'idea of a niversity' today: http://www.historyandpolicy.org/policy-papers/papers/the-idea-of-a-university-today

Beere, C. A., Votruba, J. C., and Wells, G. W. (2011) *Becoming an engaged campus: A practical guide for institutionalizing public engagement*, San Francisco, CA: Jossey-Bass.

B-HERT (2006) *Universities' third mission: Community engagement*, Fitzroy, Australia: Business/Higher Education Round Table.

B-HERT (2015) *Business / Higher Education Round Table*. Retrieved July 13, 2015, from Mission: http://www.bhert.com/about.html

Bourdieu, P. (1986) "The forms of capital", In J. G. Richardson, *Handbook of theory and research for the sociology of education*, Greenwood.

CIFRE (2014) *Association Nationale Recherche Technologie*

2016 Copyright©World Technopolis Association

(National Association for Research and Technology). Retrieved July 15, 2015, from Doctoral research, Business thinking (CIFRE): http://www.anrt.asso.fr/fr/espace_cifre/pdf/plaquette-cifre-inde.pdf

Etzkowitz, H. (2003) "Research groups as 'quasi-firms': the invention of the entrepreneurial university", *Research Policy* 32: 109–121.

European Commission (2013, December 12) *Education, Audiovisual and Culture Executive Agency*. Retrieved July 15, 2015, from About Lifelong Learning programme: http://eacea.ec.europa.eu/llp/about_llp/about_llp_en.php

European Commission (2015, July 15) *Education, Audiovisual and Culture Executive Agency*. Retrieved July 15, 2015, from ERASUMUS+: http://eacea.ec.europa.eu/erasmus-plus_en

Ferguson, D. L., and Fernández, R. E. (2015) "The Role of the University in the Innovation Ecosystem, and Implications for Science Cities and Science Parks: A Human Resource Development Approach", *World Technopolis Review* 4(1): 132-143.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., and Wenderoth, M. P. (2014) "Active learning increases student performance in science, engineering, and mathematics", *Proceedings of the National Academy of Sciences* 111(23): 8410-8415. doi:10.1073/pnas.1219030111

Friedenthal, J. (2014) *Africa/South African MOOCs in 2014*, Globalstatement.

Hansen, C. P., Andersen, R. S., and Rasmussen, H. (2011) *Building stronger universities in developing countries: Partnerships for change,* Denmark: Universities Denmark.

Laredo, P. (2007) "Revisiting the third mission of universities: toward a renewed categorization of university activities?", *Higher Education Policy* 20: 441–456. doi:10.1057/palgrave.hep.8300169.

Mugabi, H. (2014) *Institutionalisation of the 'Third Mission' of the University: The case of Makerere University (Doctoral dissertation), ISBN 978-951-44-9643-1 (print)*, Tampere, Finland: Tampere University Press.

Nur, Y., and Oh, D.S. (2010) *UNESCO-WTA Cooperative Project*. Retrieved August 19, 2015, from Science Park and Technology Business Incubator: Unesco-WTA Initiatives: http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/sc_unesco-wta_initiatives_en.pdf

Office of Innovation & Entrepreneurship (2013) *The innovative and entrepreneurial university: Higher education, innovation & entrepreneurship in foucs,* U.S. Department of Commerce. Retrieved from http://www.eda.gov/pdf/The_Innovative_and_Entrepreneurial_University_Report.pdf

Peterson, T. W. (n.d.) *Creating an innovation ecosystem*, National Science Foundation. Retrieved from http://www.nsf.gov/od/oia/programs/epscor/natcon/presentations/PetersonPresentationEPSCoR.pdf

Real Academia Española (2015) *Real Academia Española*. Retrieved July 7, 2015, from Diccionario de la lengua española: http://lema.rae.es/drae/?val=ecosistema

Rudy, W. (1984) *The universities of Europe*, Rutherford, NJ: Fairleigh Dickinson University Press.

Steen, L. A., and Madison, B. L. (2011) "Reflections on the Tenth Anniversary of Mathematics and Democracy", *Numeracy* 4(1): 1-8. doi:http://dx.doi.org/10.5038/1936-4660.4.1.1

The Library of Congress (2015, March 19) *The Library of Congress*. Retrieved July 09, 2015, from Primary Documents in American History: The Morril Act: http://www.loc.gov/rr/program/bib/ourdocs/Morrill.html

UNESCO (1963) *The development of higher education in Africa: Report of the Conference on the Development of Higher Education in Africa*, France: The United Nations Educational, Scientific and Cultural Organization.

Waugaman, A. (2014) *Using technology for social good: An exploration of best practice in the use of information and communication technologies (ICTs) for development,* Nashville, TN: United Methodist Communications.

World Technopolis Association (2015) *World Technopolis Association*. Retrieved August 19, 2015, from http://www.wtanet.org/main.html

Received March 13, 2016
Accepted May 09, 2016

2016 Copyright©World Technopolis Association