AC 2012-4989: EXAMINING THE ROLE OF THE UNIVERSITY IN CREATING JOBS

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Examining the Role of the University in Creating Jobs

Abstract

This paper begins by setting out the rationale for why today's university must be involved with job creation in terms of institutional mission and global competitiveness. We present a review of recent literature, from both sides of the Atlantic, regarding universities, technology and science parks and job creation. Measuring the impact of university actions is reviewed in terms of general criteria, impact of incubators, and where jobs are being created. A case study of Silicon Valley is reviewed as well as a discussion of roles that government might play. The paper concludes with the presentation of findings from the literature review and the lessons learned from them. Finally the authors advance a set of recommendations for universities as they address this increasingly important imperative. This paper should be of interest to university administrators seeking to refine or broaden third mission activities.

Current Context and Global Competitiveness

No less an astute observer of the contemporary scene than President Obama, in a September 8, 2011 speech to a joint session of Congress, highlighted the importance of jobs in the economy:

> Now, the *American Jobs Act* answers the urgent need to create jobs right away. But we can't stop there. As I've argued since I ran for this office, we have to look beyond the immediate crisis and start building an economy that lasts into the future -- an economy that creates good, middle-class jobs that pay well and offer security. We now live in a world where technology has made it possible for companies to take their business anywhere. If we want them to start here and stay here and hire here, we have to be able to out-build and out-educate and out-innovate every other country on Earth.

Business leaders also have recognized the imperative of job creation for our economies. For example, writing in the July 2010 *Business Week*, former Intel CEO Andy Grove wrote on the necessity of 'job-centric' leadership and incentives to expand the US domestic economy:

> … job creation must be the No. 1 objective of state economic policy. The government plays a strategic role in setting the priorities and arraying the forces and organization necessary to achieve this goal. The rapid development of the Asian economies provides numerous illustrations. In a thorough study of the industrial development of East Asia, Robert Wade of the London School of Economics found that these economies turned in precedent-shattering economic performances over the '70s and '80s in large part because of the effective involvement of the government in targeting the growth of manufacturing industries.[3]

The almost daily swings of the USA's economy, and that of the balance of the world's, forcefully demonstrates the complexities and connectedness of economics, politics and indeed the situation faced by our universities. Given rhetoric focused on jobs and the link to a nation's sense of its well-being, it is more than prudent for universities to consider their role in job creation. In particular, university faculty and administrators dealing with science, engineering and technology programs must consider how they and their activity make and can make contributions to this critical imperative. A call to this end has come from President Obama as documented by Olson & Merrill[24]:

> The enactment of the *America COMPETES Act* in 2006 (and its reauthorization in 2010), the increase in research expenditures under the 2009 American Recovery and Reinvestment Act (ARRA), and President Obama's general emphasis on the contribution of science and technology to economic growth have all heightened interest in the role of scientific and engineering research in creating jobs, generating innovative technologies, spawning new industries, improving health, and producing other economic and societal benefits. (P.1) [24]

It is worth taking an external view to obtain a 'non-engineering/non-technological' perspective. The World Economic Forum (www3.weforum.org) publishes a *Global Competitiveness Report*, which provides a snapshot of the competitiveness of the majority of the world's national economies based on a global competitiveness index (GCI). The GCI is structured around twelve pillars covering the three themes of Basic Requirements, Efficiency Enhancers and Innovation and Sophistication factors. Basic Requirements include measures such as ethics, crime, laws, infrastructure, health, etc. Efficiency Enhancers include higher education and training and technological readiness. Innovation and Sophistication factors include innovation as a significant set of measures. This comprises capacity for innovation, quality of scientific research institutions, company spending on R&D, university-industry collaboration in R&D, government procurement of advanced technology products, availability of scientists and engineers, utility patents and intellectual property protection.

The countries that consistently rank highly in the *Global Competitiveness Report* all have excellent higher education systems with a strong focus on technology and innovation. In 2011, the top ten ranked countries in order were Switzerland, Singapore, Sweden, Finland, United States, Germany, Netherlands, Denmark, Japan and the United Kingdom. Other notables include Israel (22nd), China (26th) and Ireland (29th).

Barack Obama spoke to the issue of US innovation in his State of the Union Speech on 25 January 2011. In this speech he outlined his plan:

> …to help the United States win the future by out-innovating, out-educating, and out-building our global competition....What America does better than anyone – is spark the creativity and imagination of our people. We are the nation that put cars in driveways and computers in offices; the nation of Edison and the Wright brothers; of Google and Facebook. In America, innovation doesn't just change our lives. It's how we make a living. Our free enterprise system is what drives innovation. But because it's not always profitable for companies to invest in basic research, throughout history our government has provided cutting-edge scientists and inventors with the support that they need. That's what planted the seeds for

> the Internet. That's what helped make possible things like computer chips and GPS. Just think of all the good jobs – from manufacturing to retail – that have come from those breakthroughs.

The GCI in 2011 placed the United States 6th in innovation, behind Switzerland (unemployment rate 3.1%), Sweden (unemployment rate 6.9%), Japan (unemployment rate 4.5%), Finland (unemployment rate 6.2%) and Germany (unemployment rate 6.6%).

Purpose of this paper

There is little argument about the value of higher education and its contributions to society. For example, Duderstadt in 2004 wrote that the "contemporary research university reaches into every aspect of modern society. It educates the graduates that sustain commerce, government, and professional practice; it performs the research and scholarship so essential to a knowledge-driven global economy; and it applies this knowledge to meet a diverse array of social needs including health care, economic development, and national security."[29]

What the authors attempt to do in this paper is to examine one aspect of the value that universities contribute to society, i.e., how they contribute to job creation. We focus on job creation for two reasons. First, in both the United States and Ireland – unemployment is a current and pressing economic and social problem. Currently unemployment in Ireland is 14.3% (Eurostat 2011)[8] and in the United States is 8.6% (US Bureau of Labor Statistics, 2011). Therefore it is appropriate to ask the question of organisations receiving public monies what role they can and should play to address such problems. Second, universities today generally accept their role as being much wider than teaching and research, and so engage in a range of 'third mission', i.e., engagement, activities. Much has been written of the necessity and benefits of university third mission activities with respect to economic development. But less has been written with respect to a key aspect of economic development – job creation – and this paper looks for evidence of sustainable job creation resulting from the activities of universities.

Technology, economics, and politics are inexorably intertwined. This interaction has been recognized for some time as evidenced by Landau and Rosenberg, who, in their introduction to their 1986 work observed:

> We start from the premise that engineers and economists share a common interest in technology and technological change. They do, however, approach the subject from different vantage points, and the very differences in these vantage points have been intensified by the inevitable increase in specialization that has characterized industrial societies. (p. v-vi)[16]

The authors' goal for this paper is to explore the literature and practice of job creation by the university. To this end, we will:

- Examine the role of the university in job creation,
- Analyze the literature addressing university job creation,
- Present findings and critique some 'sacred cows' associated with the topic, and
- Conceptualize a way forward.

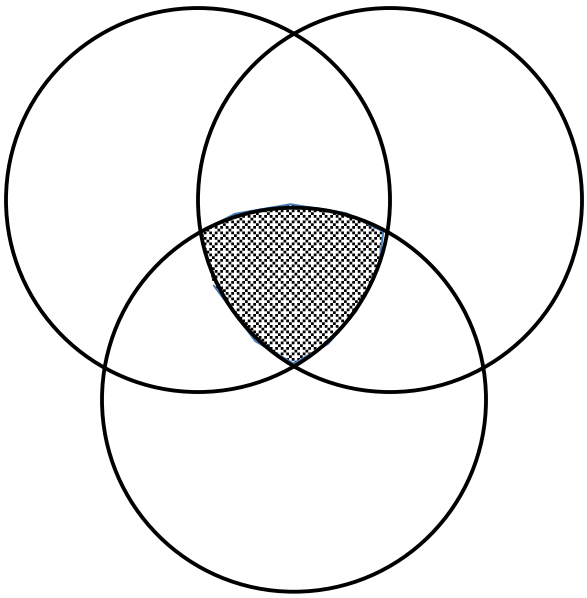

Figure 1. Literature search logic

In this way, the authors seek to continue the initiative of Landau and Rosenberg by bringing to the technology field some of the key literature from economists and others who have examined economic development and job creation. By doing so, we hope to develop "a better understanding of the conditions under which technological innovation can be made to function more effectively in the generation of economic growth" (p. v-vi) [16].

Review of the Literature on Universities & Job Creation

To establish a valid understanding of what is known about the link between universities and job creation, the authors conducted a systematic search of the literature using databases provided by Purdue University and the online resources of national and international agencies. Databases included in this search were: *Academic Search Premier*, *Applied Science Abstracts*, *Business Source Premier*, *Compendex*, *EconLit*, *Inspec*, *Omnifile FT Mega*, *Purdue Library Catalog*, *Reader's Guide Full Text*, *Science Citation Index*, and *Wilson Business Abstracts Full Text*. In addition we accessed online resources of organizations such as the Organization for Economic Cooperation and Development (OECD, http://www.oecd.org/), the USA's National Academies Press (http://www.nap.edu/), the German Association of Innovation, Technology and Business Incubation Centres (ADT, http://www.dwih.com.br/index.php?id=61), the Association of University Technology Managers (AUTM, http://www.autm.net/Home.htm), the Association of University-Related Research Parks (AURRP, http://www.aurp.net/), the National Business Incubator Association (NBIA, http://www.nbia.org/), and the European Business & Innovation Centre Network (EBN, http://www.ebn.be/DisplayPage.aspx?pid=1).

The search strategy, while widespread was relatively simple as illustrated in Figure 1 above. The bulk of our search focused on post year-2000 literature, but several pre-2000 documents were included because of their perceived importance.

The Role of the University

Today it is generally accepted that the core functions of the university are knowledge distribution (via learning), knowledge generation (via research) and knowledge transfer (via engagement with stakeholders outside of the university). These are described respectively as first, second and third mission activities of the university. University involvement in each of these core functions developed historically. Oosterlinck described this development as follows:

> The oldest function of a university, dating back to the Middle Ages, is knowledge distribution. This is what universities have done for many centuries, without bothering too much about knowledge creation. Only towards the end of the 18th and the beginning of the 19th centuries, did universities feel the need to contribute to knowledge progress, and to actively create new knowledge. ... The third essential activity, apart from knowledge distribution and knowledge creation, is still younger. We have to wait till the second half of the 20th century to witness the birth of what is called knowledge transfer to society at large. This meant that universities started to realize that they are not located in an isolated ivory tower, but that they have responsibilities to fulfil which go beyond knowledge creation and knowledge distribution, not only among our students, but in society at large, which should benefit from the very existence of universities. [29]

Individual universities with distinct mission statements will balance these three core activities in pursuit of their specific mission, but modern universities pursue all three functions in order to justify the name "university". These core functions contribute individually and collectively to the well-being of society, but to differing degrees. Each of these will be explored with regard to its role and effectiveness in creating jobs.

Universities can be viewed passively as facilitators of economic development or actively as engines of economic development. Either way, there is generally no mission confusion regarding their first and second mission activities. However, third mission activities have gained prominence only since the latter half of the 20th century. Consequently, as universities engage in an expanding set of third mission activities, it is not surprising that their importance and relevance to the individual university are questioned and arguments are made about mission dilution and mission confusion. Thus, for example, a former president of Stanford University warned against some types of engagement as distractions from the fundamental purpose of a research-intensive university[4].

Third mission activities span a wide spectrum. They can be grouped into three distinct sets of activities: (a) Technology Transfer & Innovation activities; (b) Continuing Education activities, and (c) Social Engagement activities [35]. The activities within the grouping of Technology Transfer & Innovation are those most directly associated with economic development and include such elements as: intellectual property licensing, technology parks, support for spin-out companies, support for external consultancy, technology problem solving, etc. Generally, third mission technology transfer and innovation activities are driven by economic objectives. Economic value and value for money are becoming more and more important for universities. Again, while teaching and learning missions are well understood, it is imperative that the university examine and define its engagement activities to ensure that it balances appropriately its activities across teaching, learning and engagement.

A Positivist View of Potential University Roles and Benefits

Today's universities are re-examining their roles in society, particularly as they continue to evolve beyond a focus only on teaching and research (or learning and discovery). The most notable change has been a significantly expanded and re-conceptualized view of the traditional third mission from one of service to one of engagement. For example, Martin Jischke, former president of Purdue University, termed engagement as "a mutually beneficial interaction with the constituencies around the university"[36].

In this section we present extended findings from three sources that point to the economic and societal benefits of an engaged university. According to Smilor et al. (p. 206) [26], the outcomes resulting from a culture of innovation "are the creation and transfer of technology, job and wealth creation, and enhanced recognition and prestige, all of which feed back to, and reinforce, the role of the university".

But first, we note that Wessner[33] summarized the changing role of the university and its concomitant benefits as follows, with footnotes included:

> The role of universities has evolved tremendously over the past two decades. In today's knowledge economy, universities are recognized increasingly not only as centers of learning but also as focal points of regional growth and employment[32].
>
> Today's science-driven industry increasingly draws upon university research for new ideas for improved products and processes, while university researchers frequently draw ideas from commercial trends to explore new veins of scientific inquiry[33]. Support of university research by industry is also a common source of funds for equipment and research assistance for university laboratories[34]. Such partnering between university and industry contributes to innovation and growth in the United States and is expected to remain an indispensable element for future economic growth[35]. This recognition, in turn, is focusing new policy attention to strategies that grow new technology-based companies and growth clusters and the role that universities can play in this regard[36].

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[32] See Roger L. Geiger and Creso M. Sá, *Tapping the Riches of Science: Universities and the Promise of Economic Growth,* Cambridge MA: Harvard University Press, 2009. See also Federal Reserve of Chicago, "Can Higher Education Foster Economic Growth?—A Conference Summary," *Chicago Fed Letter,* March 2007.

[33] Rosenberg and Nelson have argued that university research enhances and stimulates R&D in industry, while Pavitt (1998) describes such research as "augmenting the capacity of business to solve complex problems." See N. Rosenberg, and R. R. Nelson, "American universities and technical advance in industry," *Research Policy, 23*:323-348, 1994. See also K. Pavitt, "The Social Shaping of the National Science Base," *Research Policy, 27*:793-805, 1998.

[34] Y. S. Lee, "The Sustainability of University-Industry Research Collaboration," *Journal of Technology Transfer, 25*(2), 2000.

[35] Bronwyn Hall, "University-Industry Research Partnerships in the United States," Kansai Symposium Paper, February 2004.

[36] Some analysts point out, however, that not all universities are structured and funded in ways that encourage commercialization. They point to university technology transfer offices (TTOs) that are often faced with conflicting demands of generating revenues while managing the high volume of early-stage innovations resident and available for potential commercialization See Robert E. Litan, Lesa Mitchell and E. J. Reedy, "The University as Innovator: Bumps in the Road," *Issues in Science and Technology* Summer 2007, pp. 57-

66. Others note that universities generally do not have the financial resources to provide early-stage capital, specialized support services to the inventors, entrepreneurs, and start ups, and a physical infrastructure and organization that allows their research faculty and students to network with corporate partners, investors, service providers and other entrepreneurs to help build and grow cluster capabilities. See Diane Palmintera, "Accelerating Economic Development through University Technology Transfer," Innovation Associates, February 2005. This makes it harder for university based entrepreneurs to secure outside early-stage capital, even as angels and venture capital funds shift their focus to larger and later stage investments. See Bo Fishback, Christine A. Gulbranson, Robert E. Litan, Lesa Mitchell and Marisa Porzig, "Finding Business "Idols": A New Model to Accelerate Start- Ups," *Kauffman Foundation Report*, 4, 2007.

Smilor et al. (p. 204) [26] summarized the findings of the benefits associated with engaged research universities:

> Other studies have shown that if a research university is not in place, a technology center is not likely to develop. Smilor, Kozmetsky, and Gibson (1988) identified three main factors necessary for the development of a technology center and in which the university plays an important role: (a) the achievement of scientific excellence, (b) the development and maintenance of new technologies for emerging industries, and (c) the attraction of major technology companies and the creation of home-grown technology companies. The last factor also implies that the university can affect the promotion of technology spin-out companies by fostering an environment to promote the formation and development of new firms (Brett, Gibson, & Smilor, 1991). One outcome of the increasingly dynamic role of the research university in the creation of technology centers, not only in the United States but internationally as well, has been the emergence of the "technopolis," which involves linking technology commercialization with effective public and private sector initiatives to create new infrastructures for economic growth, diversification, and global competitiveness (Gibson, Kozmetsky, & Smilor, 1992).
>
> As a result, the paradigm of the university has been changing. A 2002 report by Tornatsky, Waugaman, and Gray reinforced the critical importance not only of Stanford University but also several other research universities, such as Georgia Tech in Atlanta, Georgia; Ohio State University in Columbus, Ohio; and Carnegie Mellon University in Pittsburgh, Pennsylvania, in creating dynamic technology centers. The authors point out that research universities are becoming more innovative and entrepreneurial by taking on new roles in a knowledge economy. And other reports have shown how the research university has become more engaged in the venturing business by more actively promoting technology transfer and commercialization (Smilor & Matthews, 2004).

Another key role of university third mission activities is workforce development. Lowe [20] has documented the critically important combination of university educational roles with targeted and customized workforce development. In her analysis of knowledge-based industries and the very successful North Carolina model, she observed that:

> This role is certainly not a new one for workforce development agencies in the United States. Project Quest in San Antonio, Jane Addams Resource Corporation in Chicago, the Wisconsin Regional Training Partnership in Milwaukee, and New York City's Garment Industry Development Corporation have all influenced the employment practices and growth strategies of regional employers by acting as workforce intermediaries, that is, agencies that expand local employment

> opportunities by simultaneously promoting regional industrial development and upgrading. In each of these cases, business establishments receive structured technical assistance from these agencies to make them more competitive in quality-demanding consumer markets. Vocational training supports play a crucial role in the upgrading process by enabling firms to enhance and expand worker skill, and thus sets to incorporate new technologies and production processes (Fitzgerald & Green Leigh, 2002; Harrison & Weiss, 1998). In most cases, these training supports are linked to local hiring goals and commitments, which enable these agencies to influence regional hiring and promotion decisions including those that involve disadvantaged populations
> (Lautsch & Osterman, 1998). (Lowe p.340)

The above three studies point to a variety of means by which the university can positively contribute to job creation that our societies and economies will benefit from. The traditional teaching or first mission role of the university is not to be overlooked when examining means of job creation. Countries should have an effective continuum of technologically capable people, i.e., a workforce sufficiently diverse and educated to staff its economy. This continuum ranges the spectrum from operatives who can function effectively with a minimal amount of training, through skilled craft workers, technicians, technologists, engineers and researchers. Universities clearly generate many technologically capable people. But they are not the sole providers. Community colleges, other non-university colleges and industry-based training programs also generate workforce capability.

The means by which the university can positively contribute to job creation are depicted in Figure 2 as extensions of Learning (first mission), Discovery (second mission), and Engagement (third mission) of the university.

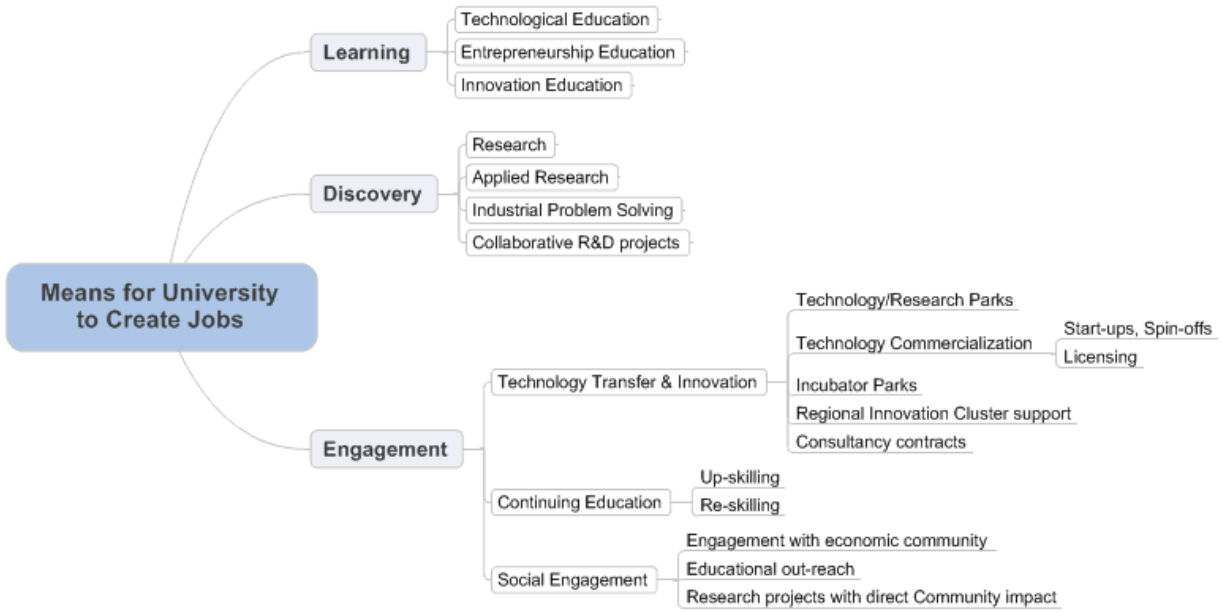

Figure 2. Mind map of university activities with job creation potential

Smilor et al concluded that "universities have assumed a more proactive role in shaping the economies of their regions" (p. 205) [26]. It is notable to see how they see this occurring:

> The result is the emergence of a culture of innovation that revolves around role models worthy of emulation; personal and organizational networks; enhanced capital resources; and a mindset that encourages tolerance of, and diversity in, the population. The outcomes of this process are the creation and transfer of technology, job and wealth creation, and enhanced recognition and prestige, all of which feed back to, and reinforce, the role of the university. (Smilor 2007, p. 206)

University Leadership

Another lesson learned from the review of the literature was the importance of university leadership for job creation. Researchers and authors who have focused on enterprise and job creation, such as Smilor et al. [26], identified a necessary condition as Visible, Visionary, and Passionate Leadership. Smilor et al. detailed this as follows:

> This article examines the drivers that have shaped a more proactive and entrepreneurial approach to the creation of high-technology centers through three detailed case studies of research universities: the University of California, San Diego; the University of Texas at Austin; and the University of North Carolina-Chapel Hill, North Carolina State University, and Duke University in Research Triangle Park. The cases show the importance of committed leadership, the power of a mobilizing event, the influence of an organization that can effect change, the acceleration that can come from the arrival of key corporations, the value of compelling role models, the impact of financial resources, and the benefit of a tolerant mind-set. Above all, they highlight the critical importance of a research university that can serve as instigator; promoter; collaborator; and magnet for talent, technological innovation, and entrepreneurial activity. (Abstract)

> All of these leaders shared some common attributes. They bridged the worlds of academia, government, and business and could interact comfortably and knowledgably in each. They controlled and could allocate resources, personal and institutional. And they exerted influence because of their stature, success, and personal persuasiveness. (p. 218)

Technology/Research/Science Parks

One of the prime university tools for job creation has been the Technology/Research/Science Park. In reporting on a NRC symposium about research parks Wessner[33] added the concept of regional innovation clusters to the mix of such entities.

> Responding to the challenges of fostering regional growth and employment in an increasingly competitive global economy, many U.S. states and regions have developed programs to attract and grow companies as well as attract the talent and resources necessary to develop innovation clusters. These state and regionally based initiatives have a broad range of goals and increasingly include significant resources, often with a sectoral focus and often in partnership with foundations and universities. These are being joined by recent initiatives to coordinate and concentrate investments from a variety of federal agencies that provide significant resources to develop regional centers of innovation, business incubators, and other strategies to encourage entrepreneurship and high-tech development. This has led

to renewed interest in understanding the nature of innovation clusters and public policies associated with successful cluster development. (p. xiii)

The OECD[22] as early as 1997 identified three major types of business incubators.

> **General/Mixed-Use Incubators:** The main goal of these incubators is to promote continuous regional industrial and economic growth through general business development. While these incubators include knowledge-intensive firms, they also include low technology firms in services and light manufacturing. A main focus of support is access to local/regional sources of technical, managerial, marketing and financial resources.
>
> **Economic Development Incubators:** These are business incubators whose main aim is to stimulate specific economic objectives such as job creation and industrial restructuring. Often the result of local government initiatives, the main goal is to help create new firms and nurture existing firms that create jobs. In some countries, this goal may target specific groups such as youth, long-term unemployed, women and minorities. In the United States, examples include "empowerment/micro-enterprise" incubators.
>
> **Technology Incubators:** These are incubators whose primary goal is to promote the development of technology-based firms. These are mainly located at or near universities and science and technology parks. They are characterised by institutionalised links to knowledge sources including universities, technology-transfer agencies, research centres, national laboratories and skilled R&D personnel. Specific industrial clusters and technologies may also be targeted such as biotechnology, software or information and communications technologies. A main aim is to promote technology transfer and diffusion while encouraging entrepreneurship among researchers and academics. In some countries, technology incubators not only focus on new firms but also help existing technology-based small firms, including subsidiaries of larger established firms. (p.15)

Given the focus of this paper, it is worth highlighting that, according to the NBIA (National Business Incubator Association), in the United States, approximately 30 per cent of the 550 business incubators affiliated with the NBIA are technology-oriented incubators (NBIA, 1995).

Such parks/technology incubators, according to the OECD[22] in their seminal conference document, have four main objectives:

> 1) economic development; 2) technology commercialisation; 3) property venture/real estate development; and 4) entrepreneurship. Job creation is a main underlying purpose of incubator support for new business formation, especially of technology-based firms. Incubators can also play an important role in strengthening co-operation between public and private actors in regional economic development. They have an outreach role, fostering entrepreneurship and training in the local community. Moreover, incubators have a symbolic role in that they allow governments to demonstrate their efforts to address problems of regional development and unemployment. (Executive Summary)

Measuring Impact & Assessing Outcomes

The goal of this paper was to examine the link between universities and job creation. Because one of the prime roles of technology/science/research parks is to establish enterprises and through them create jobs, the authors reviewed the literature dealing with assessments of such performance. OECD[22] in their seminal conference document stated:

> Evaluations of the effects of technology incubators on firm survival rates tend to be positive, but evidence regarding their impacts on job growth and net firm creation is mixed. (Executive Summary)
>
> …
>
> The success of incubators generally depends on the objectives of the stakeholders. At times, the objectives are not explicit from the outset nor are the mechanisms for measuring success necessarily linked to objectives. Nevertheless, in most OECD countries, incubators are considered successful when they generate income for stakeholders, develop new businesses which move out, create jobs, diffuse technology, and generate tax revenue. (Executive Summary)

Notably, more recent literature reviews (Phan, Siegel, & Wright, 2005; Zhang, 2005)[34] did not contradict the OECD's earlier mixed review.

General Evaluation Criteria. Among the evaluation criteria reported by the OECD[22] were "1) number of jobs created; 2) number of graduates/survival rates; 3) increased sales and profits of tenant firms; 4) clients served; 5) increased incubator revenue (self-sufficiency/profit); 6) new technologies brought to market; and 7) taxes paid by incubators." (p. 24). Despite the availability of this number of criteria, the OECD[22] concluded that:

> In terms of job growth, the evidence is mixed. A US study found no substantial difference in job growth between firms in Pennsylvania business incubators and firms outside (Allen and Bazan, 1990). One reason is that firms that do experience job growth do so once they have entered an "accelerated growth stage" – which generally occurs after a firm has left its nurturing environment. The NBIA estimates that graduates of incubators in 1994 created an average of 216 jobs per incubator or 23 927 jobs, excluding jobs created in "affiliate firms". A survey of graduate firms in the US found that while nearly 99 per cent had less than 10 employees on entry in the incubator, 44 per cent had more than 10 employees after exiting the incubators and 6 per cent had more than 50 employees…. In the United Kingdom a study of technology-based firms located on and off science parks found that resident firms had higher job growth between 1986 and 1992 than firms located off the park, however most job growth was concentrated in a small number of tenant firms (Westhead and Storey, 1994). The same study, however, found that location in a science park had no effect on overall financial performance of independent business but that their turnover did appear to benefit from being located in the park. (p. 25)

Tamásy[28], in a more recent and important paper, also described the prevalence of parks and incubators, but felt compelled to conclude that in general they were less successful than their aspirations would suggest. He observed:

> Today, technology-oriented business incubators are a worldwide phenomenon, although empirical research evidence clearly suggests that they tend to fail in

> supporting entrepreneurship, innovation, and regional development and, therefore, do not fulfil their expected role as policy instrument. The paper focuses on this obvious antagonism. It deliberates upon political rationales, reviews evaluation literatures, and delineates suggestions for the future of the incubation industry. (p. 460)
>
> …
>
> Publicly available information and cursory research undertaken by the incubation industry portrays business incubators as a success story. A prominent example, repeatedly cited in the policy arena around the world, is based on NBIA data. In brief:
>
> 1. NBIA estimates that North American incubator client and graduate companies have created about half a million jobs since 1980. That is enough jobs to employ every person living in Denver, Colorado.
> 2. Every fifty jobs created by an incubator client generate approximately twenty-five more jobs in the same community.
> 3. In 2001 alone, North American incubators assisted more than 35,000 start-up companies that provided full-time employment for nearly 82,000 workers and generated annual revenue of more than $7 billion. (p. 461)
>
> …
>
> Finally, the business incubator idea in practice is actually a very modest contributor to regional economic development. Using the logic of the NBIA, creating on average 20,000 jobs per year in a nation with a labour force of 147.4 million and an unemployed rate of 5.5 percent (in 2004) is not really a big push. (p. 460)

Given today's imperative for providing people with rewarding (both economically and personally) work and the converse of avoiding the numerous negative effects of unemployment, Ibsen & Westergaard-Nielsen[12] stated that:

> Job creation and destruction should be considered as key success or failure criteria of the economic policy. Job creation and destruction are both effects of economic policy, the degree of out- and in-sourcing, and the ability to create new ideas that can be transformed into jobs." (Abstract)

Hijzen et al.[11] in their recent UK study observed that much of the job creation literature there pertained primarily to manufacturing. They, however, reviewed 1997 to 2008 data from all sectors, and found that:

> firms in the service sector exhibit much higher rates of job creation, but almost exactly the same rates of job destruction as those in manufacturing. 'Small' firms account for a disproportionately large fraction of job creation and destruction relative to their share of employment. Jobs created by small firms are no less likely to persist than those created by large firms. (Abstract, p. 621)

Universities have other mechanisms for job creation than technology parks and incubators. The entire university, including its research and development activity is in itself a job creation mechanism. The USA's National Academy Committee on Measuring Economic and Other Returns on Federal Research Investments, Board on Science, Technology, and Economic Policy, Committee on Science, Engineering, and Public Policy, Policy and Global Affairs conducted a

workshop focussing on measuring the impacts of federal investments in research. In the 2011 report of this workshop, rapporteurs Olson & Merrill[24] stated that:

> Based on preliminary results for U.S. metropolitan areas, a positive correlation exists between wages, employment, and academic R and D, he said. The results indicate that a 1 percent increase in academic R and D is associated with roughly 120,000 more people employed and $3 billion more earnings in a metropolitan area. (P.22)

Assessing the Impact of Incubators. The NBIA has developed an Incubation Impact Toolkit (www.nbia.org/impact/index.php). This includes rationales for assessment and preparation, what and how to collect data, suggested metrics, hints for analysis and comparison, case studies and downloadable tools. Among the suggested metrics for such assessment are the following (quoted from www.nbia.org/impact/suggested_metrics.php):

1. Number of current clients. The number of companies your incubator currently serves.
2. Total number of graduates since program inception. Quantifying the number and performance of graduates is essential to demonstrating program success.
3. Number of graduate firms still in business or that have been merged or acquired. Graduate firms that remain in operation demonstrate your program's ability to produce successful companies that survive. Additionally, mergers and acquisitions are successful business outcomes; therefore, graduate firms that have executed these exit strategies should be tracked and included in your tallies of successful graduates.
4. Number of people currently employed full-time (at least 32 hours) by client and graduate firms. To make data collection easier, don't ask entrepreneurs for complicated information like average full-time employment, full-time equivalents, etc. If you collect current employment figures from both clients and graduates on a regular basis you will be able to show growth over time.
5. Number of people currently employed part-time (>32 hours) by client and graduate firms. Depending on the type of company, there may be significant part-time employment.
6. Current monthly salaries and wages paid by client and graduate firms. If you ask for current monthly salaries and wages (as opposed to annual numbers) you will be able to calculate current average wages using the current employment information you've collected. This information also will be easier to collect from your clients and graduates than annual figures.
7. Gross revenues for the most recent full year for client and graduate firms. For the company's last full year, what is the total (gross) revenue amount shown on its income statement?
8. Dollar amount of debt capital raised in most recent full year by client and graduate firms (bank loans, loans from family and friends, revolving loan funds, or other loan sources). How much money was borrowed in the last full year?
9. Dollar amount of equity capital raised in most recent full year by client and graduate firms (include investments from angel investors, venture capitalists, seed funds, or other equity capital sources). Certain stakeholders are keenly interested in the level of investment your clients and graduates attract. Additionally, touting these investments can help you recruit clients.

10. Dollar amount of grant funds raised in most recent full year by client and graduate firms (SBIR, state grants, etc.). Again, many stakeholders are interested in the ability of your clients and graduates to attract grant funds. Touting their success in attracting grant funding also can help you recruit clients.

Where are jobs being created? Regarding the location of most job creation, in 2011 the OECD[21] reported:

> SMEs (small and medium-sized enterprises) account for 60 to 70 per cent of jobs in most OECD countries, with a particularly large share in Italy and Japan, and a relatively smaller share in the United States. Throughout they also account for a disproportionately large share of new jobs, especially in those countries which have displayed a strong employment record, including the United States and the Netherlands. Some evidence points also to the importance of age, rather than size, in job creation: young firms generate more than their share of employment. (Executive Summary, p.3)

Notably, however, a dissenting view was raised by the former CEO of TRW. He indicated (Mettler in Landau & Rosenberg, 1986)[16] that while they increased their employment by only approximately 5000 during the last decade, they increased their outside purchases by more than fourfold during the same period. The clear implication is that they thereby created outside jobs by this means and that consequently the actual large enterprise employment figures significantly underestimate the actual job growth attributable to such enterprises.

According to Michael Dell in an interview with the Irish Times newspaper, "fast-growing small businesses were the engine of jobs growth in the global economy."[13]

Prediction Mechanisms. Rosenberg in his chapter (pp. 28-31) entitled, The impact of technological innovation: A historical view …, in Landau & Rosenberg's [16] *The Positive Sum Strategy: Harnessing Technology for Economic Growth* noted that:

> it seems to be much easier to anticipate the employment-displacing effects of technological change than the employment- expanding ones. Partly this is because we do not have a good technique for dealing with the impact of product innovation. The anticipation of the employment- expanding consequences of innovations seems to require a much greater exercise of the social imagination, an ability to foresee uses in entirely new social contexts. (pp. 28-31)

The authors of this ASEE paper also noted that, in some circles at least, there was an increasing concern about inequities being created by technology induced job creation and shifts. Clearly not everyone in society is feeling the effects of advancing technology in the same positive manner.

Case Study – Silicon Valley

Silicon Valley is used repeatedly as an example of innovation and job creation success and many regions and countries seek to emulate this success. According to Gerhard Casper, former president of Stanford University, "Silicon Valley has become a metaphor the world over for a productive relationship between a university and the surrounding region"[4].

Smilor et al.[26] found:

> Several studies provide evidence that the nucleus in the development of a technology center is a research university. One of the first assessments in 1984 showed the important impact that Stanford University has had in creating a high-technology culture. The organization of networks, money, and talent around Stanford's research engine generated "Silicon Valley Fever" and an extraordinarily vibrant regional economy (Rogers & Larsen, 1984). A 1985 landmark study (Segal Quince Wicksteed) on the "Cambridge Phenomenon" proved that the development of technology centers around a research university is not unique to the United States. The burgeoning growth of high-technology industry, led by locally formed small firms, developed in and around the university in the market town of Cambridge, England.
> (p.204)

Casper[4] characterized Stanford as a research-intensive university and stated that adherence to the fundamental purpose of such a research-intensive university has contributed to its success and the benefit of society. "A commitment to building 'steeples of excellence' in research, learning and teaching; viewing the combination of teaching and research as what we are about, despite innumerable temptations; having the freedom to set agendas; seeking industry partnerships as enrichments to, not distractions from, the research process; maintaining porous boundaries; and being open to chance and serendipity in research" according to Casper are the ingredients that created the productive relationship between Stanford and Silicon Valley.

Casper elaborates on how the research intensive university can be distracted from its fundamental purpose. "If the fate of the country – and in the face of globalization one could even say the fate of any country – depends on a professor's well-remunerated expert opinion, then the demise of the office hour with students is a price many are prepared to pay".

What Role should Government Play?

In the period between the Great War and the Second World War, John Keynes [15] developed the argument that the level of employment is determined by the spending of money. Keynes argued that it is wrong to assume that competitive markets will, in the long run, deliver full employment or that full employment is the natural equilibrium state of a market economy. On the contrary, under-employment and under-investment are likely to be the natural state unless active measures are taken. This suggests that it is not just appropriate but necessary for a Government to play an active role in trying to ensure full employment.

If it is accepted that a government should take a more interventionist role in job creation, then what policies, supports and actions should it consider with regard to our universities? This is a question with no one right answer and perhaps no right answer at all.

For example, the Irish Government[14] in *Jobs & Growth* states that "the role of Government is to help create the right conditions for enterprise to grow and prosper". This is less of an interventionist role than Grove argues for within the United States. Indeed, the Irish Government summarises its approach as one of providing the *right environment*. "The tax system is purposefully pro-business and fine-tuned to ensure it is internationally competitive. Our

regulatory environment is smart and fair and we aim to further improve administrative cost savings for business in our "better regulation" programme."[14]

However, from the perspective of the research university:

> If a research-intensive university becomes dependent on the imperatives of business product development or governmental industrial policy, it loses the advantage that it gains from its commitment to the endless process of inquiry, the search to know. We also have to keep in mind that support from industry can be of great significance, but, in light of the expenses involved, will not supplant research funding from the state. Basic research is a public good that business, given its orientation towards profit, can produce only in a limited quantity on its own. This is an insight governments tend to forget all too frequently, especially in times of fiscal crisis. Stanford would not be where it is today but for government funding in the period since World War II.[4]

But can the same be said of the non-research-intensive universities? To the extent that these receive public funding as part of their core recurrent budget, what measures or controls can and should the funding agency seek to impose in support of its agenda? For example, in Ireland most of higher education is funded through public finance. Over the last decade, regulation of higher education institutions has been described as 'light touch regulation' by the government agency (i.e., the Higher Education Authority - HEA) charged with overseeing the higher education sector.[2] With the publication of a new strategy (*The National Strategy for Higher Education,* 2011), light touch regulation will be replaced by the concept of directed diversity. Via directed diversity, "each institution will be required to define its mission and decide how it can best contribute to achieving national goals, as determined by the government."[2] Via this approach, the HEA will seek to ensure appropriate collaboration and use of resources across the Irish higher education spectrum with a view to ensuring its continued development, focus and fitness for the challenges of a competitive world.

Findings

To summarize, based on analysis of the literature, the authors noted the following general findings regarding job creation by or involving universities. This summary is followed by a section presenting the authors' perspectives on lessons learned, i.e., what these findings mean.

1. The evidence is mixed that university second and third mission activity creates jobs
2. With regards to technology transfer activities, the literature is not consistent regarding where job creation is occurring, i.e., in small and medium sized enterprises or large enterprises
3. Lessons have been learned about job creation (see below) that can inform and improve university initiatives
4. Notwithstanding Finding 3 above, it is difficult to predict the impact of technological innovations and consequently job creation; including the possibility of jobless innovation
5. There is a tension between the research university and the government (funding agency) regarding the balance between the university's need for government funding, particularly research funding, and the expectations of the government in providing that funding

6. In support of job creation, a case can be made that university first mission teaching can and should be improved.
7. Recognition that current economic prediction mechanisms are inadequate

Lessons learned

Based on their extensive recent work in analyzing what is known about jobs creation, the OECD[21] reported the following factors as contributing to jobs creation:

1. maintaining and expanding the knowledge base
2. improving the efficiency and increasing the leverage of industrial R&D support measures.
3. strengthening technology diffusion mechanisms
4. reducing mismatches between demand and supply for skills
5. improving conditions for the creation and growth of new technology-based firms
6. creating an environment conducive to the emergence of demand and jobs in new growth areas
7. improving techniques and institutional mechanisms for the evaluation of policies will increase their efficiency. (p.4-5)

The authors of this ASEE paper also consider as lessons learned the three main factors identified earlier by Smilor, Kozmetsky and Gibson[37] that are necessary for the development of a technology center and in which the university plays an important role. These are: (a) the achievement of scientific excellence, (b) the development and maintenance of new technologies for emerging industries, and (c) the attraction of major technology companies and the creation of home-grown technology companies.

Finally, the authors conclude that the last lesson to be learned from the jobs creation literature, although not always explicitly stated, is the need for a pervasive and comprehensive system of technological education. Landau & Rosenberg[16] in the overview to their cogent analysis of the economic and technological situation facing the USA and the world, pointed out that one of the main shortcomings facing us is:

> inadequate technical and general education and inadequate retraining at all levels (Pettit, Young, Kennedy). Needed are education and retraining that can inspire a positive outlook toward science and technology, and an urge to maintain the American edge in technological competitiveness and entrepreneurial creativity. In education and training lies an important and enduring long-term American advantage. Kennedy emphasizes the unique American research university structure, where education and research are located in the same place. Nevertheless, there is inadequate government support of basic engineering, manufacturing, and process research in the universities; in this regard the new Engineering Research Centers are potentially a very important innovation (Swanson). The obsolescence of much university equipment and many facilities also represents a serious neglect (Kennedy). (p. 13)

The Way Forward – Recommendations for Universities

Based on the findings derived from the reviewed literature, and the authors' interpretation of the lessons learned, the following recommendations are advanced to decision-makers at universities on both sides of the Atlantic:

1. Each university should know and understand its mission and particularly how to assess which initiatives are in support of its mission, and which initiatives are distractions. Each university should consequently understand the balance between learning, discovery and engagement and those measures it will use to gauge progress in support of its first, second and third mission activities.

2. With regard to their first mission of learning, universities should broaden their education to include problem solving, innovation skills and technological education while infusing throughout systematic and thoughtful consideration of societal needs such as sustainability and equity.

3. With regard to its second mission of discovery, irrespective of whether a university sees itself as research-intensive or research informed, it should cultivate a culture of inquiry. Technological universities should be careful to incorporate both theoretical and applied research foci.

4. With regard to its third mission of engagement, each university should develop its model for three-way collaboration with industry and society. The objective should be to ensure that faculty and students are as knowledgeable as possible regarding the needs and workings of industry and society. These initiatives should consequently be systematically fed back into the institution's learning and discovery activities.

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