Universities as Engines of Economic Development : More than a Metaphor?

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Abstract

Universities are often described as engines of economic development because they are sources of intellectual capital, and human and technological resources, all of which have the potential to stimulate the growth of an economy. There is considerable evidence of the impact of major research intensive universities on the economy in their locality. MIT and Cambridge University are perhaps the best known examples. Whilst the study of such effects is generally associated with Business Schools where explanations rely on socio-economic paradigms; some previous work has shown substantial similarities between the laws of nature governing engineering and the behavior of business entities. In this paper, the extent to which the laws governing the design and performance of engines is applied to technology transfer and, more specifically, to the creation and growth of student-led spin-out companies. It is shown that the development of a spin-out company has many similarities to rocket design where concerns about destination (market position), payload (degree and, or complexity of innovation), propulsion system (team and mentor); and fuel (time and energy of founders) are paramount. The extension of the metaphor to analogy allows a number of conclusions to be drawn about the development of more efficient technology transfer and student entrepreneurship at Universities.

Introduction

The high profile success of a number of leading universities in stimulating economic success in their locality has given much credence to the belief that research intensive universities can be engines of economic growth. This is particularly relevant in mature economies, with high labor costs, faced with the challenge of maintaining a commercial and competitive advantage over low-wage economies. In such circumstances the creation and exploitation of knowledge plays a key role in competitiveness and leads to the term 'knowledge-based economy'. Universities would be expected to be key players in such an economy since their common mission is to research and teach, i.e. to discover and disseminate knowledge. Many national and regional policies encourage universities to participate in technology transfer and of course the potential profits are alluring. On the other side of the technology transfer process, many companies do not have the resources to perform the research and development required to generate the underpinning technology for new products and processes. The technology and accompanying expertise of universities offers an attractive alternative for such companies. Thus both sides of the technology transfer process have incentives for closer interaction though the perfect alignment of goals and directions is often not achieved [1].

When an inventive idea arises in a university, a range of internal influences affect whether the idea is converted into a commercial innovation and how quickly this process occurs [2]. In considering the explicit transfer of a novel technology, universities have two main choices: licensing or spin-out companies. For uncertain technology, licensing is an important and frequently used mechanism by universities while the university spin-out route is important but much less frequently utilized [3]. However, these explicit processes are perhaps a minor part of the continuum in which technology is transitioned from universities to industry [4] and both formal and informal partnerships between academia, industry and government create the most fertile environment [5]. In its broadest sense, technology transfer can be interpreted to mean: 'the creation of new products, new processes and new companies from the research finding of universities'. The concept of technology transfer is well-established and there are some notable successes

however major inventions do not arise frequently enough to render universities as reliable or predictable providers of economic growth. On the university side of the transfer process there are some high ambitions; for instance Witholt [6] has suggested the formation of 'company alumni', i.e. the spin-out companies that have 'graduated' from a university. He also suggested 'company alumni foundations' and speculated that the more 'effective universities' could cover up to 50% of their operating costs from such foundations in 50 years time, based on a percentage of annual income contributed to the foundation from companies formed within the university. The contribution would recognize soft support, and uncharged space and facilities provided in the early stages of a company's life. This model could be extended to student start-ups where equity shares are less common because intellectual property is usually vested solely in the students. Such a mechanism would allow universities to benefit from support provided to student start-ups and hence provide incentives for them to provide more support both tangible and intangible. Babson College appears to be successfully employing this approach where the College receives a nominal shareholding in a student spin-out which is realized upon flotation.

The literature is much concerned with faculty engagement, economic partnership and better-trained graduates with regard to the development of the role of the universities in society [7 – 10] but there is relatively little attention paid to the potential of student start-up companies in the portfolio of entrepreneurial activity in a university. Kuratko [11] has identified ten challenges for entrepreneurial education but the focused on pedagogy, research, instructors and administrative leadership. Universities are often seen as, and involved in, incubating innovation [12] but again the focus is on faculty, their inventions and the companies formed by them. The challenge of enabling student start-ups through extra-curricular provision and activity is not addressed and so an enormous potential is being largely ignored.

In the State of Michigan the Cherry Commission [www.cherrycommission.org] was prepared to address this challenge as part the need to move "forward to a future of prosperity and growth" based on grasping the new knowledge economy. This need must be faced by many other US states given that Michigan's per capita gross domestic product of $32,846 places it 36th out of 50 states [www.bea.gov] and ahead of many European countries including Italy and Spain as well Pacific rim countries such as Taiwan, Singapore and South Korea [www.nationmaster.com]. However, the decline in Michigan is dramatic with per capita income falling by about 30% in the 30 years prior to 2004 placing it 47th out of the 50 US states by this metric. In this context the report of the Cherry Commission contained 19 recommendations including that institutions of higher education should "create a culture of enterprise". A similar approach has been adopted in the UK with establishment of the National Council for Graduate Entrepreneurship in 2004 which has a mission "to increase the number and sustainability of graduate startups" [www.ncge.com]. By 2006 only 2.9% of first degree graduates in the UK who were employed six months after graduation had set up their own business [13]. So there is much potential and clear opportunities to stimulate growth in student start-ups. MIT provides an excellent exemplar of successful intervention with the MIT 100k competition [www.mit100k.org] which started about 20 years ago as a 10k competition and has generated more than 85 companies and 2,500 jobs. This good practice extends to the UK where the Science Enterprise Challenge has done much to introduce enterprise and entrepreneurship in student curricula and extra-curricular activity [www.enterprise.ac.uk].

Against this background, this paper considers the metaphor that universities are engines of economic development and whether a closer examination of this as an analogy allows a more effective strategy to be developed to encourage and foster university spin-out companies.

Engineering Analogy

Whilst the focus is on graduate student entrepreneurship, the parallels drawn are probably equally valid for all university spin-out companies. The premise is that the creation of a successful student start-up has many parallels to rocket science and after all a rocket is essentially a very large engine with a small payload. In the case of a start-up the payload is the technical innovation or intellectual property and the destination or orbit is a desired market position. The challenge for the designer is to identify the barriers to ignition and the driver or force to achieve escape velocity. It is worth noting at this early stage that some rocket designs will be doomed to failure if either the size

of the pay load or the distant to the destination is underestimated; and by analogy for a start-up failure is inevitable if either the size or complexity of the innovation is underestimated or the desired market position is unrealistic. A heavy payload or distant destination will require a more sophisticated design.

A good design of rocket has a light but functional body coupled to an appropriately sized propulsion system with a high power output. This can be equated in a spin-out to low overheads such as office and vehicles and an appropriately sized team with a high level of enthusiasm and commitment. Mission design is also important and for novices a small payload and low orbit is advisable; in other words simple propositions with achievable targets and low investment strategies are more likely to be successful.

The analogy can be taken a step deeper by consideration of the propulsion system in a rocket. The propellant in a rocket is required to generate a specific high force continuously and in a spin-out the propellant are the team members and their supporters who must maintain a continuously high drive or energy level. In a rocket the propellant consists of a fuel plus an oxidizing agent whereas in a student start-up company the fuel is equivalent to the student enthusiasm and commitment and the oxidizing agent could be mentoring, competition prizes and, or venture funding, i.e. a catalyst or focus for the students' enthusiasm. A rocket is often designed with multiple stages which are jettisoned when they have performed their job since discarded propellant tanks reduce weight. In a student start-up company this can be equated to reconfiguring both finance and structure as progress is made towards the destination or goals; so short-term commitments and strategic planning go hand in hand to allow timely and cost effective restructuring.

A successful launch requires the rocket to escape from the earth's gravity for which the kinetic energy of the rocket has to equal its potential energy at an infinite altitude, i.e.

$$\tfrac{1}{2} m v_e^2 = GM\, m/r \tag{1}$$

where m is the mass of the rocket, ve its escape velocity, G is the gravitational constant, M is the mass of the planet being escaped from, and r is the distance between the centre of the planet and the point at which escape velocity is being calculated. Hence escape velocity is, from (1):

$$v_e = \sqrt{2GM/r} \tag{2}$$

So a higher velocity is required to escape from a larger planet, i.e. it is harder to leave Jupiter than Earth. The analogy can be extend here too since mass is defined in terms of inertia or the resistance of a body to a change in its state of motion and hence a bureaucratic university that is resistant to change can be considered as a large mass that is more difficult to spin-out from. You usually can't chose your planet but universities can reduce their red-tape and create a 'can-do' culture, i.e. reduce their 'mass'.

Mass is also a consideration for the rocket as mentioned above. The attractive force between two bodies is given by:

$$F = GMm / r^2 \tag{3}$$

So a large student team with a resistance to change (i.e. large m) will feel a large force of attraction to the parent institution. So start-up teams must be creative and innovative to generate a low or zero resistance to change. However there is a danger here since undirected creativity is entropy and generates no change [15]. Experienced mentors and dynamic leadership can focus creativity and generate constructive innovation.

It can also be deduced from equation (2) that smaller values of r require a greater escape velocity, in other words it is easier to move away from a planet with distance from it or as you move away from an institution it gets easier to move further. So a progressive move from the laboratory, to the campus incubator, to the adjacent science park to the

purpose-built building is desirable, enabling a low overhead start (a 'light functional body') followed by assistance to reach the escape velocity.. So it is important for universities to provide this gradual path to success for student companies not only for the future of the company but also to provide the university with a role to play in the future and to seed the 'company alumnus' relationship.

Discussion and Conclusions

Handscombe et al [16] used the rocket science analogy to interpret the results of a survey of students who entered a business plan competition. They concluded that a decent prize and the promise of mentoring support are big factors in motivating students and can be seen as the 'oxidant' for the fuel of student enthusiasm. The presence of some level of supportive infrastructure providing a framework for extra-curricular activity was found to be a 'promoter' while the intransigence of peers and family could be 'inhibitors' since many students commented on the fear of loneliness being discouraging. The fear of loneliness also confirms the importance of the team. The connection between enterprise courses or modules and participation in business plan competitions was nebulous and so the pre-treatment of the fuel is not a necessity. In other words, business plan competitions can exist in the absence of the formal instruction in the curriculum. The winning of any prize was at least as important as winning the top prize probably because it signified 'lift-off' and represented a major psychological step.

This paper has proposed that the metaphor of universities as engines of economic growth can be converted into an analogy and used to develop guidelines for good practice in nurturing university spin-out companies by considering well-known engineering principles to analyze behavior. In particular student spin-outs have been equated to rockets in which the fuel is student enthusiasm, the payload is the intellectual property or innovation and oxidants are things that turn student enthusiasm into forward thrust. Spin-out teams must have mentors and dynamic leadership to focus creativity while universities must create a 'can-do' culture and ruthlessly remove bureaucracy. A combination of strategic vision and short-term commitments are crucial to allow timely re-structuring 'in-flight' for the spin-out which is analogous to the use of multi-stage rockets that are dumped when their usefulness is exhausted. Finally a university can help by providing a progressive path from the laboratory to the real-world via incubators and science parks; in return established or 'graduated' companies can become company alumni to help the university provide the same for future generations.

Space limitations inhibit the considerations of other aspects of rocket design but the analogy can be constructively carried further by terms such as: 'pyrotechnic igniter' which ignites the fuel and oxidizer mixture and is equivalent to seminars on entrepreneurship and business planning; or 'catalysts' which make a reaction go faster so appoint a entrepreneurship champion; or sparks which are highly charged events such as inspirational speakers, or 'promoters' that get things going such as First Steps funding; and even 'inhibitors' which stop things happening – *"leave it to me, it really needs to go to a committee…"*

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