

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

185,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Critical Development Paths of University Spinoff Ventures

Philip Bowe and Rory O'Shea
*Quinn School of Business, University College Dublin
 Ireland*

1. Introduction

University spinoffs (USOs) are seen as important and a potential means of generating wealth through the commercialisation of research (Bray & Lee, 2000; Etzkowitz, 1998; Shane, 2002; Vohora et al., 2004). They are becoming a significant global phenomenon with spinoff activity increasing in many different regions, including the United States and Western Europe (Shane, 2004). Recognising the economic contribution that these firms can make, disparate groups are increasingly interested in spinoff activity, including university administrators, policy-makers, venture capitalists (VCs) and entrepreneurs, both internal and external to the university environ. This has led to the creation of Technology Transfer Offices (TTOs) in many universities across Europe and the United States, and the availability of funding for USOs from business angels and VCs.

In Ireland, the Government recently published a report detailing the requirements of a knowledge based society, where the importance of research and commercialisation were seen as central to economic recovery (Department of the Taoiseach, 2010:7). But despite the growing importance of USOs in this roadmap, there has been very little research into the many issues faced by Irish spinoffs and their impact on entrepreneurs and the academic community.

This paper aims to address these issues by investigating how spinoffs develop by using a Resource-Based View (RBV) of firms and a life-cycle/ development model developed by Vohora et al. (2004). It will fulfil three research objectives:

1. Examine the stages that a USO experiences;
2. Detail the main barriers faced by spinoffs;
3. Use a grounded theory approach to develop a conceptual framework for detailing USO development.

This research draws on two literature themes used to analyse new firm development. The first is around stage-based models (Greiner, 1998; Miller & Friesen, 1984; Smith et al., 1985; Van de Ven et al., 1984; Wernerfelt, 1984) and the model developed by Vohora et al. (2004) in particular, as detailed in Figure 1. It shows how USOs go through a number of distinct phases of development. Each phase involves an iterative, non-linear process of development where earlier decisions and activities may have to be re-visited. Additionally, at the boundaries between each phase, junctures exist in terms of the resources and capabilities that are needed

to proceed to the next phase. The junctures are critical because they have to be surmounted in order to progress.

The second theme is RBV, a framework for understanding how resources within a firm can be used to achieve sustained competitive advantage (Barney, 1991; Eisenhardt & Martin, 2000; Teece et al., 1997; Wernerfelt, 1984). It assumes a firm can be thought of as a bundle of resources, spread in a heterogeneous manner across the enterprise, and that competitive advantage depends on this heterogeneity (West III & DeCastro, 2001). Internal resources, such as knowledge, learning, culture, teamwork and human capital, play a vital role in the RBV and are likely sources of sustained competitive advantage (Barney, 2001b; Wright et al., 2001), particularly when they are embedded in value-creating strategies (Barney, 1991; Daft, 1989). Resource deficiencies and weaknesses may constrain the development of a USO and may be exacerbated by a non-entrepreneurial university environment (Vohora et al., 2004; West III & DeCastro, 2001). Therefore, as suggested in the literature, USOs need to nurture resources over time in order to progress through the different phases of development.

2. Research methodology

To gain an understanding of the development stages of a USO, the barriers that have to be surmounted and the resources needed to sustain growth, the research methodology makes use of inductive investigation. To create a conceptual framework of USO development and enhance the theory proposed by Vohora et al. (2004), spinoff case studies are used to explore the various dynamics at work. This inductive methodology allowed for the correspondence between theory and data, resulting in theory enrichment through a grounded approach (Bryman & Bell, 2007; Strauss & Cobin, 1990:487). The outcome is a thorough examination of theory through replication logic (Eisenhardt, 1989).

USOs in Ireland were chosen as the research population. Spinoffs were chosen from physics and chemistry based-fields because the firms need similar resources and substantial investment to bring the technology from an initial concept stage to generating a commercial return (Vohora et al., 2004). USOs were chosen that were at different stages of development. Representatives from relevant TTO(s) (Technology Transfer Office) and business development managers also contributed to the research.

Primary data was recorded using in-depth, semi-structured interviews, ensuring cross-case comparability (Bryman & Bell, 2007). Four interviews were face-to-face; another four were carried out over the telephone. Each lasted approximately one hour, recorded and later transcribed. Detailed case studies were prepared for each USO making it possible to develop a database that included table shells to record the data (Miles & Huberman, 1984). Relevant trends were extracted using cross-case analysis techniques suggested by Eisenhardt (1989) and Miles & Huberman (1984). The outcome was accurate and reliable information (Eisenhardt, 1989).

For a grounded theory approach to work effectively, it was necessary to use theoretical sampling to select the desired cases. Glaser & Strauss (1967) described theoretical sampling as a data collection process for the generation of theory where analysts jointly collect, code and analyse the data. Subsequently, they decide what data to collect next and where to find

it in order to develop the theory. By focusing on USOs at varying stages of development, and looking at extremes, the emergent theory will be replicated or extended (Pettigrew, 1990).

3. Literature review

3.1 University spinoffs

Shane (2004) defines a spinoff as a new company created to exploit a piece of intellectual property (IP) created in an academic institution. Patents, copyrights and other legal mechanisms can be used to protect IP. At other times, IP may take the form of trade secrets and know-how. Faculty staff and/or students can be involved in the creation of USOs. The leader of the spinoff may be a surrogate entrepreneur and not necessarily a member of the university community.

The economic impact of spinoffs has been widely recognised. O'Shea et al. (2008); Shane (2004) identify how spinoffs encourage economic development in three different ways. Firstly, spinoffs generate significant economic value. In the United States, according to the Association of University Technology Managers, American universities generated \$33.5 billion of economic value from 1980 to 1999, and the indirect value may be even greater (Shane, 2004). Secondly, university spinoffs create employment, particularly for highly educated people. Lastly, spinoffs create new industries and stimulate economies by contributing to employment and wealth creation.

Clarysse et al. (2007) detailed the growing importance of TTO ownership of IP rights which has increased relative to that of university faculties. This is seen as a step towards professionalising the spinoff process (Siegel et al., 2003). There is also increasing pressure on universities to commercialise research, evident in Ireland where the Prime Minister's office reported that the generation of knowledge is most beneficial to the Irish economy (Department of the Taoiseach, 2010). Lastly, many universities are facing crises in budgets, placing enormous pressure on governing bodies. Therefore, the TTO has the role of formalising the transfer of technology by licensing or through the creation of spinoff ventures in a bid to realise and collect possible economic rents associated with the technology, product or service (Siegel et al., 2003).

Hindle & Yencken (2004) identify two inputs that facilitate technology absorptive capacity, which, in the long run, will determine the survival and growth of new ventures. The first input is finding ideas convertible into opportunities; the second is the ability to access resources and knowledge. Therefore, opportunity identification is one of the most critical factors in a technical transfer and is dependent on prior knowledge and personal history of the entrepreneur, where the trait of lateral thinking proves to be advantageous (Hindle & Yencken, 2004; Shane, 2000). Knowledge inputs also play a role in the early stages of new ventures, including prior knowledge in the discovery stage, background and both codified and explicit knowledge. Codified knowledge inputs include the published knowledge base of the science or engineering involved in the discovery, new knowledge contained in patents, copyrights, registered designs, etc., and the codified content of postgraduate or undergraduate training in entrepreneurship and/or technology management (Hindle & Yencken, 2004).

Tacit knowledge inputs are also seen as important and include entrepreneurial expertise, experience in managing a spinoff, a track record of original inventions and the ability to come up with ideas that can be converted into commercial opportunities (Hindle & Yencken, 2004).

3.2 The resource-based view of the firm

RBV is a framework for understanding how resources within a firm can be used to achieve sustained competitive advantage (Barney, 1991; Eisenhardt & Martin, 2000; Teece et al., 1997; Wernerfelt, 1984). It assumes that a firm can be thought of as a bundle of internal resources, such as knowledge, learning, culture, teamwork and human capital, spread in a heterogeneous manner across the enterprise. Competitive advantage depends on the heterogeneity (West III & DeCastro, 2001). Because they are not mobile resources they are more likely to be long lasting (Barney, 1991) and leveraged across the organisation to create and sustain value for all the stakeholders involved.

First mover advantage in the RBV approach is also important for USOs because it gives some protection in the form of a resource position barrier. Just like entry barriers, resource position barriers indicate the possibility of high returns. Also, for a resource position to be of value, it should translate into an entry barrier in at least one market. In the case of a spinoff, this offers some protection from possible competitors for a limited amount of time (Wernerfelt, 1984). An entry barrier without a resource-based barrier leaves the organisation vulnerable. Because many USOs are limited in the availability of resources, Wernerfelt (1984) explains that it is better to develop the resource in one particular market and then to enter other markets from a position of strength.

Alvarez & Busenitz (2001) highlight the importance of entrepreneurship in USOs and suggest that it is the entrepreneurial process of cognition, discovery, knowledge and the understanding of markets that results in heterogeneous research resources and outputs. Rangone (1999) outlines three key entrepreneurial concepts relating to the use of resources in small enterprises: innovation capability, production capability and marketing management capability. Under the correct conditions, with these concepts in place, the entrepreneur can give an organisation a sustained competitive advantage. Therefore, entrepreneurs can be regarded as heterogeneous and unique and enhance the possibility of sustained competitive advantage. Alvarez & Busenitz (2001) also explore the role of entrepreneurs in USOs, focussing on their social capital as a determinant of successful business outcomes. One example of such social capital and how it might help achieve success is when an entrepreneur has a relationship (direct or indirect) with VCs prior to the formation of the firm.

3.3 Dynamic capabilities

Eisenhardt & Martin (2000) argue that dynamic capabilities are a set of specific and identifiable processes such as product development, strategic decision-making and alliancing. In fast moving, unpredictable markets, these resources become a source of competitive advantage when integrated into the culture of the company. They are not vague and recursive as has been suggested, but dynamic processes that make a difference by their ability to alter a resource base (Barney, 2001a; Deeds et al., 2000).

In a high-tech venture it is noted that the rapid development of new products is viewed as a key determinant of success. Their development generates cash flow for new ventures, grows market share and increases the chance of survival. Zahra et al. (1999) observed that technology and strategy influence one another in a continuous loop and it is this interplay that fosters organisational learning and knowledge. Know-how and embedded processes eventually drive organisational strategy (Kusunoki, 1997). It has been noted that the tension that is created between an organisation’s technological capabilities and possible strategic decisions is often the most difficult dilemma for senior management (M.M.J & Taggart, 1998). Successful managers realise that the interplay between technology and strategy offers an opportunity to develop the firm’s competitive capabilities (Zahra et al., 1999). To gain an advantage from the available technical and strategy choices, the firm needs to make use of the relationship between these variables. Success depends on simultaneously managing the company’s internal forces and the external environment. The external forces are defined by the rate of change of technology in the firm. The internal forces are usually reflected strategically in a company’s ability to develop and deploy new products and technology (Zahra et al., 1999).

3.4 Development of university spinoffs

A stage-based development model of USOs, proposed by Vohora et al. (2004) will be used as part of this research. By drawing on other stage-based models (Miller & Friesen, 1984; Van de Ven et al., 1984) and taking a RBV (Barney, 1991; Lockett & Thompson, 2001; Penrose, 1959; Wernerfelt, 1984), Vohora et al. (2004) was able to identify the particular stages of firm development and the key challenges the spinoff faces. Five stages were identified: research, opportunity framing, pre-organisation, re-orientation and sustainable returns. Specific barriers or junctures are also identified that must be overcome in order

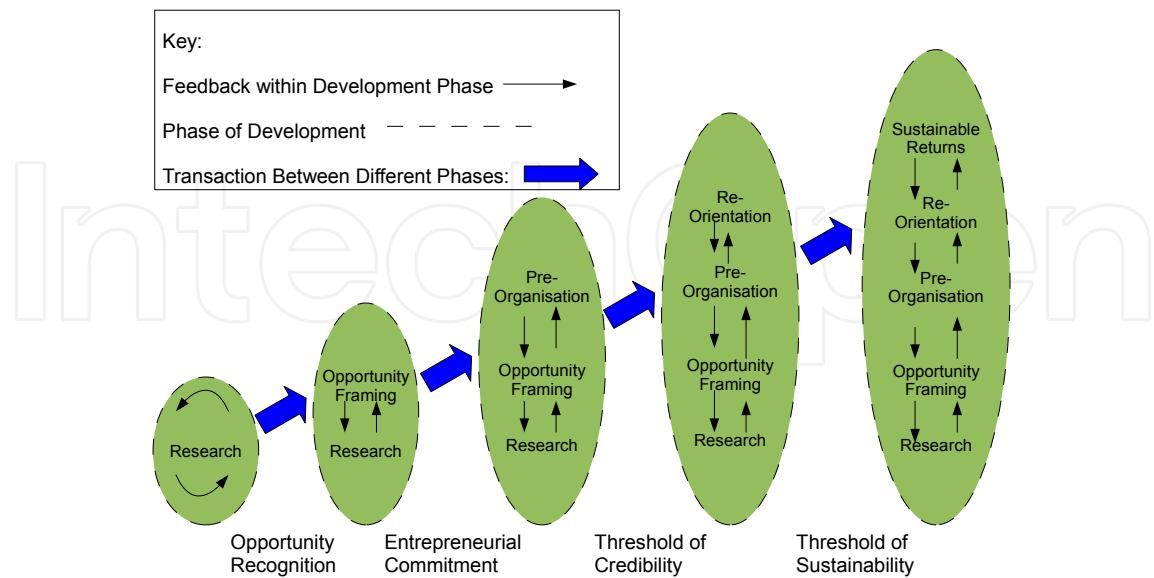


Fig. 1. The critical junctures in the development of university spinoff companies (Vohora et al., 2004:152).

to move from one stage to the next: opportunity recognition, entrepreneurial commitment, threshold of credibility and threshold of sustainability.

An outline of the model as seen in Figure 1 shows how each spinoff must pass through a particular phase before progressing. Each phase involves an iterative, non-linear process of development and there is often a need to return to some of the earlier processes or decisions. Vohora et al. (2004) recognise that the most successful spinoffs were those that were capable of transforming existing capabilities and resources, thereby achieving a clear route to market and profitability.

4. Empirical evidence

4.1 Development stages of USOs

The USOs in this analysis and subsequent discussion are denoted by the Greek letters, Alpha, Beta, Gamma, Sigma, Pi and Theta. All the USOs investigated were founded by men where the average number of founders was two. Two academics working in the USOs, Alpha and Theta, appeared to be serial entrepreneurs with track records in startups.

The majority of founding academics associated with the USOs retained their academic posts and are not full-time employees of the spinoffs. Alpha was the exception, where the academic took leave from their position to work with the company before recently returning to the university. The number of employees employed by the USOs varied from 2-16 employees, with the average being eight. Interviews were carried out with informants as well as academics, including a TTO employee directly involved in licensing and spinning out technology. In one instance, a partner in a company that licenses and helps commercialise technology was also interviewed. This company will be denoted by the term Evolution.

4.1.1 Research phase

The data shows that in all cases USOs emerged from scientific research that had occurred over a number of years within various university departments. For example, the initial research carried out by Sigma was part of a European Consortium that the academics were already involved in. In the case of Beta, the research group have, over a 15 year period, published extensively in the area of optical sensors. Additionally, the associated academic developed many contacts within industry, pursued patents and licensing agreements and was searching for a USO opportunity.

The academic associated with Pi had worked previously in industry and brought that experience to his research group. This individual was of the opinion that the creation of a spinoff “should be very important” and that academics should “go and work in the real world first”, sharpening their research objectives. This academic also noted that a lack of funding and equipment in Irish universities has led to “third world science”. Developing a USO was one way, in his view, to overcome such obstacles.

It is evident from the data that all the academics involved in the USOs were at the forefront of research in their associated fields. Many are highly productive individuals with useful experience gained from previous interactions with industry, giving them characteristics associated with repeat commercialisers (Hoye & Pries, 2009).

4.1.2 Opportunity framing phase

With the help of the TTO, academics take the first step in creating a spinoff to leverage the inherent value in commercialising their research. During this framing phase, the technology must show sufficient commercial promise and be seen to work. Additionally, the academic and the TTO will attempt to identify suitable markets which the spinoff and its proposed technology could approach and attempt to enter. It's a phase that many USOs find difficult. Sigma, for example, identified what was perceived as two very promising markets when "two industrial partners on the project highlighted particular market spaces". But after developing the product for these markets the opportunity "didn't take off like they expected". There were "already competitors in the highlighted spaces...this forced us to move out of this space very quickly".

A different approach was taken by the academic associated with Pi. He was relying on prior industry experience to create a market, but at this moment has "probably have not done a great deal of initial work in terms of planning, marketing etc". He was preoccupied with the engineering physics rather than "framing a possible market". An academic with Gamma admitted to a similar mistake, not spending enough time exploring the market opportunity before setting up the company.

Representatives of the TTO noted that many academics have good scientific ability but poor business experience. "A strong technical focus but who was doing the marketing?" as one put it. The interviewee from Evolution also spoke of how many academics do not understand how to properly frame an opportunity and miss "the key issue about the technology...trying to discover what is it about the technology that is new or novel". He noted that the fundamental question was not who is going to pay the most for the technology but who is going to pay first. Failure to answer the question suggests the technology has been incorrectly framed for a particular application reflecting "a misunderstanding of the market".

A noted exception was the approach taken by Alpha and its academic who "had pretty much a marketing plan prior to starting the company", having gone to six or seven potential customers and spent up to an hour with them. He also rang up potential competitors.

The academic from Theta took a similar approach, gathering information on the "framed market opportunity". He saw this stage as a way of identifying and then providing a solution to a particular problem found in the marketplace.

4.1.3 Pre-organisation phase

At this stage, the opportunity has been framed, all the stakeholders are committed to commercially exploiting the opportunity and the management team is ready to make strategic decisions. Such strategic plans involve a number of factors which include making decisions on the use of existing resources and capabilities, how such factors could be used now and in the future, and what further resources would be needed (Vohora et al., 2004).

The academic entrepreneur of Sigma attempted to surround himself with people who had prior experience in spinoffs or startups, a resource of benefit to the organisation. He also believes that having people with more than one talent is a key criteria, "people wearing

multiple hats...scientists who are also carrying out engineering and manufacturing, and admin people who are covering anything from accounting to HR”.

The sourcing of human capital for Beta did not prove as troublesome compared to the other USOs. This company hired the university researchers who had created the codified knowledge: “We had at our fingertips access to researchers who wanted to work for us and move away from the university environment”. The academic in Gamma developed a business plan with help from Enterprise Ireland (government agency body in Ireland), but currently sees the most important resource in the company as himself. He readily admits that a weakness in his business is that he is consistently torn between his university work and committing time to his spinoff.

Alpha recognised the need to continue to work with the customer in this phase and to prepare the spinoff for product development. However, the academic cautioned that USOs sometimes start product development too early before gaining an understanding of the technology in an industrial setting. “This is a complete disaster and should not happen.” he said.

Confirming research by Vohora et al. (2004), this phase is the steepest learning curve for academic entrepreneurs, particularly if the spinoff and the associated academic have little experience of the market, VCs and business angels. Alpha, Beta and Sigma went some way to addressing this by spending considerable time identifying and contacting potential customers.

4.1.4 Re-orientation phase

At this phase the companies has gained sufficient resources to start the venture and attempt to generate something of value. The management teams now face the challenge of continuously accessing, identifying, configuring and reconfiguring resources (Eisenhardt & Martin, 2000; Galunic & Eisenhardt, 2001; Newbert et al., 2008; Peteraf, 1993; Teece et al., 1997). Such re-configuration was often required because of incorrect identification of markets. At Sigma, the spinoff launch did not go as expected. There were already competitors in the marketplace and the company had to re-organise and change its strategy to the extent that the organisation is focused on entirely different customers today.

Beta also experienced problems at this stage. The sales team found it difficult to access the required markets resulting in little or no sales. Simultaneously, product development was also taking longer than expected. “When the technology was transferred from the university, we didn’t realise just how much work was required to turn it into a product which could be sold to customers” said the company’s entrepreneurial lead.

A number of staff were made redundant as the spinoff took a change in direction. After the change in business strategy, the company recognised that it did not have the required funds to acquire the skills and resources needed to push itself into its newly defined market, so they actively looked to be acquired. Such a drastic step, going from attempting to build the company to seeking a buyer, was forced upon them as they “needed somebody who had funds to help”. The former manager from Beta explained their case further: “Because of no sales, the investors were disappointed and costs were cut along with wages. This meant that the organisation underwent a large restructuring and a large number of staff were made redundant”.

New practices and regimes had to be introduced into several of the other USOs during the re-orientation phase. Once a spinoff had developed a product and was ready to introduce it to the market, the company was forced to introduce further resources in a bid to support the new products and customers. The academic from Alpha believed that the creation of such supports was essential: "You will survive if you support your customer. You won't if you don't support your customer". The structures required to do this were the ability to "make use of your channels" and "proper profit and loss, balance sheets with inventory control, quality assurance...proper company structures".

4.1.5 Sustainable returns phase

This final phase is generally characterised by USOs attaining sustainable returns. It is the aim of the management team involved in USOs to reach such a phase by the careful configuration and re-configuration of resources and the correct use of such resources and capabilities. In arriving at this phase, USOs will have come through each of the previous stages and overcome the barriers in moving from one stage to another (Vohora et al., 2004).

The academic associated with Alpha knew that ongoing sales placed the firm in a very strong position. The company was investigating the possibility of further expanding its product range but the academic was aware of the risks associated with such a move: "A poorly defined product developed in the product development stage is very difficult to sell...it kills spinoffs". Alpha believes that this is the stage that the entrepreneur should make way for management with business experience.

Another company that reached this phase of development was Sigma. Although the business was sustainable with a given amount of revenue, the company continued to undergo re-orientation as predicated by (Vohora et al., 2004), resulting in changes and reconfigurations in resources and capabilities. The CEO of the Sigma had to re-evaluate and re-orientate because sales didn't reach the levels expected by the investors. With re-evaluation and re-orientation the organisation expects to continue thanks to sustainable revenues.

4.2 The critical junctures

In order to ensure growth as a spinoff, organisations have to progress through the different stages (Vohora et al., 2004). As evident from Figure 1, a spinoff has to make a transition from one phase to another. These transitions are barriers or critical junctures preventing the firm from progressing into later stages of development. The critical junctures are identified as: 1) opportunity recognition; 2) entrepreneurial commitment; 3) venture credibility, and 4) venture sustainability (Vohora et al., 2004).

4.2.1 Critical juncture A: Opportunity recognition

The opportunity recognition juncture is found at the barrier between the research phase and the opportunity framing phase. Opportunity recognition can be described as the match between a solution and the market requirement it fulfils (Bhave, 1994). There is a skill in looking at a piece of research and being able to draw from it a sense of what market

it can service. It is recognised that such an ability requires skills, aptitudes, insights and circumstances that are not widely found (Venkataraman, 1997).

From case evidence, this author noted that the majority of academics interviewed appeared to have a good grasp of the markets or had previously worked in industry, providing them with valuable insights. A number of people from outside the university environment had a different view. The interviewee from Evolution spoke of how academics in many cases have “great technology but no idea in the slightest to what to actually do with it”. This opinion was also found in the TTO where the informant spoke of how academics are very strong technically but do not have the ability to see how or what has to be undertaken to sell the idea

A number of respondents spoke of how Irish universities had too little contact with industry, both multi-nationals and Irish SMEs. Alpha described how “universities have got to start trusting Irish SMEs...not just the multinationals”, and the importance of finding ways for Irish universities to work closely with industry.

The TTO interviewee said that this situation was currently changing for the better. She also noted that traditional businesses that do not undertake much R&D are feeling the competition and need to diversify, fueling the possibility of closer ties with third-level research.

4.2.2 Critical junction B: Entrepreneurial commitment

To move from the opportunity phase to the pre-organisational phase, the entrepreneurial commitment barrier has to be overcome. The academic who founded Alpha believed that entrepreneurial commitment should come from the academic surrounded by an experienced management team. This stance stems from the fact that “academics do not understand market penetration”. To overcome this barrier, this academic “ideally want[s] people with experience in working in a spinoff environment”. The informant from Evolution shared this view because academics, “usually don’t have the experience for the technology management role”.

From the analysed cases, many academics believed that the TTO should play a stronger role in ensuring and aiding entrepreneurial commitment. It was evident from a number of different interviews that academics think that the TTOs are introducing barriers to the progression of the spinoff and preventing the progression from the opportunity framing to the pre-organisation phase. The academic with Alpha thinks “universities are counter-productive...universities don’t understand spinoffs...a spinoff is alien to an university”, because universities “don’t understand the time required to develop products from lab research”. However, the academic believed that things are slowly changing within the university environment in Ireland. This change stemmed from the fact that people working within universities and the TTO now have industrial experience. The TTO informant echoed this, noting how “everybody in [the TTO] has worked in industry and understands that side of things”.

The academic founder of Pi also spoke of his frustration with university structures and a culture where he gets “no credit from the university”. The CEO of Sigma believed that TTOs and universities in general have attempted to force the same structure and policies on all spinoffs resulting in difficulties in negotiations between the TTO and the USOs. One size does not fit all, he argued, and more flexibility is needed.

4.2.3 Critical juncture C: Credibility

At this stage, the academic or his associated management and technical team have conceived the opportunity, spotted a particular gap in the market and have moved forward in their attempts to develop the company. The critical juncture that faced all the spinoffs at this stage was acquiring the resources for the business to move from the pre-organisation phase to the re-orientation stage. A key factor in the pre-organisation phase was raising financial resources or seed finance necessary to acquire the required resources.

Many of the contacted USOs highlighted problems with securing sufficient seed capital. In many cases, the USOs management team cited the characteristics of VCs in Ireland as a problem when it came to securing funding. The academic associated with Alpha put this down to the business background of the VCs: "In Ireland they are very much part of the banking community and know how to handle money but don't understand the required business models". The academic in Pi also spoke of his frustration in working with local VCs who "don't support anything in Ireland associated with risk. There is no venture".

The CEO of Sigma spoke of how VCs in Ireland don't understand the available technology in universities research laboratories. A solution, according to the same respondent, was to diversify the VCs base here to better "understand sophisticated opportunities". The respondent from Evolution described it as "risk averse venture capitalism due to a lack of understanding [of the technology] by investors in Ireland".

Alpha looked at this phase from a different angle and highlighted the importance of building customer relationships to ensure that revenues are forthcoming, self-financing further investment in resources to overcome the critical juncture of credibility, speeding up the move into the sustainable returns phase. At every stage this USO was taking into account what the customer required and what the spinoff could do to sell more products. The CEO of Sigma also highlighted that "customer relationship building is tricky", a sentiment echoed by Alpha which said it could be hard for a spinoff to engage effectively.

4.2.4 Critical juncture D: Sustainable returns

The final barrier to overcome, the juncture of sustainable returns, may take a number of different forms, including revenues from customers for products or services sold and possible further investment funds from VCs. By overcoming this juncture, it is a strong sign that the USO and its management team have acquired the appropriate resources and reconfigured to ensure sustainable growth (Vohora et al., 2004).

At the previous barrier, the juncture of credibility, the spinoffs were required to acquire, assemble and suitably employ resources to ensure that the spinoff reaches a credible position. However, the sustainable returns juncture required the management team to use and reconfigure existing resources to meet the challenges.

Alpha and Sigma have proved their ability to use acquired resources, create value and ensure sustained growth. Alpha placed great importance on developing capabilities to overcome weaknesses and inadequacies as they arise. The CEO of Sigma describes a stepping stone approach, thinking in terms of "rolling six month blocks". By re-configuring resources in earlier stages they are always ready for what comes next.

This point highlights Sigma's ability to continually re-orientate their business model to satisfy the needs of any given time, finishing up with a suitable business model that meets market needs. Sigma recognised all the changes that it had to undertake to ensure investors were kept interested in the venture. Much of this was focussed on product and providing better customer support.

The juncture of sustainability proved to be troublesome for other USOs. At this stage Beta had received four years of funding but was unable to make an impression in the marketplace. The spinoff had developed a product and IP portfolio but lack of sales resulted in the investors refusing to invest further money. The academic associated with Theta also experienced problems. Inadequate funding led to resource weakness. Investment was required because the developed product was "not what the general market wanted". Therefore this spinoff wasted time raising money when it should have been concentrating on getting the product right. The spinoff was unable to raise extra investment and the academic decided to bring the technology back to the university for further development.

5. Discussion

5.1 Stages of USO Development

5.1.1 Research stage

In this phase it was evident from the analysed cases that academics involved in university spinoffs also continued in high-end research, winning research grants, publishing their work and presenting it at conferences. The academic associated with Beta, for example, had in excess of 35 researchers, one of the largest groups in the university. Other academics had close relationships with industry which was reflected in their research activities. In the analysed cases, the academics could be described as "star-scientists", a "breed" of academic who align themselves with the need or desire to create spinoffs, license technology and undertake collaboration with industrial partners (Shane, 2004).

All of the contacted USOs acknowledged the importance of building relationships with industry especially in terms of their own academic research. It was observed from the cases that such relationships took on the form of working in European projects with industrial partners or being part of a research group carrying out specific work for industry.

The analysed cases highlight the importance of the research phase for generating knowledge, IP and know-how. Other authors have also highlighted research as being paramount in the creation of knowledge. Dosi (1988); Godoe (2000); Sternitzke (2010) show that the emergence of new technologies is in many cases triggered by scientific discoveries which have occurred both in public institutions and private companies. Sternitzke (2010) discusses how such discoveries and research go hand in hand with the development of new technology fields, leading to the development of new products and new spinoffs to develop these products.

The Irish government also recognises the importance of research in generating knowledge, investing €2.4 billion in science, technology and innovation programmes, which in turn will drive "commercialisation of research outputs...transforming the enterprise base to drive economic renewal" (Department of Finance, 2010:IX).

5.1.2 Opportunity-framing stage

A number of different observations were made from the case notes about how academics and management teams frame opportunities. Pi and Gamma, for example, were under the impression that the development of a new organisation was all about the technology. These spinoffs were in their very earliest stages and were still developing the required technology and did not appear to be developing the networks needed to develop a market space for the final product.

This was in complete contrast with spinoffs Alpha, Beta, Sigma and Theta. Specific markets were identified for each of these USOs and the associated management teams had aligned the business to target these markets. However, it was evident from the analysed cases that incorrect markets were frequently targeted. Unfortunately this mistake was not noticed until the organisation had progressed into the later stage of development, perhaps a sign of an inability to frame the opportunity and technology correctly.

The incorrect framing of the technology and markets meant that a number of the analysed USOs were unable to overcome the resulting issues and money was wasted incorrectly aligning resources. Beta, for example, appeared to never adequately highlight the target market, which resulted in poor sales and the eventual closing of the company. After developing a product for a specific customer, Theta realised that the developed product was not required by the wider market.

But it was not just entrepreneurial academics who had difficulty in framing the proper market. Despite having an experienced management team, Sigma also went through massive changes in later development stages due to improper opportunity framing. Alpha did not appear to have problems in identifying markets and the academic did not talk of having to re-organise company structure because of in-correct opportunity framing. However, this was a very experienced individual who had previously been involved in at least four different spinoffs/startups, developing the required networks to make success more likely.

It can be seen that the framing of the technology, regardless of the presence of an experienced team, proved difficult. Opportunities were defined imprecisely, targeted ambiguously and often turned out to be impracticable. Perhaps one reason why academics had problems in framing their research is that it required them to think in a very different way, alien to the academic and university environment (Etzkowitz, 1998; Ndonzuau et al., 2002). The main problem is reconciling the scientific conception, where science is a goal in itself, with the economic conception, where making money is paramount. Ndonzuau et al. (2002) details how “in the assessment of ideas” both the technology and the economic imperative have to be assessed in addition to the potential markets.

An important factor in this stage was ensuring that the technology works and was capable of meeting the specific needs of the customer. However, whilst the interviewed USOs never doubted that their associated technology would work, many failed to undertake a proof of principal at this stage to ensure that the research could be framed correctly and therefore provide a solution to a problem found in the market place. This proof of principal would consist of two important details. Firstly, that the research and science had the capacity to be developed into a product. Secondly, the product or service would solve a customer problem (Shane, 2004).

Generally, it was at this stage that the spinoffs discovered if they had a product that could satisfy a market need. From a RBV perspective, a number of authors have also recognised that this knowledge can prove to be an important resource leading to heterogeneous outputs (Barney et al., 2001; Wright et al., 2001).

5.1.3 Pre-organisational stage

All the interviewed USOs at this stage had framed their opportunity and had committed themselves to the new venture. Many of the strategic decisions concerned the use of existing resources and capabilities, and how they could be used now and into the future. Alpha, Beta, Sigma, Pi and Theta attempted to acquire the required human resources during this stage of development, hiring people with prior spinoff/startup venture experience. To cope with competitive pressures, Ndonzuau et al. (2002) observe how it is vital that competent people are acquired, ideally people who have prior experience in such an environment. Acquiring such a resource goes further than just gaining the right people to fill technical positions. The academic and surrogate entrepreneurs sought management expertise (know-how) and good social networks (know-who). Such an approach was recognised in the analysed cases, particularly by Alpha, Sigma and Theta who used such networks and key people to fill the resource requirements. Such an approach is important in the development of USOs (Ndonzuau et al., 2002).

As a consequence of acquiring suitable human resources, the spinoff was also now in a position to use and generate knowledge or intellectual capital which, as described by Barney (2001a), is seen as an internal resource from a RBV of the firm. It is tacit knowledge that people bring to the USOs and coded knowledge generated through venture operation and technology transfer from the university research laboratory. Beta, Theta and Sigma, for example, were undertaking considerable basic research during the pre- organisation stage resulting in large amounts of knowledge being generated, whilst simultaneously undertaking product development. Many of the USOs appeared to encourage the development of knowledge at this stage.

Knowledge plays a vital role in the RBV of a firm and the value creation process (Johannessen et al., 2005; Wernerfelt, 1984). Johannessen et al. (2005) detail how, through the use of knowledge, a USO has the capability to develop resources and create competitive advantage. Cooper (2000) also highlights the importance of resources in technology development, and, in particular, having the resources in place to develop and drive product innovation. All the USOs attempted to locate and hire human capital which ensured they met a further aspect of the RBV, the identification of weakness. West III & DeCastro (2001) observe that if weaknesses were not identified or taken into account then human capital would not be a source of competitive advantage.

Beta, Sigma, Pi and Theta acquired excellent resources in terms of human capital to develop the technology and proceed into product development, but in the cases of Beta and Theta, some weaknesses were not observed by management teams. One way to identify weaknesses is through the development of suitable business plans. All the USOs had developed business plans but the aspect of the plan and the means through which it was carried out were seen to be mostly informal, a characteristic observed by Smith et al. (1985) in early stage organisations.

Although all the analysed spinoffs had a business plan, whether informal or otherwise, they emphasised the technology and overlooked the marketing requirement. This was confirmed when two of the academics spoke of the importance of technology and implied that the marketing would fall into place without any real planning.

The importance of a business plan and how it plays a vital role in accessing the market is recognised by Chesbrough & Rosenbloom (2002). They say that a successful business model creates a heuristic logic that culminates in connecting technical potential with the realisation of economic value. A successful business model is one that, firstly, articulates a value proposition based on the value created for users by using the product. Secondly, it must identify a suitable market segment. Thirdly, it must define the structure of the value chain within the firm required to create and distribute the product offering or service. Lastly, the business plan should estimate the product offering and cost structure of producing the product or service (Chesbrough & Rosenbloom, 2002).

But a number of interviewed academics did not understand the logic of a connection between technical potential and economic value, fueled by the customer and the market. This was in contrast to others who continued to talk to potential customers and competitors, gaining the required information to implement a suitable business plan that would determine the best way to access customers. The USOs that attempted to build a relationship with stakeholders were the most successful in using and re-configuring resources as required by the market.

As a consequence of over-zealous management teams and technically minded academics, the USOs (with the notable exception of Alpha) had started product development in the opportunity framing stage or early in the pre-organisational stage. This could be due to an ill-conceived business plan with little or no information gained from the market. Starting product development too early in the life-cycle of the spinoff appeared to have been a mistake.

5.1.4 Re-orientation phase

According to Vohora et al. (2004), USOs have at this stage gained the required resources to start the venture and will attempt to offer some product or service to its customers. As a consequence, USOs must continuously identify, acquire, integrate, and reconfigure resources ((Eisenhardt & Martin, 2000; Galunic & Eisenhardt, 2001; Teece et al., 1997). Such re-configuration was evident among a number of USOs that had attempted to enter incorrect markets early in the USO life-cycle and then had to change direction. Beta, Sigma and Theta made this mistake. This is a consequence of inexperienced management and a sales team unable to make any impact on the customer base with the developed technology. Such spinoffs lack the innovation leaders that are required to cultivate the strategic fit of an organisation with its environment. Carmeli et al. (2010) demonstrate that proper managerial leadership of the organisation is essential in finding the right fit in a global business world that is becoming more complex.

Reconfiguration is also required when product development is started too early, in the opportunity framing or pre-organisational stage, when there is a poor understanding of the market and the place for the developed technology. Gruner & Homburg (2000) emphasise a link between strong customer interaction and success in product development. They

note how such involvement can play a vital role in the marketing of the product, and how interactions between a spinoff and a customer provide invaluable information that will inform the business going forward.

A lack of experienced management and market knowledge means many USOs fail to find the right “fit” for their technology. This explains why Beta, Sigma and Theta had misguided expectations about how their USO was going to perform. Verhees et al. (2010) detail how small firms can improve their performance by monitoring customer needs and by having the resources in place to respond to them as required. Alpha successfully overcame barriers by ensuring resources were in place at each stage of development, whether it was in product development, marketing or sales. Product development did not even start until there was a full understanding of a customer needs.

An observation at this stage was the introduction of more formal structures in all of the analysed cases, which resulted in further re-configuration of resources. These included the introduction of ISO standards and more formal structures around HR and accounting. Alpha, Beta and Sigma introduced such practices, following a pattern observed by Davenport et al. (2002) that notes procedures within spinoffs became more formal as time progresses.

5.1.5 Sustainable returns

The final stage, according to Vohora et al. (2004), is sustainable returns. At this point the spinoff has configured and re-configured capabilities and resources and overcome many barriers. It has used internal resources such as knowledge, learning, culture, teamwork and human capital to drive development.

Alpha reached this stage in a strong position. The academic spoke of continuing to expand its product portfolio and working on customer relationships to ensure sustained competitive advantage. Sigma was also seeking new market opportunities to expand. By continually looking at how resources can be used and new resources acquired, such spinoffs have met the required factors for sustained competitive advantage. Both of the USOs that reached this stage have built up a knowledge base and a strong portfolio of products, valuable resources of a highly technical nature that are difficult to imitate. This give the spinoff sustained competitive advantage and a platform for further growth in the future (Barney, 1991).

5.2 Critical junctures prohibiting the growth of university spinoffs

5.2.1 Opportunity recognition

Many of the academics involved in the analysed USOs were high achievers in their chosen academic fields. They were heads of large research groups, had specific contacts with industry or previous experience in spinoff/startup companies. Prodan & Drnovsek (2010) observe how entrepreneurial self-efficacy was an important driver when it came to academics interest in creating spinoff opportunities. It was clear that many of the involved academics, and even the management teams they had put in place, do not have the required experience. Consequently, many of the USOs identified opportunities that turned out to be unsuitable. This was true for Beta, Sigma and Theta who were unable to grow and progress.

These problems occurred even though two of the spinoffs, Sigma and Theta, spoke to potential customers in the early stages. This author believes that the technology output from these USOs had been improperly framed, requiring major reconfiguration of acquired resources at a later stage. Spending capital on correcting these errors would prevent further growth and development. The opportunity was possibly not recognised correctly because of a lack of market knowledge. Though many of the USOs attempted to gain information on the market by contacting potential customers and competitors, it wasn't enough to prevent pitfalls. Van Geenhuizen & Soetanto (2009) observe that the number one obstacle to growth in spinoffs is lack of marketing knowledge. Perhaps one reason why it is difficult to acquire the relevant market information is because of the highly specialised areas in which the spinoffs were operating.

The TTO respondent believed that one way of overcoming the framing problem would be through the creation of networks between the USOs, SMEs and multinational companies in Ireland. This notion was also put forward by other Alpha, Evolution and Enterprise Ireland. Van Geenhuizen & Soetanto (2009) claim that the main ingredient in firm enhancement is the creation of networks where there is openness between partners as well as variation among the participants. Li & Tang (2010) iterate how external network linkages provide an opportunity to learn more about customers and markets, gaining knowledge and information that becomes a valuable resource and critical source of competitive advantage. ***

5.2.2 Entrepreneurial commitment

This critical juncture prevents a spinoff moving from the opportunity framing stage to the pre-organisation stage. It is evident that the TTOs have put in place certain measures to aid the USOs. Mentors, for example, are made available to many of the academics. Additionally, USOs are given advice on developing business plans, on how to approach VCs and the way to incorporate proper measures to ensure spinoff development.

However, many of the USOs believed that the TTO does not do enough to aid the development of the organisation. All of the USO respondents spoke of their frustration at some level of the interaction between the TTO/university and the USO. Degroof & Roberts (2004) emphasise the difficulties in achieving commitment when weak entrepreneurial infrastructure for academics spinoff ventures are in place.

From this research it was noted that a perceived lack of know-how from the TTO frustrated many academics. However, the respondent from the TTO office spoke of how policies have been introduced to encourage academics to commit to spinoff ventures, measures that ensure the offices are committed to their development.

From this analysis, and in agreement with Vohora et al. (2004), one of the features of this juncture is the failure of the university to provide sufficient resources, clear policies and a network of external relationships with key stakeholders, such as mentors, surrogate entrepreneurs and industry. But this author believes that the spinoffs have unrealistic expectations in the type of help they will receive from the TTO.

A further barrier at this critical juncture is the attitude of many academics in Irish universities. Those who undertake spinoff activity believe that there is a general lack of motivation from

other academics when it comes to entrepreneurial activities because they are in a “public job”. Therefore, it can be said that Irish universities are not doing enough to encourage scientists in developing commercialisable research, and perhaps Irish universities should be doing more to change this culture.

5.2.3 Credibility

Credibility is recognised as a general problem for new ventures and in particular USOs. It manifests itself in a number of ways but acquiring funding is a major source of concern at this juncture. Capital is required to finance the resources that will drive the spinoff forward to sustained competitive advantage.

In raising capital from VCs the majority of the academics spoke of the risk adverse nature of VCs in Ireland. Many of the management teams associated with the USOs noted how VCs had no interest in giving finance and taking risks. This led to many of the investigated USOs feeling frustrated in their attempts to raise capital.

VCs go through various stages before deciding to invest in a project (Kollmann & Kuckertz, 2010). One of these steps is deal evaluation (Kollmann & Kuckertz, 2010). During this process, the investors carefully analyse the potential spinoff company. Therefore, if USOs have had difficulties in framing their technology it will become evident to experienced investors and VCs. This problem of framing the technology as described in previous stages has been shown to come about because of the inability of the USO to realise what problems the technology can service, what markets equate to this problem and how to enter the market.

The personality of the academic or the surrogate entrepreneur also appears to play a major role in dealing with VCs. Macmillan et al. (1985) propose that five out of ten of the most important decision criteria are related to the personality or experience of the entrepreneurs. This appears to again work against the academic entrepreneur, who, because of his professional background, has worked in the academic world with little or no exposure to business development and entrepreneurship.

The trickle effect of funding also led to difficulty in acquiring resources for the USO. Many of the USOs spoke of facing problems in acquiring resources, dealing with customers and product development because the spinoff has only received six to eight months of funding. The USOs believed that this is a result of the risk-adverse nature of VCs in Ireland, prohibiting the growth of the spinoff. However, there is little current research to back this up.

Van Geenhuizen & Soetanto (2009) did, however, detail a factor that was observed in this research, the credibility of the firm within the marketplace. This manifests itself in the failure to create a market because of no prior history in dealing with customers. Highly-innovative firms, however, appeared to overcome this credibility issue. Another way to build credibility is through long lasting relationships with customers. To do this a USO must build protocols and systems to deal with customer and sales issues. Secondly, they must hire sales teams that understand the required market and the importance of customer relations. The spinoffs that have acquired the resources to overcome these highlighted credibility issues will progress to the final stage of spinoff development (Van Geenhuizen & Soetanto, 2009; Vohora et al., 2004).

5.2.4 Sustainability returns juncture

The main difference between those USOs that overcame this critical juncture and those that remained in preceding stages was their ability to continuously use and reconfigure available resources and their ability to acquire other resources when needed. The proper use of these resources ensured sustained revenue. Alpha and Sigma achieved this and were able to increase their product portfolio to attract new as well as existing customers.

A further observation within the analysed cases, especially with Sigma, was the ability of the USOs to overcome weakness and mistakes made in previous stages of development. By gaining resources to overcome such weaknesses, to grow and ensure the correct use of resources it was made certain that the USO overcame each juncture leading to growth and development. Spinoffs like Beta and Theta failed because they did not correctly deal with social capital deficiencies, resources weaknesses and inadequate internal capabilities (Cohen & Levinthal, 1990; Zahra & George, 2002). Gurdon & Samsom (2010) observe that an effective combination of management team processes and the availability of capital lead to the best use of the resources and capabilities.

6. Using grounded theory in creating theory associated with USO development

Grounded theory can be used to improve upon already accepted theory. Therefore, this author will attempt to improve upon the stage-based model as proposed by Vohora et al. (2004). During this work a number of important features were observed in the development of USOs. However, in this author’s opinion, one central point appeared to have a major role in USO development, the correct framing of the opportunity. To investigate this observation further a mind-map was created to clarify the observed results, as shown in Figure 2.

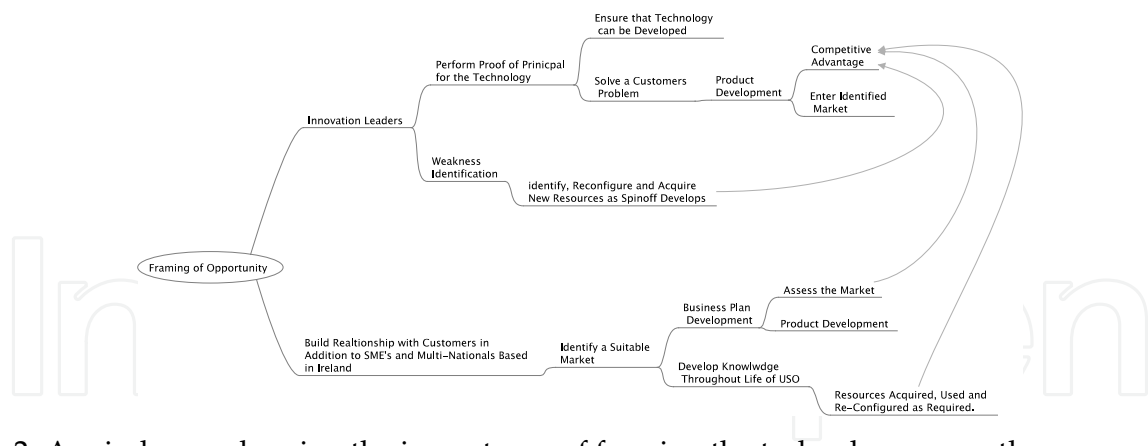


Fig. 2. A mind-map showing the importance of framing the technology correctly

Developed using two main arms or trains of thought, the first arms represented the internal forces affecting the firm, the second represented the external environment (Zahra et al., 1999). This author believes that internal factors and the external environment, as observed by Zahra et al. (1999), play a major role in the long term success of the USOs and that it was the proper framing of technology that determines whether the venture will succeed or fail. By developing relationships with customers, SMEs and multi-nationals, a need within the marketplace will be identified. This need will drive on the development of knowledge within the USOs through

the use and acquisition of resources. Additionally, business plan development will signpost the best routes to market and appropriate product development.

Secondly, the framing of an opportunity will mean that the innovation leaders and management team will drive the USO in a particular direction. In addition to acquiring, configuring and correctly using resources, the management team should undertake a proof of principal for the technology, ensuring that customer needs are met, leading to the correct approach in terms of product development. Additionally, weakness identification will be undertaken, which, in turn, will lead to the acquisition of required resources. Both of these arms within the mind-map have the potential to lead a USO to competitive advantage.

Using this mind-map, a stage-based approach was developed using the proper framing of the technology as an initial step I, as shown in Figure 3

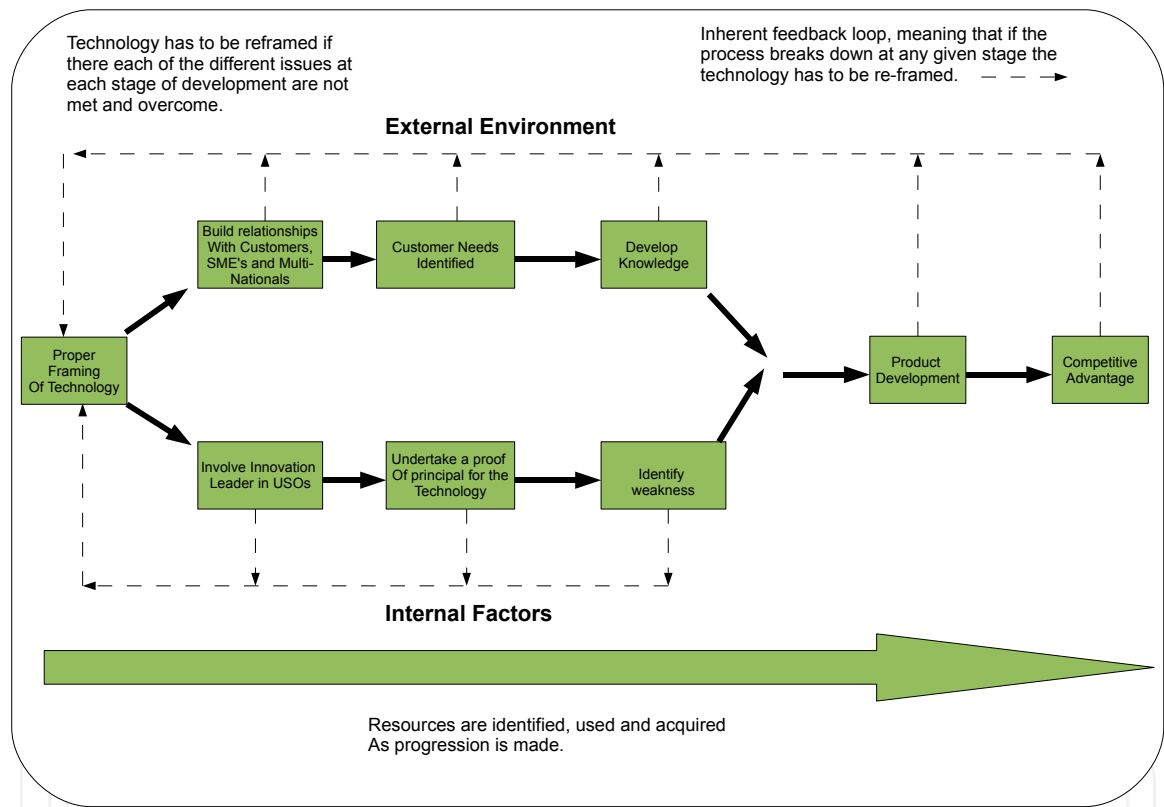


Fig. 3. Importance of proper framing of technology in university spinoff ventures.

The first step in the success of a USO is the correct framing of the technology. After this has occurred, internal and external factors affecting the USO should be aligned. The dynamic interplay between the two emphasises the importance of building relationships with stakeholders and identifying weaknesses while simultaneously acquiring and configuring resources. Such actions ensure appropriate products will be developed for the identified markets, resulting in sustained competitive advantage and the emergence of dynamic capabilities. However, as seen in Figure 3, if any stage of the process breaks down there is an inherent feedback loop and the technology has to be re-framed. The USO must return to the initial stage of opportunity framing.

7. The European Context

In February 2004, the European Commission published “Action Plan: The European agenda for Entrepreneurship” (European Commission, 2004) highlighting a number of strategic areas which could be used to enhance entrepreneurship across the EU, including, promoting the entrepreneurial mindset, encouraging more people to become entrepreneurs, gearing entrepreneurs for growth and competitiveness, improving the flow of finance, and creating a more SME-friendly regulatory and administrative framework. The highlighted challenges in the report are similar to the barriers to academic entrepreneurs identified in this research.

The EU commission and governments throughout Europe continue highlight the importance of innovation and entrepreneurship. The recent FP7 funding programme suggested measures to drive innovation, highlighting the importance of incorporating SMEs and the need to ensure that research projects have a definable impact. The agenda is about transformative mechanisms for translating knowledge into growth, which has been a problem for Europe to date. One example is the AEGIS FP7 project (European Commission, 2011), where analytic findings will be translated into diagnostics tools for country or sector-specific assessment of knowledge-intensive entrepreneurship. The outcome will be operational policy recommendations for advancing key aspects of knowledge-intensive entrepreneurship in Europe.

8. Summary

The economic importance of university spinoffs has generated significant interest in this area amongst VCs, academics and university and government research policy makers. To aid such activity it is important that the creation and development of university spinoffs is fully understood. The purpose of this research was to analyse the development of USOs using the development model as proposed by Vohora et al. (2004) and in doing so complete the defined objectives. Each of these research objectives will now be concluded upon.

Objective 1 Examine the stages that a USO experiences

In this research it was decided that the stages of growth within USOs would be compared to the non-linear model as developed by (Vohora et al., 2004). As can be seen from the analysed cases, the development of USOs associated with Irish universities are characterised by a number of distinct stages. Each stage had particular characteristics, which resulted in USOs behaving in a specific manner, requiring re-configuration and acquirement of various resources throughout the various stages. In addition, the non-linear nature and the role of feedback was present. This was particularly evident when USOs had to return to earlier decisions made in previous stages.

How resources were used throughout the development of the spinoffs was also evident. Initially USOs attempted to make use of resources available to them within the university environment through the use of staff within the university and the use of university equipment. However as USOs developed further resources had to be acquired. It appeared that it was those spinoffs which had access to these resources, human capital for example, were in a position to progress. These resources were acquired through social networks the entrepreneur team had developed and through capital provided from various sources, for example, business angels, VCs and funds available to the entrepreneur.

Objective II: Detail the main barriers faced by spinoffs.

As seen by Vohora (2004), critical junctures or barriers were observed to exist between the varying stages of development. In order to progress to the next stage of development, USOs had to overcome these barriers. There were many varying reasons in USO development that resulted in the presence of such barriers. But the totality of these deficiencies is due to a number of reasons. Inadequate human resources, inadequate capital and inadequate capabilities. Each of these factors combined in a very evident manner in the form of resource weaknesses. Unless the USOs were in a position to overcome these resources weaknesses, the USOs did not have the capabilities to progress through the differing stages of development.

Inadequate resources were seen to be due to poor planning on behalf of the USO entrepreneurial team. Such a factor resulted in the USO not knowing what resources are required now but more importantly in the future. This resulted as observed from the analysed cases, the technology been developed for the wrong markets, sales teams with insufficient experience been hired and an inability to acquire the required funding. Therefore capabilities of the USO, in particular, the entrepreneurial management team showed how important it was to have innovation leaders involved with the venture. Having such team members involved in the USO will ensure that weakness will be identified.

Objective III: Use a grounded theory approach to develop a conceptual framework for detailing USO development.

An attempt was made to improve on Vohora's (2004) stage-based model using observations made in this work. This entailed the hypothesis that it was the correct framing of the technology that would in the long term ensure that the USOs would reach a stage of sustainable returns. Framing of the technology, through relationship building with industry, in a particular manner would result in internal resources and the external environment being correctly aligned so as to allow for the development of resources, development of a product/service and a sustained competitive advantage.

An important fact to acknowledge is the inherent feedback loop in this process. As the USOs progresses through each process resources are used, acquired and re-configured. However if a particular process fails, the technology associated with USOs will have to be re-framed. This will result in having to return back to the first stage again and acquire the resources required to "re-frame" the technology.

By identifying weaknesses the USO will be in a position to overcome the fact that a USO is a resource limited venture. Therefore by identifying the inherent weaknesses in a USO, the entrepreneurial team will be in a position to use the available resources and acquire the required.

9. References

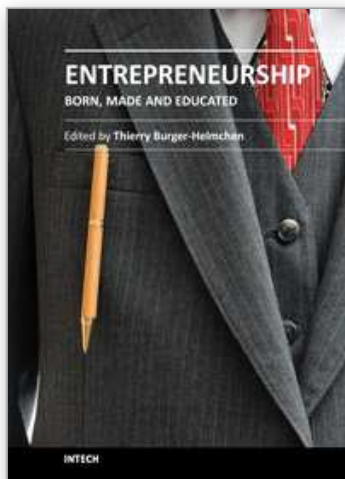
- Alvarez, S. A. & Busenitz, L. W. (2001). The entrepreneurship of resource-based theory, *Journal of Management* 27(6): 755 – 75.
- Barney, J. (1991). Firm resources and sustained competitive advantage, *Journal of Management* 17(1): 99 – 120.

- Barney, J. B. (2001a). Is the resource-based "view" a useful perspective for strategic management research? yes, *The Academy of Management Review* 26(1): 41 – 56.
- Barney, J. B. (2001b). Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view, *Journal of Management* 27(6): 643 – 50.
- Barney, J., Wright, M. & Ketchen Jr., D. J. (2001). The resource-based view of the firm: Ten years after 1991, *Journal of Management* 27(6): 625 – 42.
- Bhave, M. P. (1994). A process model of entrepreneurial venture creation, *Journal of Business Venturing* 9(3): 223 – 42.
- Bray, M. & Lee, J. (2000). University revenues from technology transfer: licensing fees vs. equity positions, *Journal of Business Venturing* 15(5-6): 385–92.
- Bryman, A. & Bell, E. (2007). *Business research methods*, 2nd edn, Oxford : Oxford University Press.
- Carmeli, A., Gelbard, R. & Gefen, D. (2010). The importance of innovation leadership in cultivating strategic fit and enhancing firm performance, *The Leadership Quarterly* 21(3): 339 – 49.
- Chesbrough, H. & Rosenbloom, R. (2002). The role of the business model in capturing value from innovation: evidence from xerox corporation's technology spin-off companies, *Industrial and Corporate Change* 11(3): 529 – 55.
- Clarysse, B., Wright, M., Lockett, A., P., M. & Knockaert, M. (2007). Academic spin-offs, formal technology academic spin-offs, formal technology transfer and capital raising, *Industrial and Corporate Change* 16(4): 609 – 40.
- Cohen, W. M. & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation, *Administrative Science Quarterly* 35(1): 128 – 52.
- European-Commission (2010), AEGIS FP7 Project, viewed July 2011, <http://www.aegis-fp7.eu>.
- European-Commission (2004), Action Plan: The European agenda for Entrepreneurship, viewed July 2011, <http://www.euractiv.com/innovation/entrepreneurship-europe>.
- Cooper, R. G. (2000). Product innovation and technology strategy, *Research Technology Management* 43(1): 38 – 41.
- Daft, R. (1989). *Organization theory and design*, 3rd edn, St. Paul : West Pub. Co.
- Davenport, S., Carr, A. & Bibby, D. (2002). Leveraging talent: spin-off strategy at industrial research, *R&D Management* 32(3): 241 – 54.
- Deeds, D. L., Decarolis, D. & Coombs, J. (2000). Dynamic capabilities and new product development in high technology ventures: An empirical analysis of new biotechnology firms, *Journal of Business Venturing* 15(3): 211 – 29.
- Degroof, J. & Roberts, E. (2004). Overcoming weak entrepreneurial infrastructures for academic spinoff ventures, *Journal of Technology Transfer* 29(3-4): 327 – 52.
- Dosi, G. (1988). Sources, procedures, and microeconomic effects of innovation, *Journal of Economic Literature* 26(3): 1120 – 71.
- Eisenhardt, K. M. (1989). Building theories from case study research, *Academy of Management Review* 14(4): 532 – 50.
- Eisenhardt, K. M. & Martin, J. A. (2000). Dynamic capabilities: What are they?, *Strategic Management Journal* 21(10/11): 1105 – 21.
- Etzkowitz, H. (1998). The norms of entrepreneurial science: cognitive effects of the new university-industry linkages, *Research Policy* 27(8): 823 – 33.

- Galunic, D. C. & Eisenhardt, K. M. (2001). Architectural innovation and modular corporate forms, *Academy of Management Journal* 44(6): 1229 – 49.
- Glaser, B. G. & Strauss, A. L. (1967). *The discovery of grounded theory : strategies for qualitative research*, 1st edn, Hawthorne, N.Y : Aldine de Gruyter.
- Godoe, H. (2000). Innovation regimes, r&d and radical innovations in telecommunications, *Research Policy* 29(9): 1033 – 46.
- Greiner, L. E. (1998). Evolution and revolution as organizations grow, *Harvard Business Review* 76(3): 55 – 68.
- Gruner, K. E. & Homburg, C. (2000). Does customer interaction enhance new product success?, *Journal of Business Research* 49(1): 1 – 14.
- Gurdon, M. A. & Samsom, K. J. (2010). A longitudinal study of success and failure among scientist-started ventures, *Technovation* 30(3): 207 – 14.
- Hindle, K. & Yencken, J. (2004). Public research commercialisation, entrepreneurship and new technology based firms: an integrated model, *Technovation* 24(10): 793 – 803.
- Hoye, K. & Pries, F. (2009). Repeat commercializers,' the habitual entrepreneurs' of university-industry technology transfer, *Technovation* 29(10): 682 – 89.
- Johannessen, J., Olsen, B. & Olaisen, J. (2005). Intellectual capital as a holistic management philosophy: a theoretical perspective, *International Journal of Information Management* 25(2): 151 – 71.
- Kollmann, T. & Kuckertz, A. (2010). Evaluation uncertainty of venture capitalists' investment criteria, *Journal of Business Research* 63(7): 741 – 47.
- Kusunoki, K. (1997). Incapability of technological capability: A case study on product innovation in the japanese facsimile machine industry, *Journal of Product Innovation Management* 14(5): 368 – 82.
- Li, H. L. & Tang, M. J. (2010). Vertical integration and innovative performance: The effects of external knowledge sourcing modes, *Technovation* 30(7-8): 401 – 10.
- Lockett, A. & Thompson, S. (2001). The resource-based view and economics., *Journal of Management* 27(6): 723 – 754.
- Macmillan, I. C., Siegel, R. & Narasimha, P. N. S. (1985). Criteria used by venture capitalists to evaluate new venture proposals, *Journal of Business Venturing* 1(1): 119 – 28.
- Miles, M. & Huberman, A. (1984). *Qualitative data analysis: A sourcebook of new methods*, California : Sage Publications.
- Miller, D. & Friesen, P. (1984). *Organizations : a quantum view*, Englewood Cliffs ; London : Prentice-Hall.
- M.M.J, B. & Taggart, J. (1998). Combining technology and corporate strategy in small high tech firms, *Research Policy* 26(7-8): 883 – 95.
- Ndonzuau, F. N., Pirnay, F. & Surlemont, B. (2002). A stage model of academic spin-off creation, *Technovation* 22(5): 281 – 89.
- Newbert, S. L., Gopalakrishnan, S. & Kirchhoff, B. A. (2008). Looking beyond resources: Exploring the importance of entrepreneurship to firm-level competitive advantage in technologically intensive industries, *Technovation* 28(1-2): 6 – 19.
- of Finance, D. (2010). *Infrastructure investment priorities 2010-2016: A financial framework*, Dublin.
- of the Taoiseach, D. (2010). *Building ireland's smart economy: A framework for sustainable economic renewal*, Dublin: Department of the Taoiseach.

- O'Shea, R., Chugh, H. & Allen, T. J. (2008). Determinants and consequences of university spinoff activity: A conceptual framework, *Journal of Technology Transfer* 33(6): 653 – 666.
- Penrose, E. T. (1959). *The theory of the growth in the firm*, 4th edn, Oxford : Blackwell.
- Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view, *Strategic Management Journal* 14(3): 179 – 91.
- Pettigrew, A. M. (1990). Longitudinal field research on change: Theory and practice, *Organization Science* 1(3): 267 – 92.
- Prodan, I. & Drnovsek, M. (2010). Conceptualizing academic-entrepreneurial intentions: An empirical test, *Technovation* 30(5-6): 332 – 47.
- Rangone, A. (1999). A resource-based approach to strategy analysis in small-medium sized enterprises, *Small Business Economics* 12(3): 233 – 48.
- Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities, *Organization Science* 11(4): 448 – 69.
- Shane, S. (2002). Executive forum: University technology transfer to entrepreneurial companies, *Journal of Business Venturing* 17(6): 537 – 52.
- Shane, S. (2004). *Academic Entrepreneurship: University Spinoffs and Wealth Creation*, Cheltenham [U.K.] : Edward Elgar Publishing Limited.
- Siegel, D. S., Waldman, D. & Link, A. (2003). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study, *Research Policy* 32(1): 27 – 48.
- Smith, K. G., Mitchell, T. R. & Summer, C. E. (1985). Top level management priorities in different stages of the organizational life cycle, *The Academy of Management Journal* 28(4): 799–820.
- Sternitzke, C. (2010). Knowledge sources, patent protection, and commercialization of pharmaceutical innovations, *Research Policy* 39(6): 810 – 21.
- Strauss, A. & Cobin, J. (1990:487). *Basics of Qualitative Research: Grounded Theory Procedures for Developing Grounded Theory*, Thousand Oaks : Sage Publications.
- Teece, D. J., Pisano, G. & Shuen, A. (1997). Dynamic capabilities and strategic management, *Strategic Management Journal* 18(7): 509 – 33.
- Van de Ven, A., Hudson, R. & Schroeder, D. (1984). Designing new business startups: Entrepreneurial, organizational, and ecological considerations, *Journal of Management* 10(1): 87 – 107.
- Van Geenhuizen, M. & Soetanto, D. (2009). Academic spin-offs at different ages: A case study in search of key obstacles to growth, *Technovation* 29(10): 671 – 81.
- Venkataraman, S. (1997). The distinctive domain of entrepreneurship research: an editor's perspective, in J. In: Katz (ed.), *Advances in Entrepreneurship, Firm Emergence and Growth*, Vol. 3, . JAI Press, Greenwich, CA, pp. 119 – 138.
- Verhees, F. J., Meulenbergh, M. T. & Pennings, J. M. (2010). Performance expectations of small firms considering radical product innovation, *Journal of Business Research* 63(7): 772 – 77.
- Vohora, A., Wright, M. & Lockett, A. (2004). Critical junctures in the development of university high-tech spinout companies, *Research Policy* 33(1): 147 – 75.
- Wernerfelt, B. (1984). A resource-based view of the firm, *Strategic Management Journal* 5(2): 171 – 180.

- West III, G. P. & DeCastro, J. (2001). The achilles heel of firm strategy: Resource weakness and distinctive inadequacies, *Journal of Management Studies* 38(3): 417 – 42.
- Wright, M., Hoskisson, R. E. & Busenitz, L. W. (2001). Firm rebirth: Buyouts as facilitators of strategic growth and entrepreneurship, *Academy of Management Executive* 15(1): 111 – 25.
- Zahra, S. A. & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension., *Academy of Management Review* 27(2): 185 – 203.
- Zahra, S., Sisodia, R. & Matherne, B. (1999). Exploiting the dynamic links between competitive and technology strategies, *European Management Journal* 17(2): 188 – 203.



Entrepreneurship - Born, Made and Educated

Edited by Prof. Thierry Burger-Helmchen

ISBN 978-953-51-0210-6

Hard cover, 336 pages

Publisher InTech

Published online 14, March, 2012

Published in print edition March, 2012

Entrepreneurship has a tremendous impact on the economic development of a country. As can be expected, many public policies foster the development of self- entrepreneurship in times of unemployment, praise the creation of firms and consider the willingness to start new ventures as a sign of good fortune. Are those behaviours inherent to a human being, to his genetic code, his psychology or can students, younger children or even adults be taught to become entrepreneurs? What should be the position of universities, of policy makers and how much does it matter for a country? This book presents several articles, following different research approaches to answer those difficult questions. The researchers explore in particular the psychology of entrepreneurship, the role of academia and the macroeconomic impact of entrepreneurship.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Philip Bowe and Rory O'Shea (2012). Critical Development Paths of University Spinoff Ventures, Entrepreneurship - Born, Made and Educated, Prof. Thierry Burger-Helmchen (Ed.), ISBN: 978-953-51-0210-6, InTech, Available from: <http://www.intechopen.com/books/entrepreneurship-born-made-and-educated/critical-development-paths-of-university-spinoff-ventures>

INTech
open science | open minds

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2012 The Author(s). Licensee IntechOpen. This is an open access article distributed under the terms of the [Creative Commons Attribution 3.0 License](https://creativecommons.org/licenses/by/3.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

IntechOpen

IntechOpen