

University Spinoffs: What, Why, and How?

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“The medieval university looked backwards; it professed to be a storehouse of old knowledge. The modern university looks forward, and is a factory of new knowledge.”

Thomas Henry Huxley (1825–1895)
Comparative anatomist; known as "Darwin's Bulldog"

University spinoffs have remarkably strengthened the linkage between universities and industry. The number of technology patents and spinoffs coming out of university research has a significant impact on regional economic and social development. To further highlight the importance of university spinoffs, the aim of this article is to review available literature on university spinoffs and present a comprehensive overview of what university spinoffs are, why they are important, what makes them significant, and how they are or can be created. In addition to reviewing existing models of university spinoff creation, we also propose a new, multi-stage, holistic model.

Introduction

Over past two decades, the field of academic entrepreneurship has found greater visibility, and universities are being increasingly considered as a source for creation of high-technology firms. With greater attention focused on the linkage between science, technology, and university spinoffs, universities are moving from their traditional roles of research, teaching, and knowledge dissemination to a more advanced role of creating spinoffs and promoting academic entrepreneurship (Lerner, 2004).

Cohen and colleagues (1998) highlighted the need to emphasize the transfer and commercialization of knowledge generated within universities. Other scholars also point towards the growing need for universities to disseminate their generated knowledge beyond the narrow confines of the academic community (Branscomb et al., 1999; Hague & Oakley, 2000). Universities and governments, both in technologically advanced and developing nations, have shown greater interest in academic entrepreneurship and university spinoffs as a means of building links between universities and industry.

To help guide stakeholders from government, industry, and academia itself in the promotion of university

spinoffs, this article examines three questions that are often asked in the advancement of any phenomenon: what, why, and how. We first answer the question "What is a university spinoff?" and examine definitions from the literature. Next, we address the question "Why is there a need for university spinoffs?" Finally, we examine various models that address the question "How are university spinoffs created?", and we then propose our own multi-stage model. There is a need for a new model that can highlight various stages that lead to the creation of a university spinoff – from the identification of capabilities to the disclosure of invention to the final decision of creating a spinoff. Our model addresses this need by bringing clarity to the existing body of literature on university spinoffs. Finally, we conclude by pointing towards some of the potential research avenues that can be taken up by scholars in the area of academic entrepreneurship.

What is a University Spinoff?

According to Pirnay and colleagues (2003), "spinoff" is a fuzzy and general concept that covers a wide variety of phenomenon among which a university spinoff represents only one specific type. This assertion may also lead to a confused understanding of spinoffs, which may impede definitional understanding of the concept. There have been several attempts in the academic literature

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to define university spinoffs, and although they are not all consistent, common threads may be identified. They represent different perspectives that many not be compatible. Table 1 presents four definitions of university spinoffs, from which we can distil the following salient characteristics of a university spinoff:

1. the parent organization from which the innovation emerges has to be a university or academic institution
2. the output that is a university spinoff has to be a separate legal entity and not an extension or controlled body of the university
3. the new entity has to exploit knowledge produced from academic activities or academic pursuits
4. the spinoff should be aimed at profit generation and commercialization of technology

Table 1. Common definitions of "university spinoff"

Author	Definition
Smilor et al. (1990)	"a company that is founded (1) by a faculty member, staff member, or student who left the university to start a company or who started the company while still affiliated with the university; and/or (2) around a technology or technology-based idea developed within the university" (p. 63)
Weatherston (1995)	" a business venture which is initiated, or becomes commercially active, with the academic entrepreneur playing a key role in any or all of the planning, initial establishment, or subsequent management phases" (p. 1)
Bellini et al. (1999)	"companies founded by university teachers, researchers, or students and graduates in order to commercially exploit the results of the research in which they might have been involved at the university. ... the commercial exploitation of scientific and technological knowledge is realized by university scientists (teachers or researchers), students and graduates." (p. 2)
Klofsten & Jones-Evans (2000)	"[a] new firm or organization to exploit the results of the university research." (p. 300)

Why Is There a Need for University Spinoffs?

University spinoffs are not very common, but they are important for economic development (Lowe, 2002), for commercializing university technologies (Etzkowitz, 2003), and for helping universities with their major missions of research and teaching (Jones & Gold, 2001). Below, each of these potential benefits of university spinoffs is examined in greater detail.

Enablers of economic development

University spinoffs contribute to the economic development of the locality to which they belong. Firstly, they create business opportunities by translating research results into workable technologies leading to market solutions. Secondly, they typically conduct most of their basic activities locally (e.g., hiring, sourcing supplies, production) and thus have significant multiplier effects on local economic activity. Spinoffs frequently serve as catalysts for the formation of geographic clusters of new firms in particular technologies (Lowe, 2002).

Commercialization of university technologies

University spinoffs make use of university technologies that might otherwise would go undeveloped. Researchers have identified two ways that spinoffs enhance the development of technology:

1. Spinoffs provide a mechanism for firms to commercialize inventions that have very high uncertainty, which reduces interest from other larger establishments (Etzkowitz, 2003)
2. Spinoffs provide a way to ensure inventor involvement in the subsequent development of university technologies, which is crucial when technologies are based on tacit knowledge (Shane, 2004).

University spinoffs also provide effective mechanisms for involving the inventor of the technology in the process of commercialization, which is a necessary condition for the development of products or services from university technology (Hindle & Yencken, 2004; Jensen & Thursby, 1998). University spinoffs achieve inventor involvement because many scientists perceive that spinoffs are better places to work than established firms, where the projects may be less interesting or challenging (Kenney, 1986). As a result, inventors are more inclined to work with new companies seeking to commercialize their university inventions than they are to work with established companies seeking to commercialize their own inventions.

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Also, startups firms focus more on technology development as opposed to other aspects of business, and university researchers tend to be more interested in technology development than in other aspects of business. Also, equity is a more effective tool to ensure inventor involvement in spinoffs than other forms of compensation (Geuna & Nesta, 2006). Spinoffs can provide inventors with equity holdings more easily than established firms because the distribution of equity at the time of firm founding does not involve the transfer of equity from someone who has it to another individual, as is the case when equity is distributed after founding.

University spinoffs and the mission of research and teaching

Attracting and retaining productive science and engineering faculty can be a substantial challenge otherwise, and the potential for university spinoffs can help on both counts. By allowing faculty to supplement their salaries with equity in their own companies, universities provide a financial mechanism to retain and recruit faculty, particularly in the biomedical areas, where this approach is similar to the use of practice plans common with clinical faculty in medical schools (Jones & Gold, 2001). In the discipline of biological sciences, researchers have observed that allowing faculty to found spinoffs reduces the number of faculty leaving the university to take higher paying industry jobs (Powell & Owen-Smith, 1998).

How Are University Spinoffs Created?

The creation of the technology used by a university spinoff is a multi-stage process. Funding from the governments, industry, and foundations are used to support scholarly research in science and engineering. In a typical process, some of this research results in the creation of new technology that is then brought to the attention of the university. The university technology-licensing office may then decide whether or not to seek intellectual property protection for the invention, after which efforts may be made towards licensing the technology. Policies regarding the retention and protection of intellectual property will vary from university to university, but in most cases, established companies are the licensees of university inventions, and in some cases, newly formed companies are the licensees. Beginning with the initial research phase, the process of university technology development involves significant amounts of hard work, with only some efforts leading to outcomes that mark progression to the next stage.

This section discusses some of the three most widely accepted models for the creation of university spinoffs. After systematically reviewing these three models, we then propose a new operational model

A review of existing models

After reviewing the extant literature on university spinoffs, we identified three such models for a detailed discussion. In the first model, Ndonzuau, Pirnay, and Surlemont (2002) identified four important stages in the development of university spinoffs: i) generating a viable business idea, ii) translating the idea into a business process, iii) creating a firm, and iv) contributing value to customers, employees, investors, and all other stakeholders (both internal and external). The four stages of the model are dependent on each-other as decisions made in earlier stages can severally impact the later stages.

The second model, by Shane (2004), includes five stages in describing a typical process to create a university spinoff. The first state is purely academic but the model also allows for tangential technologies that have the potential to facilitate new products and services. In cases where the researcher believes that their new technology is an invention that can be commercialized, they then disclose it to the university's technology-licensing office. Then, in the third stage, the potential for intellectual property protection is evaluated and a patent application may be made. Based on the limited monopoly via the patent, the technology transfer office can either license the technology to an established company or the researcher may establish a spin-off firm.

Building on the models by Ndonzuau and colleagues (2002) and Shane (2004), Vohora, Wright, and Lockett (2004) offered a new perspective on the development of university spinoffs. Their model also has five stages, but it emphasizes four critical junctures, or hurdles, that must be crossed before transitioning to the next stage:

1. Research
 - *Opportunity recognition*
2. Opportunity framing
 - *Entrepreneurial commitment*
3. Pre-organization
 - *Threshold of credibility*
4. Re-orientation
 - *Threshold of sustainability*
5. Sustainable returns

Similar to the model proposed by Shane (2004), the first stage of this third model involves research and is

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primarily aimed at producing academic knowledge. This stage starts with research into new technology and ends when intellectual property is created, although not all technologies will be commercially viable.

Thus, the first critical juncture is opportunity recognition. In the next phase, if an opportunity has been identified, it has to be framed or, in other words, structured and tested for viability. The next critical junction is entrepreneurial commitment, which represents the hurdle that must be overcome to move from the opportunity framing stage to the pre-organization stage. Vohra and colleagues propose that, once intention of the entrepreneur is set, a re-orientation of the organization in terms of resources available occurs. Access to resources requires credibility and thus this represents the next critical juncture. Finally, similar to any venture, university spinoffs require sustainable returns for survival and when this viability threshold is passed, the university spinoff creation process is completed.

On a comparative note, the model proposed by Vohra and colleagues provides a rather systematic approach for the development of university spinoffs. The model recognizes that opportunity analysis and identification is critical to successful commercialization. However, connecting academic research to a market opportunity is not an easy task and requires more than scientific knowledge; it also requires sound business knowledge. In a broad sense, the opportunity is an end result of the research, but it does not mean that ultimate endpoint has been reached. The opportunity must be scrutinized for value in relation to the potential market.

These three models are valuable, but they leave some questions unanswered, such as: How does a researcher identify and decide on specific opportunities? What kind of funding is available for conducting research? Do similar opportunities exist for both pure and applied research and the results thereof? What modes for commercializing research results are available to the researcher or the university? These gaps must be explored for a better understanding of how university spinoffs take shape. In the following section, we propose a conceptual model that encompasses the nuances that the existing models fail to address.

A multistage, holistic university spinoff creation model

The previous section condensed the most prevalent models concerning university spinoffs and identified certain gaps in those models in terms of identifying specific opportunities based on research, funding research, related processes for pure versus applied research, and

modes of commercialization. In this section, we propose a more holistic multistage conceptual model (Figure 1) to help fill the gaps we identified.

Newbert (2007) indicated that capabilities act as pre-conditions to research in any setting. From capabilities, competencies can be identified; an understanding of competencies is required to understand the availability of resources (Hodgetts et al., 1999). Most important of all resources at this stage would be finance. The research can be self funded or university funded, or it can be funded by corporate or public entities. Capabilities and competencies are fundamental determinants of creating market viable technology spinoffs. Thus, capabilities dominate the first stage in our model.

The existing models are silent regarding the nature of research and which type – pure or applied – may be better suited for spinoffs. Pure or fundamental research is intended to advance the knowledge in the field, which may further provide a foundation for applied research. In our model, based on the nature of research conducted, whether pure or applied, the results are tested and confirmed for reliability, validity, and viability. A formative understanding of the commercial potential of a proposed spinoff should originate at this second stage, where the opportunity should also be analyzed and framed.

Research results as outcomes of either public, corporate, or self/university funding should be treated differently. In cases of corporate-funded research, disclosure leading to patents is not possible unless explicitly mentioned in the general terms and conditions of engagement, as is the case with public/state-funded research. It is essential to understand the nature of funding because that would be the deciding factor in whether a certain invention can lead to spinoff creation. In Stage 3, terms and conditions of funding permitting, the university or innovator discloses an innovation and a decision is made on whether or not to file a patent.

Mikhail (1999) commented that patents do not necessarily reflect commercial viability. If that is so, the previous models again miss out on who conducts the analysis of commercial viability. A gap develops when there is a lack of clarity as to which kind of technology is most suitable or ends as university spinoffs. There arises the role of a technology licensing office. The technology licensing office seeks out possible buyers or less-ees for the technologies that have the potential to create commercially viable business opportunities. Leasing or buying depends on how businesses view the

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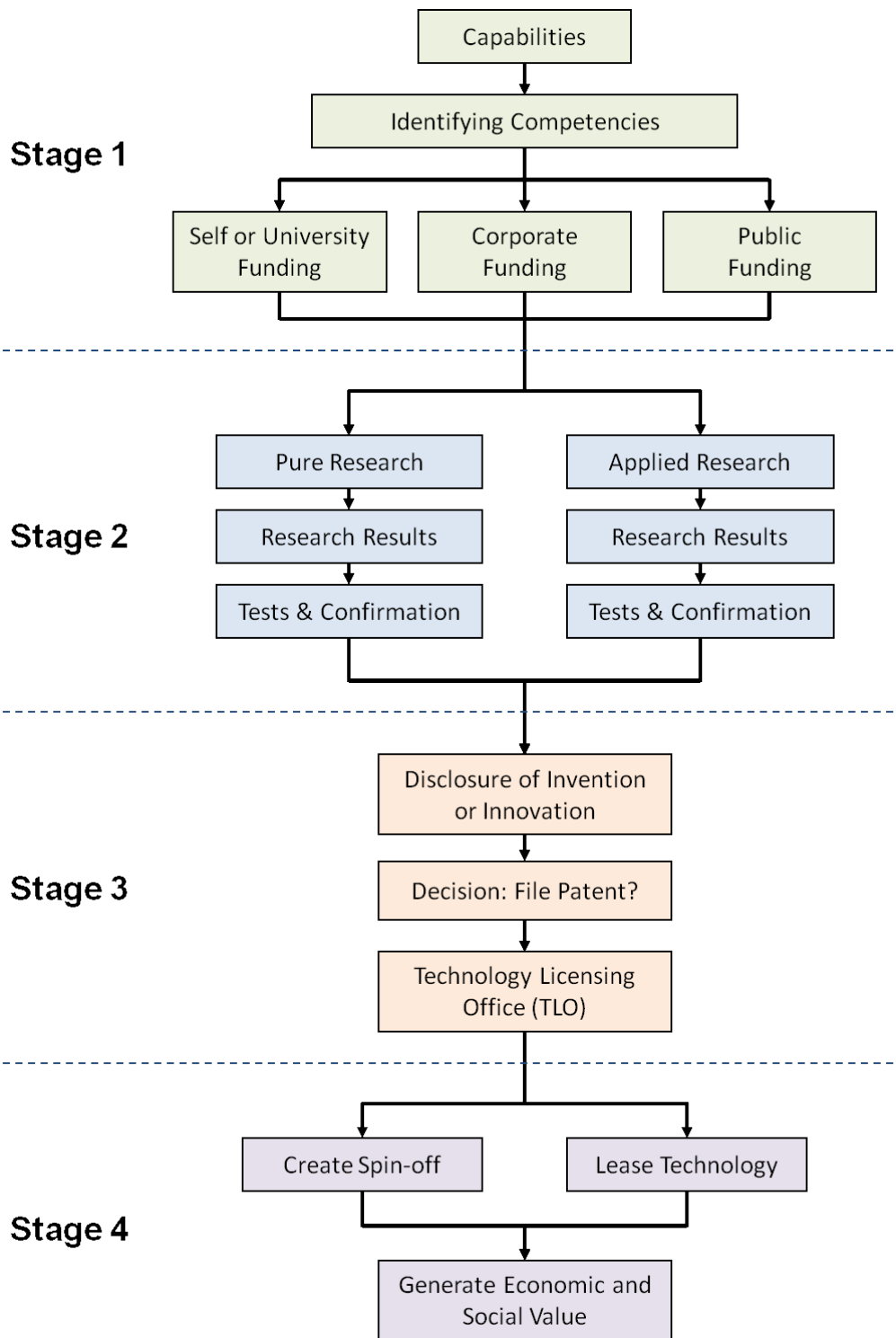


Figure 1. A multistage holistic model for creating university spinoffs

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commercial potential of the technology. It has been observed that mostly incremental or adaptive technologies are the ones that businesses seek out. Zahra and Van de Velde (2007) reported that technologies that are radical in nature resulting from pure research primarily lead to inventor-led enterprises or university spinoffs. Thus, we reach Stage 4, the final stage of our multi-stage model. If all goes well, economic and social value is created through university spinoffs via financial returns to the inventor and university (if the university holds equity), job creation, and economic development.

Conclusion

Spinoffs are one of the rare yet significant engines of direct commercialization of university intellectual property. They are a valuable entity because of the various benefits they bring to universities and society at large; they are a source of local and national economic growth with the capability of providing significantly higher revenue to the universities than licensing (Bray and Lee 2000) as a result of equity partnerships between universities and spinoffs.

In this article, we first presented what university spinoff are by examining and synthesizing existing definitions. Second, we discussed why university spinoffs are needed in light of past scholarly work stating their economic and social benefits. Finally, we examined how university spinoffs are created by reviewing three existing models of university spinoff creation and then proposing a more comprehensive multistage model based on the gaps we identified in the existing models.

The focus of this study was to develop a wider understanding of university spinoffs for those who are interested in knowing about and researching academic entrepreneurship. The multistage model of university spinoffs proposed in this study can be used by scholars in the area of academic entrepreneurship to build case studies and do phenomenological studies. These studies can be undertaken in universities that promote spinoffs to identify variations in the capabilities, funding, and licensing of spinoffs. Statistical generalizations can be possible in future studies that take into account causal relationships between identified competencies, attempts to patent the invention or innovation, spinoffs created, and economic value generated in large-scale survey-based studies. However, care should be taken by researchers doing such studies because bi-causality can be an inherent characteristic of this kind of data, where more than one variable can influence or cause change in another variable.

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