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Paper Title: The Faculty Cooperative: An Innovative Approach to the Formation of Academic Entrepreneurial Ventures

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Abstract:

Objectives:

In this article we aim to introduce a novel entrepreneurial model, the "*Faculty Cooperative*" ecosystem, for creating and managing academic entrepreneurial ventures. The goal of this model is to promote academic entrepreneurship, by providing a guiding concept and tools that overcome the lack of alignment between individual academic attributes and faculty efforts in driving academic spin-out companies.

Prior Work:

Most of the discussion of academic entrepreneurship has focused on the hard end of entrepreneurial outputs rather than addressing the alignment of both soft and hard activities. The lack of an effective entrepreneurial model for developing academic entrepreneurship is regarded as one major barrier in universities (Philpott et al, 2011). This paper based, on prior studies, addresses this gap by introducing a different organisational form and approach that is likely to lead to successful academic entrepreneurship.

Approach:

Through an empirical inquiry based on an academic spin-out company in a UK university context, we have explored the key activities, actors, organisational processes and outcomes related to the formation and development stages of the academic entrepreneurship process. We attempt to gain insights in the organisational process of an embryonic company, *FortiTo*, and identify the key success factors associated with the university structure and environment.

Results:

The empirical evidence reveals that the key principles of the "*Faculty Cooperative Model*", such as openness, freedom and collective shareholding, are likely to promote the entrepreneurial culture within a university context. In addition, a new methodology for product innovation, Science Fiction Prototyping (SPF) is introduced and shown to play an important role in bridging teaching and research, in a way that is likely to improve product innovation outcomes.

Implications:

This study reveals that academic institutions may have competency deficiencies that could hinder the commercialisation of product innovation and the new venture creation process. Further, our study reveals that academic entrepreneurial models are likely to be more successful when they align with university traditional values and structures, as the "*Faculty Cooperative*" presented in this paper has sought to achieve.

Value:

It addresses the importance of developing entrepreneurial culture in conventional research focused universities, which not only improves the traditional values of teaching and research, but also enhances the dynamic capabilities of universities in a global marketplace. Entrepreneurship education can be significantly improved through the development of academic spin-out companies when the right structure and strategy are aligned to support the circle of 'learning and doing'. It is suggested that the entrepreneurial ideal is not contradictory to the conventional university missions, rather it is complementary.

Introduction

Entrepreneurship and enterprise skills are crucial to the future of the UK economy, especially as an agency to innovate and revive from the economic recession so as to continue the wealth creation process. Universities are seen as an increasing source of innovation and technology development that is beneficial to entrepreneurial activity (Shane, 2004; Powers and McDougall, 2005). It is difficult to gauge the existing level of educational entrepreneurial activities but a recent 'National Council for Graduate Entrepreneurship' study suggested that an average 28 student and graduate startups were created per university in 2009-10 (Corbyn 2012). Academic spin-off companies are regarded as an important means for transferring technology and knowledge from academia (Prodan and Drnovsek, 2010) but although there being some notable examples of localised pockets of support, such as Stanford's 'StartX', the wider picture appears somewhat bleak. This is echoed in the large body of literature written on academic start-ups, which describes the ever increasing demand for expanding technology transfer activities from universities to the market, but suggests that more research is needed to inform practice as to the most effective way to achieve this (Powers and McDougall, 2005). Indeed, our understanding of the innovation process is currently changing and more than ever, universities are moving to the centre of society's knowledge production system (Philpott et al, 2011; Godin and Gingras, 2000; Caloghirou et al, 2001). As O'Shea et al (2004) suggest that there is a need for more studies to systematically explain, from an organisational perspective, why some universities may be more successful than others in the commercialization of university technologies. However, the literature on academic entrepreneurship makes little reference to the alignment of individual attributes and faculty efforts in driving academic spin out companies.

In this research we aim to fill in this gap by shedding new light on a set of methods that collectively arm a would-be entrepreneur with a competitive arsenal of techniques that enable him to take a product through the entrepreneurship process. Particularly, we focus on the *academic entrepreneur* who despite being overloaded with academic qualifications, frequently fails to capitalize on their insights and inventions (Philpott et al, 2011). Since academic entrepreneurship is a continuous process comprised of a series of events (Friedman and Silberman, 2003; Wood, 2011), it is critical to understand what key factors are driving through such a multi-stage process. This paper, based on case study research, explores this process and proposes an entrepreneurial model that embraces key phases of academic venture from funding, through management to marketing mechanisms that we call the *Faculty Cooperative Model*.

Theoretical Foundation and Research Propositions

Academic entrepreneurship is an umbrella term, which refers to the efforts and activities that universities and their industrial partners undertake in the hope of commercialising the outcome of faculty research (O'Shea et al, 2004). The academic entrepreneurship process is often inhibited by a lack of business experience and commercial skills among academics (Vohora et al, 2004; Rasmussen et al, 2011). Consequently, the creation of spin-offs typically lacks consistent support at school level, despite the support of central administration. In this respect, universities may have competency deficiencies that could hinder the commercialisation of product innovation and new venture creation process (Clarysse et al, 2005). Typically, having created an idea, a person (or team) is faced with the challenge of developing a business model, in particular, finding funders,

sales people and customers. While universities may be well suited to producing high quality research outputs and qualified graduates, some literature has suggested that they are poor platforms for entrepreneurial aspirations as many academic disciplines may be unsuited to undertake hard entrepreneurial activities, such as spin-off company formation and commercialization of technology (Agrawal and Henderson, 2002; Povia and Rapini, 2010). Evidence from Cohen et al (2002)'s research indicates that the best way for universities to transfer their knowledge to industry is based upon the 'soft' channels, such as publications, conferences and consulting services. It has also shown that university graduates, with the skills necessary to launch companies, are likely to have a much greater economic impact than direct spin-off companies based on university IP. For example, MIT graduates have founded over 4000 companies, which account for \$232 billion in annual revenues worldwide (BankBoston, 1997). Cohen's research seems to suggest that a university should not promote the entrepreneurial culture at the cost of losing its traditional role and values. Despite the debate over academic entrepreneurship, the dominant view stresses that the growing shift to developing hard entrepreneurial activities in universities is unlikely to be reversed in the near future due to economic, legal and financial pressures and changes happening as a global phenomenon (see Philpott et al, 2011; Eitzkwitz et al, 2000 for the explanation of these pressures). It raises the concern of what needs to be done to develop the university's entrepreneurial capabilities while it will not compromise the core competency of teaching and research in the university context.

Yet if the entrepreneurial model is to be achieved within a university, as an inevitable trend, the question remains how the faculty can integrate and align the missions of teaching and research with hard entrepreneurial outputs such as spin-off company formation? Most of the discussion of academic entrepreneurship has focused on the hard end of entrepreneurial outputs rather than addressing the alignment of both soft and hard activities. Through a detailed case study investigation, we attempt to provide an insight on what can be achieved through a "*Faculty Cooperative*" organisational arrangement. First of all, in proposition (1), we argue that in this model, when producers (the spin-off academic company) and consumers (the University teachers and students) become stakeholders in a shared organisational form, it returns improved profits and better quality products as a consequence of the nature of the shared ownership. Secondly, in proposition (2), we also introduce a new way in which the business and product innovation process can be initiated and driven, *Science Fiction Prototyping* (SFP), which is likely to help new start-ups build a unique competitive advantage in the marketplace, when it is aligned with product strategy. Finally, in proposition (3), we suggest that the key values of the faculty cooperative model are likely to promote the entrepreneurial culture and hard entrepreneurial outputs within the university context as it also aligns with university traditional value and structure which, in return, provide academics and students who create spin-out company products, with experiences that improve their teaching or learning. We illustrate how these factors can come together to form a successful academic entrepreneurial venture by reference to a case study company, *FortiTo* inspired from Science Fiction Prototyping (SPF) and operated within a "*Faculty Cooperative*" mechanism.

Methodology

This research adopts an in-depth literature analysis in combination with an exploratory case study approach to explain how universities can develop its entrepreneurial culture and capabilities without compromising its traditional values (Yin, 2003). Our empirical investigation based on a case study research, reveals a novel approach to integrate entrepreneurial process in the university context. Furthermore, we stress a new method,

SFP derived from creative science study, to not only train students' creative skills but also to facilitate the product innovation in spin-out companies. The data was collected from multiple sources of information: (1) A number of professorial /intellectual informants as they are in both roles of academic participants and owners of the spin-out company featured in the case study, having significant experience operating within the university environment and interacting on the marketplace in the technology commercialisation process. (2) A one-year period of case study investigation to explore the spin-off company's development processes, from idea generation, patenting activity, start up formation and the generation of external funding to marketing and product development. (3) Information is also gathered from document and archives relating to university policies and industry linkages. (4) Students' experience and participation. The remainder of this paper presents the main findings of the case study analysis.

The Faculty Cooperative Model

Historical roots of the cooperative model

Collectives can be regarded as a variation of a much earlier scheme for self-help and cooperation, the Cooperative Movement in which people formed mutually supportive groupings to benefit their wider community. In more practical terms under socialism, collectives were an instrument to boost agricultural productivity and provide a much-needed measure of food security (Zheng, 2010; Chen, 1998, Zuo, 2001). As far as production was concerned, the advantages lay in the nature of ownership and control (Pierson, 1995). Under capitalism, the means of production and economic surplus are privately owned, while under socialism, the ownership and economic surplus were transferred to government, legally, in the name of the people. The distribution of this 'publicly-owned' surplus is subject to claims by all sectors of socialist society and is a deliberate political process (Davis, 1985). The collectively owned cooperatives were literally owned by the employees, in which the distribution of profit was subject to claims by the collective shareholders (Chen, 2008; Yano, 2004). The Cooperative Movement can be traced back to the UK in the 18th century when groups, such as the Scottish "Fenwick Weavers Society" (formed in 1769) or the "English Lockhurst Lane Industrial Co-operative Society" (formed in 1832) and now known as the "Heart of England Co-operative Society" became the forerunners of a worldwide movement that saw cooperative groups move from community stores to schools through to business cooperatives. One notable cooperative was the English "Rochdale Society of Equitable Pioneers" (founded in 1844), which established a set of principles that co-operatives still use. These principles include the need to have an open and voluntary membership, the need to avoid unfair discrimination between people, that members should have a sense of Altruism (note that this does not prevent members enjoying financial rewards) and that the enterprise should be funded by the members. (Zeuli and Cropp, 2004). There are numerous variations of these principles such as the "Emelianoff's three cooperative business principles" which seek to embody a principle whereby members may receive "outputs at-cost" (but to non-members at good profit levels), a "proportionality principle" which seeks to allocate benefits according to stakeholding and a "self-financing principle". Cooperatives remain popular options for organising work and, to emphasise that point, the United Nations has designated 2012 as the "International Year of Cooperatives" and have estimated that, globally, around 800 million people are members of cooperatives with almost 100 million people being employed by them (Diepenbeek van, 2007). The arrival of the Internet has also spawned some community based self-help support for start-ups, such as the UK 'Kickstarter' (www.kickstarter.com) which claims to have enabled almost 30,000 creative projects since starting in April 2009. Another somewhat interesting development is that the current financial downturn in the West is driving a revival in the popularity

of cooperatives, or their close relative, the mutual (a company or organisation owned by more than 51% of the employees). At a recent conference "*Business as a Mutual*" the UK *Minister for Civil Society*, Nick Hurd MP, remarked "*When money stops, thinking starts*" and the thinking of the conservative government is that they see significant attractions in turning government services (eg education, health, fire services etc) into mutual companies, owned by the employees having made this one of their big new policies (and passed some new laws to support this) (Hurd, 2012). Part of the attraction might be that some findings suggest Mutual's can save up to 30% over traditional government counterparts by eliminating bureaucracy and improving motivation and responsiveness of organizations. In his keynote talk Nick Hurd said that the current government thought the age of mutual models for business had arrived which is particularly motivating as that type of approach proposed in this paper. Of course, there are numerous potential hybridisations of the cooperative model, one of which we describe in this paper which we call the *Faculty-Cooperative* which we argue provides a powerful means to motivate and empower academics to have a hand in investing, directing and benefiting from the fruits of their intellect.

How does the Faculty Cooperative fit in the university context?

The *Faculty Cooperative* organisational arrangement seeks to lever some of the founding principles of universities, which were characterised by an ethos of sharing knowledge and providing mutual support. By pooling knowledge and effort, educators have historically gained a collective synergy, which has benefited educators and students alike. To date, such sharing of knowledge and resources has largely been an informal process via publishing papers and harnessing of personal relationships between academics. In that spirit the "*Faculty Cooperative is a venture that provides a means whereby academics (and students) can be both the owners and customers of the IPR they generate, thereby providing synergy to optimize the educational product for the market, provide an embedded sales team and offer a source of investment for academic enterprise*" (Callaghan, 2012). As explained earlier, it is based on the earlier principles of social cooperatives and collectives originating in the western world and China. The general idea is that academics who originate innovative product ideas can become entrepreneurs by creating businesses that offer stake-holding to the wider academic community in the form of investment, shareholding and work. In addition, for the case of educational technology, the academic investors are likely to be experts and users in the area concerned which means the product specifications are well matched to the usage needs and, the investing academics are well placed to act as marketing evangelists in support of the company sales. The *Faculty Cooperative* model promotes the self-reinforcing cycles that lead academic entrepreneurs to dedicate their expertise and knowledge to the exploration of emerging opportunities and, more specifically, it drives their commitment and degree of involvement in the projects and continual entrepreneurial activities. Clearly this is a complex entrepreneurial eco-system. Indeed, universities are a form of educational eco-system, which can be viewed as a form of state assigned academic collective, comprising a group of academics (labelled with a university name, eg Canterbury, Essex etc), a resource (buildings, degree conferment rights etc) with the responsibility to use them to the good of the country. While the traditional view of the University system may be seen as a collective, bounded by the physical limits of a particular university, in our view we see more *virtualised boundaries* in which the entire academic system is decomposed into groups or specialities (business studies, computer science); *virtualised academic collectives*. In this organisational form, academics in differing institutions can collaborate together to advance their entrepreneurial visions. In this sense, the Faculty Cooperative, is a *virtualised academic cooperative*.

Open Innovation and the Faculty Cooperative

As was described above, academics are, by and large, strong advocates for an open approach to innovation, based on well-established principles of openly publishing knowledge and actively seeking to collaborate with fellow researchers. In a recent European led example, “*Living Labs*”, Universities have extended such open research cooperation to local government and communities engendering cooperation to mutually improve the technology that impacts all our environments (Pierson 95) (Wu, 2012). The concept of ‘*open innovation*’ gives a strategic emphasis on developing and intensifying collaboration across industry networks and partnerships, opening up their innovation processes in line with the open innovation framework (Chesbrough, 2006). One important assumption underpinning the concept of ‘*open innovation*’ is that an organisation cannot innovate in isolation (Chesbrough, 2003; Laursen 2006). Under a turbulent business environment and hyper-competitive market condition, innovation is considered as a major engine to enhance business performance and to strengthen an organisation’s competitiveness in the marketplace (Lechner, 2003) (Lee, 2001) (Lavie, 2006; Wu, 2008). In our *Faculty-Cooperative* model we are seeking to build on this principle by devising a model whereby the company structure and investment follows such an open co-creative framework by seeking to make the IPR, shareholding (investment) and strategy to be owned by the academic community in as transparent a way as is possible. Later in this paper we further explain this model from various perspectives, principally the faculty members, the students and the company personnel.

Innovation Tools and Creative Science

Innovation can sometimes be an elusive quality, being dependent not just on a good skills or knowledge but on the potential for an inventor to *imagine* a new kind of service or product that does not currently exist. Much has been written about innovation, charting examples that range from spontaneous inspiration through brainstorming to more formal approaches such as evidence-based design (ethnographic research) (Kelly and Littman, 2001). In their book “*The Art of Innovation*” Kelly and Littman suggest “*prototyping is the shorthand of innovation*”. Prototyping can take a number of forms ranging from paper descriptions through to software or hardware emulations. In all of these, potential users are invited to exercise the prototypes in order to gauge the usefulness, usability, shortcomings or benefits of the ideas. SFP is a form of paper prototyping, based on story telling. It deals with products and contexts that are set in the future and usually well ahead of a company’s implementation capabilities. The concept was devised by Intel’s futurologist, Brian Johnson, in response to the problems faced by Intel whereby they needed to specify the functionality of integrated circuits some 7-10 years ahead of their implementation (and sometimes with a life of another 15 years) which is a particular problem given that the product lifecycle of the platforms they are targeting (eg mobile phones, computers) may only be 18-36 months, meaning Intel have to think 3, or more, generations of market product ahead, which is a significant challenge (Johnson, 2010)! Added to that, their principal resource, engineers, are trained to be methodological and structured thinkers rather than imagination driven designers. To address this challenge, a *Creative Science* methodology, based around science-fiction prototyping (SFP), was developed. The authors have been instrumental in taking this from inside Intel to the wider public via a series of workshops. The core methodology is the creation of scenarios in the form of science-fiction stories that allow business professionals, scientists and engineers (or other groups) to invent new technologies or business mechanisms that can be situated in a wider social context for the explicit purpose of acting as prototypes for

people to explore a variety of futures in order to influence the development of new products or business practices. It is also possible for other sections of the community such as creative writers, film/stage directors, school children and members of the public to contribute to the pool of ideas that, in turn, form the seeds of entrepreneurship. In this way science-fiction prototyping acts as a way of involving the widest section of the population in driving the product innovation and entrepreneurship agenda (a co-creative form of entrepreneurship). Intel have been keen to make this methodology more widely available and have seed-funded an organization started by the authors, the *Creative Science Foundation* (CSf), a charitable organization, that has the goal of helping to support and promote the application of creative efforts in business, scientific and technological innovations (see www.creative-science.org). While it is possible to use a variety of product innovation methods as part of entrepreneurial activities, we have focused on this particular method (SciFi Prototyping and Creative Science) as firstly the authors are intimately involved in its development and secondly, the exemplar presented later in this paper owes its origin to this methodology.

Principles of the Faculty-Cooperative

In this section we present the underlying principles of the *Faculty-Cooperative*. It is important to understand that whilst a collective ethos underpins this model, it recognises that any new enterprise is competing in a free-market and that the company should operate in the normal way for a commercial company.

Openness	Support for open innovation (collaboration across academic, industry and customer networks and partnerships)
	Support for open implementation standards (eg interfaces)
	Support for open source design standards (eg product specifications)
	Support for open sharing of related work (eg assignments)
Freedom	To use the product for in education without restrictions
	To study and modify the products (eg student project work)
	To profit from the contributors IPR and work (eg faculty or student remuneration)
Collective Stakeholding	A mechanism whereby academics across a number of differing Universities are able to share in the operation of the company.
	A mechanism whereby academics across a number of differing Universities are able to be shareholders (to invest and share in profits)
	A mechanism whereby academics across a number of differing Universities are able to influence the educational product specification
	A mechanism whereby academics across a number of differing Universities involved in the enterprise can receive benefits (eg discounts or direct profit share)

Table 1 – Principles of a *Faculty-Cooperative* company

In setting out the principles of how the *Faculty Cooperative* functions we have drawn extensively on the principles underpinning cooperatives, collectives and other more modern mutual enterprises. From these we

have selected the following mix that we feel are appropriate to an academic or faculty cooperative. It is also useful to understand that we are still in the early stages of developing the *Faculty-Cooperative* model, and like any complex eco-system it is evolving continuously, as its fundamentally driven by its membership and the dynamics of the world it operates in. *Thus table 1 represents our starting position on the evolutionary path of the Faculty Cooperative.* In part, this is an emergent model, in that the direction is shaped by the spontaneous behaviour of its members and as such, there is no deterministic method of predicting where it will go, rather a set of principles, presented in table 1, that will guide it on its journey. Being a dynamic and evolving system one of the key attributes of the model is its interaction with the wider academic community; thus our principal tool is an associated website (www.FacultyCooperative.org).

A Stakeholders View of the Faculty Cooperative Model

Based on the empirical data, the following shows the advantages of the *Faculty Cooperative* model from the viewpoint of the various stakeholders, ranging from students to faculty. It is important to note that students are seen as important stakeholders in the *Faculty Cooperative* entrepreneurial eco-system, despite the name suggesting otherwise. In this model, the different perspectives are as follows:

- For a non-entrepreneurial members of University staff, the *Faculty-Cooperative* represents an opportunity for them to become stakeholders in the “tools of their trade”. This stake-holding takes the form of being able to contribute to the specification and nature of an educational product and to share in a financial reward from the combined intellect of the academic system that they have committed their life to.
- For an entrepreneurial member of University staff the *Faculty-Cooperative* provides all the advantages of the non-entrepreneurial member, described in the previous section but provides the academic entrepreneur with a source of finance by offering a large number of low cost shares to the academic community, thereby raising the required capital to fund the company, without seeding control to another single and dominant investor. Furthermore, it offers a pool of tangible and intangible resources to incubate any new ideas in an embryonic state for entrepreneurs aiming to start a new venture with/in the university.
- For a regular student, attending a university, they would be essentially unaware of this organisation but indirectly benefit from better-designed educational tools that arise from within the academic community.
- For an entrepreneurial student, the *Faculty-Cooperative* represents an opportunity for them to apply their newly acquired knowledge, exercise their product innovation and entrepreneurial skills, enrich their CV. Apart from that, there is the added bonus of earning some welcome income.
- From a customers' prospective (Universities, faculty members, students, public etc) they receive a better quality product, designed and tested by the leading educational experts. In the same way as there is some enthusiasm for green products that benefit the earths eco-system (the environment debate) then customers (the Universities) can feel good about supporting and improving their own *educational eco-system* via the mutually owned *Faculty-Cooperative*.
- For company personnel, the *Faculty-Cooperative* provides a “feel good factor” of being associated with both a worthy cause (the education business, that transforms lives positively) and a secure

profitable business (education generates more revenue than the music business) all of which contribute to job satisfaction.

A Case Illustration: Bringing it Together

To illustrate how these ideas could come together we describe the case of a new company that has spun out from staff and students connected to the Universities of Essex, Canterbury Christ Church and the Instituto Tecnológico de León called *FortiTo Ltd* (www.FortiTo.com), or 42 for short. This company produces innovative educational technology to support the teaching of the *Internet-of-Things (IoT)*. The IoT refers to a vision of the world in which, everything in a person's life from bathroom scales through cookers, to cars might have an Internet connection, the behaviour of which can be orchestrated by people or their agents. There are no reliable estimates for the size of this market but one estimate is that by 2020 the IoT market could be worth between 22 billion and 50 billion dollars made up of some 16 billion connected devices (Vermesan & Friess 2011). Most commentators believe this to be a conservative estimate.



Figure 1. FortiTo Modules - From Left to Right Audio, Midi, Keypad, Base (Processor), LED & Network

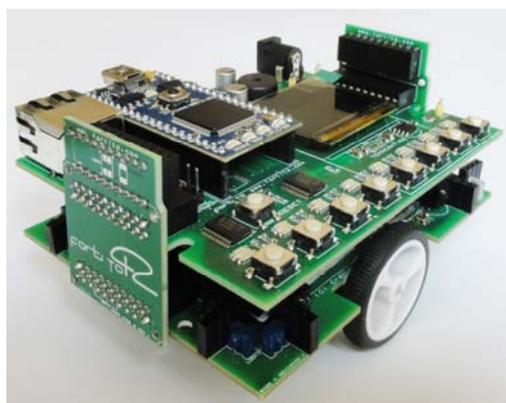


Figure 2. FortiTo Modules -A Desktop Robot Assembled from FortiTo Modules

Clearly, with such massive market potential, the IoT is an important topic to teach to future entrepreneurs and businesses. FortiTo has taken its inspiration from the power of prototyping with imaginative thinking that the Creative Science approach unlocks, which arose from the authors involvement with Creative Science and the need to produce a practical toolkit to support the more abstract innovation process of SciFi-Processing. In this respect, FortiTo was inspired by the need to provide the next phase, beyond paper-based Science Fiction Prototyping, to enable real product prototyping related to the Internet-of-Things. In particular it provides a modularised system in which components can be assembled in various combinations to produce an almost

endless variety of products (see figure 1). The particular approach taken by FortiTo is that the “plugging together”, not just effects electrical connections (as in other products) but also the product’s physical structure; thus, for example they can be plugged together to produce a desktop robot (see figure 2). Discussions with the founders of FortiTo reveal that it embodies the “*Faculty Cooperative*” principles in numerous ways. For example, considering ‘*Openness*’; FortiTo is adopting many industry standards such as mbed and RPi processors, I²C bus technology and C/C++ programming. Considering ‘*Freedom*’; the company makes use of freeware software tools (eg gnu), has opened its interface specifications and computing architecture, so that students and faculty have the important details available for educational assignments and projects. In respect of the ‘*Collective Stake-holding*’; the company, while in an embryonic stage, is currently made up of staff and students associated with the three root universities and is actively seeking to expand membership, gather funding, create product specifications, conduct evaluations and market products in cooperation with as wide a slice of the international educational community as is possible.

Resource Type	Investment	Benefits
Financial Investment	Money	Profit share
Hard Service	Time/Skills building structures (infrastructure or products etc)	Profit share
Soft Service	Time/skill providing services (management, sales etc)	Profit share

Table 2a – FortiTo Shareholding

Stakeholder Type	Role	Benefits
Employee	A person employed by cooperative	Salary product discounts
Member	Person holding a paid or unpaid role in the cooperative	Discount on products
Customer	Person owning cooperative products	Help specify products & services

Table 2b – FortiTo Stakeholding

Table 2a and 2b summarise the current cooperative membership structure for the company. From these it can be seen that members of the educational community are offered a stake-holding in the form of what is termed ‘*resource units*’ (either work packages or financial investment) in return for a shareholding of FortiTo. Beyond shareholding, the company is committed to providing benefits in the form of product discounts and profit share to its members. By virtue of this arrangement the company benefits from investment and a large sales force from its cooperative members) plus the increased levels of motivation and commitment discussed earlier. Also, and rather uniquely, a university based brings an international dimension through overseas students and staff) and FortiTo has already benefitted from this as their manufacturing and sales are already being established in other continents.

In addition to driving commercial spin-offs, the science-fiction prototyping methodology can also benefit universities by motivating and inspiring novel lines of research. For example, in the science-fiction prototype “*Tales from a Pod*” (Callaghan 2010) the scenario describes the concept of immersive learning educational pods (ePods), in which students experience personalised learning from a futuristic “mega university”. This motivated a joint research project between a variety of partners including Essex University (UK), Canterbury Christ Church University, Immersive Displays and British Telecom into exploring the possibility of bringing part of this vision to reality by creating a version of the ePod that takes the form of a desk; the iDesk (Peña-Ríos 2012); see figure 3.

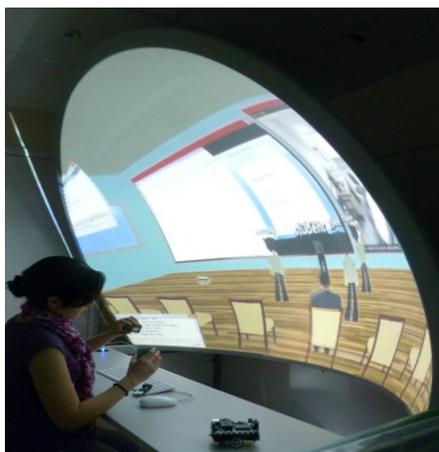


Figure 3 – The eDesk (note the virtual classroom and the FortiTo robot on the desk)

A central feature of this iDesk is an *InterReality Portal*, which is a 3D virtual environment within a semi-spherical sectioned screen that gives the student an illusion of being in a remote location (see figure 3b). More formally, it allows users to complete activities at any point of Milgram's Virtuality Continuum (Milgram and Kishino, 1994). The idea is to create a physical manifestation of an "open innovation" system in which geographically dispersed students, using these desks, can come virtually together to build innovative '*Internet-of-Things*' products based on a mix of real and virtual components (e.g. where components can be created and moved between any of the connected virtual and real worlds – i.e. between iDesks). The iDesk supports both students and teachers using a variety of agents to mediate both the users and learning content (Zhang, 2011; Peña-Ríos 2012). The iDesk is, of course, another candidate, albeit at a much earlier stage, for a spin-off based on Faculty Cooperative principles. The above are just two examples we used for this particular case study and, as the model matures and achieves wider usage, we would wish to enlarge and diversify the study of the usage of the *Faculty Cooperative* entrepreneurial eco-system.

Conclusion and implications:

This research, based on an exploratory case study of a successful academic spin out company, has shown that an appropriate organisational structure is needed to provide the conditions in which individual academic actors and faculty efforts can be aligned to achieve their separate objectives. Many academic entrepreneurship studies have advanced our understanding of knowledge transfer and innovation commercialisation activities, but have done so primarily by emphasizing the independent factors that affect performance outcomes in the creation of spin-off companies or the formation of technology licensing agreements (Agrawal, 2006; Agrawal and Henderson, 2002; Pova and Rapini, 2010). Our study departs from this perspective to consider an integrated approach to address the alignment between individual actors and the faculty structure and processes. As such, this paper provides a conceptual model (an entrepreneurial eco-system) and an associated set of propositions that integrates the operational and instrumental factors to reveal an effective approach for academic entrepreneurship at both university and individual levels. An important implication of this case study research is that under the "*Faculty Cooperative*" arrangement, where

producers (the spin-off academic company) and consumers (the University teachers and students) become stakeholders in a shared organisation, there is potential for improved profits and better quality products. Secondly, another novel discovery is that *Science Fiction Prototyping* (SFP) can be used as a new means to initiate and drive the business enterprise and innovation process, which positively facilitates the alignment of entrepreneurial hard outputs and soft ends. We, therefore, argue that the key values of the "*Faculty Cooperative*" model lies in its ability to promote an entrepreneurial culture and outputs within the university context while, at the same time, enhancing university traditional values in the learning circle.

Limitations:

While this study provides some new insights into the entrepreneurial process in universities, it is not without its limitations. It is based on the experience of a single spin-off company and a limited number of university environments that, in a wider context, the findings may not be fully generalisable to. However, we do not attempt to generalize the findings, rather we aim to explore what underpins the creation and formation processes of academic entrepreneurship and provide an explanation of what can be achieved and how different factors interact to influence the outcome, through the experience of a successful academic business venture. This can only be achieved through undertaking a more detailed case study research project. Thus, further research to test the model in different university contexts or with a larger sample size, would meaningfully inform continuous development of the effective model of academic entrepreneurship and the *Faculty Cooperative* entrepreneurial eco-system approach.

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