MEASURING THE IMPACT OF A UNIVERSITY INCUBATOR PROGRAMME ON ENTREPRENEURSHIP: THE CASE OF EPIS

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ABSTRACT

University business incubators are market oriented initiatives expected to facilitate knowledge flows from a university to the incubator firm and support new venture development. This paper examines the phenomenon of the 'university pre incubator' expected to facilitate knowledge flows between a university and a select group of new venture entrepreneurs and to contribute towards regional entrepreneurial capacity building. Drawing on a study of the Edinburgh Pre Incubator Scheme (EPIS) over its six years of operations (2004-2009), we pursue three lines of inquiry: first, we attempt to establish a pre incubator model as represented by EPIS, building the model in the context of existing incubator model classifications; second, we assess the impact of EPIS on entrepreneurs and on regional entrepreneurial capacity building; and third, we consider EPIS performance and 'value for money,' drawing on measure that includes: total funds obtained by EPIS entrepreneurs, total private investment obtained, developed R&D capacity, total IP generated and level of failure or graduation from EPIS. We find that EPIS does not fit within existing incubator model classifications. EPIS selection criteria and support and mentoring activities are closely aligned with a regional entrepreneurial capacity building rationale that is more characteristic of regional knowledge network models. Findings suggest that EPIS demonstrates good value for money, based on performance data and benefits attributed to EPIS by participants of the scheme. We identify evidence of impact on regional entrepreneurial capacity building but suggest a need for further longitudinal study. We gratefully acknowledge Frontline Consultants (2009) in allowing data access for this paper.

INTRODUCTION

The commercial application of university research is identified as a central theme for universities world-wide as policy makers and funding bodies increasingly demand more commercial application and economic impact from academic research (e.g. Howells *et al* 1998; Shane & Stuart, 2002; Markman et al, 2004; Locket and Wright, 2005). It is suggested that a new paradigm has emerged of the 'entrepreneurial university' that encompasses a more direct involvement in the commercialisation of research activities (Smilor *et al.* 1993; Gibb, 2005).

Most universities in developed countries have dedicated activities to support the commercialisation of their research through the set-up of technology transfer offices (Gulbrandsen 1997). Although returns are expected from a variety of technology transfer strategies, such as licensing intellectual property (IP), consulting and science park rents, starting new ventures and stimulating academic entrepreneurship are seen by university administrators and policymakers in the UK and other western countries as having high economic value (Lalkaka and Abetti, 1998; Deakins *et al*, 1998; Gregory and Martin, 1998; Oakey and Rothwell, 1986). Exploitation of IP through the creation of a spin-out venture, it is argued, can provide higher returns but also requires a longer time horizon to realise.

University business incubators (UBI) have become a more common feature of the institutional technology transfer infrastructure of universities. The key objective of many UBIs is to facilitate knowledge flows from a university to the incubator firm and support spin-out development (Rothaermel and Thursby, 2005a; Clarysse et al, 2005; McAdam, 2006).

An interesting version of UBI is the Edinburgh Pre Incubator Scheme (EPIS) set up by the University of Edinburgh and Scottish Enterprise (SE), Scotland's economic development agency and based on the TOP-Spin Incubator at the University of Twente (Netherlands). EPIS is described as a 'pre incubator'

model since it focuses support more on the entrepreneur than on the incubator company and is expected to progress EPIS graduates after 12 months into one of a number of 'traditional' UBIs associated with the University of Edinburgh (Scottish Enterprise 2002; 2008). EPIS is aimed at entrepreneurs intending to start a knowledge-led business in the region of Edinburgh and Lothians. Although entrepreneurs must be university graduates, they are not required to be graduates of the University of Edinburgh (Scientific Generics, 2006). EPIS is expected to contribute to increasing the region's 'entrepreneurial capacity'. We define regional entrepreneurial capacity as the knowledge and resources not yet deployable by entrepreneurs in a region and that must be acquired at cost and/or through some level of apprenticeship (Freidman 1976; Otani, 1996; Shane, 2001).

We find no studies referring to university pre incubators and wish to establish whether or not a definitive 'university pre incubator' model can be generated in our assessment of EPIS. We also know little about the value provided through EPIS for entrepreneurs, its level of technology transfer, the level of impact on entrepreneurial capacity or the value for money of EPIS as its original 7-year mandate comes to an end (2004-10). We draw upon data from an internal assessment of EPIS by Frontline Consultants in 2009 for our study.

The paper has the following outline. Section 2 reviews literature on technology transfer and discusses the concept of market intervention. We consider evidence of market failure in the Scottish context. Section 3 considers types of market intervention and discusses regional networks, business incubators, university business incubators and EPIS. Particular challenges to research on incubators are also discussed. Section 4 describes the methodology applied and Section 5 presents the empirical results. Section 6 concludes this paper with a discussion of results, limitations as well as implications for future research and public policy.

TECHNOLOGY TRANSFER AND MARKET INTERVENTION

Over the past two decades, there has been a growing trend towards integrated efforts involving government, universities and industry in supporting technology transfer and commercialising scientific research (Giget 1997; Howells *et al* 1998). According to the Association of University Technology Transfer Managers (AUTM), technology transfer is defined as 'a formal transferring of new discoveries and innovations resulting from scientific research conducted at universities to the commercial sector'. It is widely accepted that most university research is not immediately applicable in an industrial context (Howells *et al* 1998) and Malecki (1997) cautions that the presence of a local university is not enough to offset shortcomings in entrepreneurial climate. Acknowledgement of the need for greater interaction among producers, distributors and appliers of knowledge have resulted in formulation of policies and programmes that attempt to enhance technology transfer and commercialisation more widely (Edqvist 1997).

An extensive literature suggests that successful technology transfer and commercial success is a function of the support that entrepreneurs can draw from the larger community as well as industry conditions (Van de Ven 1993; Ruttan and Hayami 1984; Vaughn 1983; Pfeffer and Salancik 1977). Literature describes the '*triple helix model*' that involves university-industry-government interaction toward research activities and exploitation (Etzkovitz and Leydesdorff 1997, 1999). A key premise of the 'triple helix model' is the interaction of support activities internally from within the university and externally from the regional support system. The interactions between universities, industry and government are seen as providing a mutual interdependence and a foundation for a 'regional advantage' often seen in the commonly cited successful high technology regions of Silicon Valley, Cambridge, MA, and Cambridge, UK (Porter 1990, 1998; Saxenian 1994).

Market failure is commonly identified as a justification for the creation of regional support programmes that attempt to emulate the success of noted high technology regions (Saxenian, 1994; Shane, 2001). Market failure refers to a situation where the market has not and cannot of itself be expected to deliver an effective outcome (HM Treasury, 2003). Factors that contribute to market failure are identified at both the firm level and at the regional level. At the firm level, support is justified by complexities facing firms in non-efficient local markets, where factors such as weak commercialisation support, distance to market, short product life cycles and absence of investment opportunities present significant barriers to firm survival and growth (Segal et al 1990).

At the regional level, support is justified on the grounds that the individual firm is too weak an instrument around which to build change (Lalkaka and Abetti 1998). The concept of the

'entrepreneurial infrastructure' (Vaughn 1983; Porter 1990) emphasises the convergence of different roles and activities that contribute to the creation, development and growth of enterprises. Literature on the resource-based view of the firm (e.g. Teece, 1996; Nelson 1993; Penrose 1959) suggests that survival, growth and competitiveness are optimised when firms are able to identify and utilise local knowledge-based resources that include competencies, skills, routines and capabilities.

In the case of Scotland, market failure is identified with a combination of factors that include: a low level of private sector R&D activity but strong public science base, a low level of large technology-based firms and absence of venture capital (BERR, 2008; Scottish Enterprise, 2008). Evidence of need for intervention is further identified in recent SE-commissioned research suggesting that access to early-stage and follow-on finance is the main barrier to business start-up, development and growth in Scotland (Frontline Consultants, 2009). Other studies on the Scottish economy have found a lack of venture capital and inadequate mechanisms for investing in small firms, a shortage of small firm management expertise in strategic high-technology sectors, a lack of interaction and common purpose between academia and industry, and a weak 'entrepreneurial culture' (Collinson, 2000; Danson, 1996; Reid, 1997; Scottish Enterprise, 2007). Over the past few years, SE, as the government agency charged with promoting Scottish industry, has begun focusing a number of programmes with outside agents playing more of a facilitating role. All SE interventions are required to be founded on a clear market failure rationale (Scottish Enterprise 2008).

TYPES OF INTERVENTION

Support Networks

Entrepreneurial networks are identified as a popular strategic intervention for policy-makers aspiring to emulate successful 'entrepreneurial regions' such as California's Silicon Valley, Route 128 around Boston, MA. and Cambridge, UK (Rosenberg 2002; Cooper and Folta 2000; Shahidi 1998; Saxenian 1990, 1994). A body of research has shown that entrepreneurs gain access to resources, knowledge and information through networks to start-up, develop and grow enterprises (Starr and Macmillan 1990; Dubini and Aldrich 1991; Larson and Starr 1993; Hansen 1995; Johannisson 1996; Hoang and Antoncic, 2003). The importance of social capital for entrepreneurs in building new ventures is also well supported in the literature. Starr and MacMillan (1990) suggest that entrepreneurs need to mobilise 'social resources' because of liabilities that include size, lack of market legitimacy and newness.

Collinson and Gregson (2003) in their international comparison of knowledge network based programmes for new technology-based firms, conclude that a common objective of such programmes is actively engaging external experts, that include company directors, independent consultants, other entrepreneurs and academic experts, to further support the entrepreneur in developing the firm. They propose a three-stage model representing how regional support networks 'naturally select' and support entrepreneurial ventures.

At Stage 1, entrepreneurs with business ideas become regionally connected through various support mechanisms whose mission is to improve the level of network interactions likely to lead to the formation of new businesses. In Stage 2, filtering criteria are applied by other supportive agents to select 'potential winners' - high-potential ventures who are eligible for hands-on development, mentoring and access to resources to develop the new business. At Stage 3, high potential ventures engage in business development and a further process of filtering occurs as market factors will increasingly play their role in the natural selection process. The regional availability of certain kinds of experience and expertise, the breadth, depth and 'quality' of this second network, combined with the effectiveness of the mechanisms used to coordinate and co-opt its members for both 'informed' selection and value-added mentoring jointly determine the success of the overall process.

Business Incubators

Business incubators are identified amongst a number of market interventions such as science parks and cluster policy that are expected to contribute favourably to regional economic development ((Colombo and Delmastro, 2002; Grimaldi and Grandi, 2003; Bøllingtoft and Ulhøi, 2005; Chen, 2008).

Shahidi (1998) defines a business incubator as an organisation - public, private, public-private or university based - whose purpose is to support the development and growth of new enterprises through the provision of a variety of services. The UK Business Incubator (UKBI; www.ukbi.co.uk) definition of business incubation describes a dynamic business development process that includes one of the

following functions: 1) encourages faster growth and greater survival rates of new companies; 2) helps identify investment opportunities; 3) facilitates commercialisation of university research; and 4) helps to create jobs and wealth and tackle economic development problems. Most business incubators provide management support services to varying degrees to assist entrepreneurs in developing their ventures (Smilor, 1987; Sherman 1999). Another common objective of many business incubators is to reduce the costs of doing business for entrepreneurs by offering a set of services ranging from the provision of space, infrastructures and facilities, to more advanced services such as providing access to specialised facilities and knowledge (Grimaldi and Grandi, 2005).

More recently, the role of the incubator in network development has highlighted the incubator as a network node point for developing relationships with the wider supportive infrastructure (Hansen et al, 2000; Bollingtoft and Ulhoi, 2005). A recent study examining critical success factors in incubation support in Scotland emphasised a number of non-physical elements that include: appropriate and experienced business mentors, strong linkages with other commercialisation support initiatives in the national innovation system and close links with the investment community (SWQ Consulting, 2009).

University Business Incubators

University business incubators (UBI) can be distinguished from business incubators by an explicit technology transfer rationale that supports the flow and exchange of knowledge from a university to the incubator firm (Rothaermel and Thursby, 2005a). Some UBIs have a regional development mandate that involves engagement with public and private sector partners (Linder, 2003; Tornatzky et al, 2002). The importance of such deliberately-constructed mechanisms - driven primarily by public-sector agencies - lies in their potential for: 1) facilitating technology transfer; 2) accelerating the 'learning process' for emerging ventures, and thereby accelerating the emergence of fast-growing enterprises in new business areas, and 3) promoting 'innovative milieu' and regional benefits for a high-density of fast-growing enterprises.

Mian (1996) identifies two main categories of services offered by UBIs: 1) traditional incubators services such as shared office services, business assistance, access to capital, rent breaks and business networks; and 2) university-related services, such as faculty consultants, specialised facilities, technology transfer programmes and related R&D activity. Clarysse et al (2005) suggest three distinct incubation models offered by universities in managing spin-out activity. The Low Selective Model has a mission toward maximising the number of entrepreneurial ventures, often in line with a mission by the university to stimulate an academic entrepreneurship culture and offer self-employment opportunities, particularly to junior faculty or postdoctoral fellows. The Supportive Model is oriented towards generated spin-outs as an alternative to licensing out university IP, with a focus on those spin-outs with high potential for profit and growth. The Incubator Model makes a trade-off between the uses of research to generate contract research versus spinning off this research in a separate company.

Clarysse et al (2005) suggest that the TOP-Spin Programme at the University of Twente is an example of the Low Selective Model. TOP (Tijdelijke Ondememers Plaatseen) Programme was created with funds from the European Regional Development Fund (ERDF) and refers to the entrepreneurial mission of its parent university as the primary driver of spin-out activity (Karnebeck 2001). Many TOP companies have been started by end-of-contract researchers and students who have recently graduated; thus spin-outs represent an employment option and contribution to employment within the region.

EPIS Pre Incubator

EPIS was launched in January 2004 as a joint initiative between the University of Edinburgh, Scottish Enterprise Edinburgh and Lothian (SEEL) and the European Regional Development Fund (ERDF). EPIS is delivered through the University technology transfer office, Edinburgh Research and Innovation (ERI). The following features of EPIS are identified in the publicly available information on the scheme (Scottish Enterprise, 2002, 2008):

- The EPIS package includes incubator accommodation, an interest-free loan of £10,000 and access to University of Edinburgh resources, including mentoring from academic and commercial advisers. EPIS is limited to 12 places per year;
- EPIS Business Mentors should ideally have had at least one full board position, preferably on a small to medium-sized company (SME) and be experienced in developing young companies. Mentors are expected to dedicate up to one half-day per month over the 12-month placement. Mentoring provides first hand guidance, introductions to appropriate Mentor contacts and support, but is not designed for the provision of detailed business or professional advice;

- EPIS Academic Hosts provides the EPIS Entrepreneur with physical space for up to 12 months and up to half a day per month in support. Academic Hosts are expected to offer in-depth knowledge of the research area relevant to the Entrepreneur's business. Upon matching, the Entrepreneur and Academic Host agree to a final project, with a formal letter of support then completed by the Academic Host and final approval from the EPIS Selection Committee.

EPIS is identified as a unique initiative, the first in Scotland, which seeks to break down barriers between academia and business to encourage new entrepreneurs to develop knowledge-led business ideas on the university campus (Scottish Enterprise 2002; 2008).

Review of Incubator Research

Literature suggests a lack of systematic analysis or empirical evidence regarding the effects of incubators in facilitating technology transfer or the impact on entrepreneurs participating in incubators (Mian, 1997; Rothaermel and Thursby, 2005(a)(b); Clarysse et al, 2005). Literature appears inconclusive when assessing the impact of incubators on new venture performance. Allan and Bazan (1990) found no significant differences between incubated and non-incubated firms in terms of sales and income growth rates.

Significant methodological challenges are identified in establishing an appropriate performance metric to measure how knowledge flows that are generated within the incubator affect the performance of new technology ventures (Phan et al, 2004; Rothaermel and Thursby, 2005b). Literature suggests that revenue is an inappropriate measure for assessing technology biased incubator firm performance, given the early nature of most firms and a tendency for these firms to focus on technology rather than commercial development (Rothaermel and Thursby, 2005b). A number of studies have focused on critical success factors in managing incubators that relate more to the success in achieving pre-established targets for support provision than in measuring effects on participants (Smilor, 1987; Collinson and Gregson, 2003).

Incubators have been described as 'black boxes' where the inputs and outputs are measured with limited attempts to understand how the black box operates (Hackett and Dilts, 2004). While input-output measures can be important in providing some assessment of programme effectiveness, they are often quantitatively biased, generic and prescriptive in assuming universal application of a prescribed set of support services to a homogeneous recipient (Molina and Gregson, 2002). Autio and Laamanen (1995) suggest that process indicators are necessary to complement traditional input-output indicators of technology transfer.

We identify a number of methodological challenges to the study of intervention support programmes that have implications for research on incubators. Challenges for evaluating intervention programmes in general include attribution of cause with effect, lack of available primary data and poor monitoring of results, assessing programme 'success', costs-benefits and value for money and accommodation of program changes (Patton 1990; Gregory and Martin 1996; Lalkaka and Abetti 1998). Another challenge is need for a longer evaluation time frame to identify tangible effects on companies (Segal *et al* 1990; North and Smallbone 1996).

Attribution of support effects to new enterprises is made difficult by multiple factors explaining enterprise development - that include random factors and those uncontrolled by the enterprise (e.g. chance, timing, macro-economic change, sectoral conditions) as well as various systematic factors, such as capital investment, entrepreneurial skills and motivations and location (e.g Birley and Westhead, 1990; Storey 1994). Another identified research challenge is the context of entrepreneurial learning and knowledge accumulation as a collective for the entrepreneur and the enterprise that are not easily traced as deriving exclusively from any specific intervention (Sanberg and Logan, 1998).

Much evaluation research has arisen from a rather narrowly based concern to ensure that public programme represent 'good' value for money. Many evaluations are concerned fundamentally with assessing the success or failure of programmes (Rossi *et al* 1979), but few are able to provide definitive evidence regarding 'success', often because of the complexity of methodological issues that confront researchers (Gregory and Martin, 1998). The measurement of impacts present particular problems because of the way in which evaluators adopt various definitions of what constitutes success, i.e., job creation, firm growth or firm survival rates.

METHODOLOGY

A three-stage methodology is employed. First, a qualitative approach is used to build a pre incubator model as represented by EPIS, drawing upon social process evaluation guidelines (e.g. Patton 1987; Silverman 1993; Gregory and Martin 1996). We examine EPIS in the context of relevant model comparators, that include university incubator classifications, the 'TOP-Spin' incubator model at the University of Twente (Netherlands) - the 'parent' of EPIS - and regional support models. We consider the 'evolutionary dynamic' of the EPIS model, whereby different market failure conditions influence the model's development and distinctiveness (Clarysse et al, 2005).

Second, we examine data from a survey of EPIS participants undertaken by Frontline Consultants (2009) on behalf of Scottish Enterprise. They survey was sent to 53 EPIS entrepreneurs who participated in the scheme during the period 2004-2009, resulting in 38 responses. Respondents provided data that included: level of total funding and private investment received; intellectual property (IP) generated; annual turn-over (and 5-year projections). Respondents also rated the impact of EPIS on various elements of the business (e.g. skills, sales, productivity, IP, valuation).

Third, we employ a deductive approach in assessing the overall performance of EPIS (2004-09). We first establish EPIS progress to achieving original targets, which establishes a simple base-line measure of actual vs. expected output. We then generate five outcome measures relevant to incubator research, as suggested by Rothaermel and Thursby (2005a), which offers broad empirical data from which to consider EPIS performance, impact and 'value for money.' These measures include: total funds obtained by companies, total private investment obtained (angel or VC), developed R&D capacity, total IP generated and level of failure or graduation of EPIS companies. We consider previous process indicators of the EPIS model (e.g. Autio and Laamanen, 1995) along with outcome measures in interpreting EPIS performance, impact and value for money. We also consolidate study findings to consider the impact of EPIS in building regional entrepreneurial capacity, given its original mandate. We define regional entrepreneurial capacity as the knowledge and resources not yet deployable by entrepreneurs in a region that must be acquired at cost and/or through some level of apprenticeship (Freidman 1976; Otani, 1996; Shane, 2001).

FINDINGS

EPIS Pre Incubator Model

We begin our analysis of the EPIS model with reference to an initial evaluation of EPIS for Scottish Enterprise (Scientific Generics 2006) which highlighted differences between EPIS and the original (i.e. parent) TOP-Spin incubator model that include: a more rigorous selection process by EPIS favouring high growth and advanced market-ready business proposals and a bias in selecting more experienced entrepreneurs vs. less experienced student entrepreneurs as in the TOP model. We suggest that the more rigorous selection process identified for EPIS is the result of particular rationales behind EPIS that have informed EPIS support and mentoring activities. Table 1 considers these elements together.

Table 1: EPIS Rational, Selection Criteria, Support & Mentoring Activities

Support Rationale	Selection	Support	Mentoring
Facilitate knowledge flows between university & entrepreneur Access to specialised facilities & equipment	Demonstrate evidence of ability to benefit from university engagement over 12 month period Fully formed plan to address business problem with new technology or apply existing technology	EPIS funds placement with £5,500 academic host fee for one year Academic host identified and appointed for 12 month period	Development of technological element of business concept
Facilitate business mentoring Increase connectivity to wider business network Increase exposure and credibility of new venture in business	Detailed c.v. of Entrepreneur's academic and working life Demonstrated business project plan with milestones and timelines Intention to trade within one year	Business mentor identified and appointed for 12 month period	Develop business plan and model Assist in building network of contacts

environment Facilitate investor-readiness	Unencumbered access to IP that is required to develop business		
Direct resources and support from EPIS	Plan to use EPIS Loan Justification for business space	Interest free loan (£10k) Rent free space Assess & support professional development needs Weekly meetings EPIS exhibition to showcase business	EPIS coordinates ongoing personal development programme EPIS coordinates academic and business mentoring support
Regional entrepreneurial capacity building	Graduate from any number of recognised Universities; must possess considerable knowledge of technological & market sectors	Establish active links with regional support services Plug into other Scottish Enterprise programmes	Option of locating company in local incubation facilities and science parks

In Table 1, we identify four different but interrelated rationales behind EPIS (left hand column) that have synergies with selection criteria and support and mentoring activities. We now examine each rationale, drawing upon findings from the EPIS survey.

The first rationale is based on the perception that early stage entrepreneurs in Scotland cannot access academic expertise and equipment needed to develop a viable business concept (e.g. Scottish Enterprise 2002; 2007; 2008). Delivery of EPIS through the University of Edinburgh's technology transfer office is expected to address a perceived technology transfer gap by stimulating business-academic collaborations and increasing commercialisation of research by EPIS entrepreneurs. EPIS entrepreneurs are expected to access university knowledge through their academic mentors.

The second rationale is based on the perception that EPIS entrepreneurs are challenged in the Scottish context to attract the business support, mentoring and investment necessary to develop their business. The inclusion of experienced business mentors is expected to address these gaps and assist the entrepreneur in further developing the business plan and leveraging the mentor's contacts and networks. Table 2 identifies EPIS support that has had the most impact on the business, as perceived by respondents. From the survey, we expected to observe that academic and business mentoring would be the most highly valued element of support by EPIS entrepreneurs. However, results show that academic and business mentoring are rated lower than the £10,000 interest free loan and access to rent free premises as the support element 'having the most impact on the business'.

We interpret this finding by considering the average 'early-stage' profile of EPIS companies. The survey finds that 48% of EPIS companies are less than 3 years old, with 13% yet to be incorporated. Only 3% of companies are over 5 years old. Similarly, 76% of companies have between 1-5 employees, with a sizable proportion of these less having fewer than 3 employees. EPIS entrepreneurs, we suggest, are severely resource constrained given the nature of their businesses, and immediately deployable resources available through EPIS appear more critical for business survival than mentoring.

Table 2: EPIS Support having the most impact (n=35)

EPIS Support Element	% response
Access to £10,000 interest-free loan	34
Access to rent free premises	20
Access to academic mentoring and expertise	14
Access to specialist equipment	14
Access to experienced business mentor	9
Opportunity to collaborate with other entrepreneurs at EPIS	6
Access to other forms of public support	3

Ability to access debt/equity finance more easily	0

The third rationale behind EPIS is to provide direct resources to entrepreneurs, in the form of rent free space, interest-free loan and specialised facilities. A well defined literature suggests that severe resource limitations facing early stage companies constrain their development (e.g. Shane, 2001; BERR, 2008; Scottish Enterprise, 2008). EPIS provides immediately deployable resources that, as noted above, are perceived by entrepreneurs as having the most impact on their companies.

However, a wide range of benefits are attributed to EPIS in the survey, as shown in Table 3. Business skills (89%) would be expected to rate more highly than technical knowledge (32%), given that EPIS selection criteria requires that entrepreneurs demonstrate 'considerable knowledge of technological & market sectors and apply a new technology or existing technology to address a business problem'.

Table 3: Benefits Attributed to EPIS (n=38)

Type of Benefit	Description	% response
Business skills	Improved business skills	89
Company value	Increase in overall company value	71
Intellectual property	Protection of IP (patents, copyright, trademarks)	55
Productivity	Cost savings	50
Company value	Increase in value of assets	34
Technical skills	Improved technological knowledge	32
Business skills	Improved ability to attract highly skilled staff	32
Sales	New UK sales	29
Sales	Improved domestic sales	26
Sales	Improved overseas markets	26
Productivity	Improved delivery times	21
Sales	New export markets	18
Intellectual property	Increased value from IP	8
Business skills	Improved qualifications of staff	8

The wide range of personal benefits (i.e. business and technical skills) and company benefits (i.e. company value, IP, productivity, sales) attributed to EPIS in Table 3 suggests a strong intermediary role played by EPIS. EPIS not only provides critical company-building resources and advice to all entrepreneurs, but purposefully selects mentors depending on the needs of each entrepreneur and thus facilitates a range of different technical and business knowledge flows. This second level of associated mentor 'experts' is expected to facilitate increasingly purposeful knowledge exchange for the entrepreneur, drawing on their particular links within the wider regional network.

The prominence of company benefits attributed to EPIS, shown in Table 3, also points to a strong intermediary role played by EPIS in business development. EPIS provides ongoing personal development through the 12 months that allows entrepreneurs to consolidate their own mentoring knowledge while receiving a gradation of further support and advice from EPIS managers based on their particular business development needs. Given that EPIS is an integral part of the Scottish Enterprise regional network, EPIS entrepreneurs are able to benefit from EPIS referrals to other types of support as appropriate. Such an intermediary role is suggested from survey findings showing EPIS entrepreneurs (n=38) active in 24 additional support programmes (all funded by Scottish Enterprise).
Table 4 identifies the overall impact of EPIS on the business as perceived by EPIS entrepreneurs. Based on this evidence, we suggest that EPIS has provided a high degree of 'additionality', whereby entrepreneurs would not have established their company without EPIS or delayed business set up.

Table 4: Overall Impact of EPIS (n=38)
(companies could select more than one option)

	% response
Without EPIS, I would not have established my business	53
If EPIS was not there, I would have set up my business at a later stage	21
Without EPIS, I would have set up a different type of business	18
Without EPIS, I would have set up my business elsewhere	13

The fourth rationale behind EPIS is to contribute to regional entrepreneurial capacity building. Findings suggest that EPIS is facilitating individual entrepreneurial capacity by provide direct resources and access to other resources and knowledge that had not been previously available to the entrepreneur (Freidman 1976; Shane, 2001). Through mentoring and intermediation, EPIS also reduces the cost of acquiring knowledge about business development. We suggest that the combination of support activities and mentoring, as shown in Table 1, provides a form of 'entrepreneurial apprenticeship' for the entrepreneur during their 12 months at EPIS (Otani, 1996).

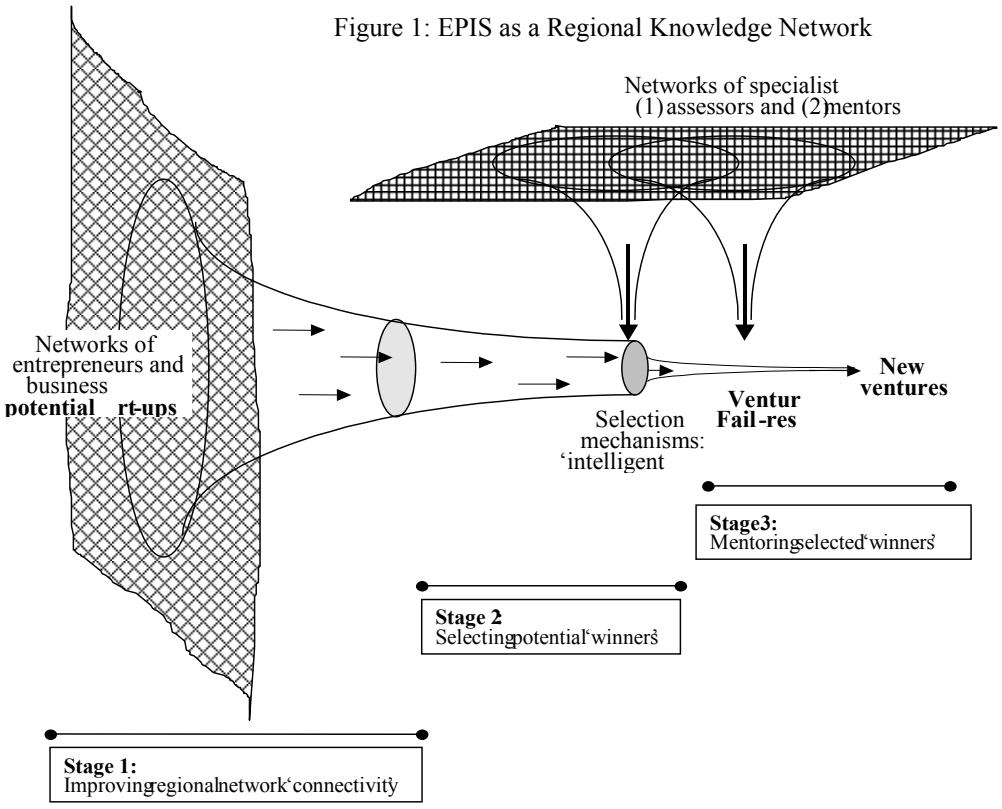
Classification of EPIS Pre Incubator Model

We now consider how the EPIS pre incubator model fits with existing incubator classifications. Certain incubator classification models do not capture the full range of rationales or level of support provided by EPIS (e.g. Rothaermel and Thursby, 2005). We suggest that EPIS does not figure amongst the three incubation models as suggested by Clarysse et al (2005). Unlike its parent, TOP-Spin, EPIS is not focused on maximising the number of university ventures or generating self-employment opportunities for university faculty or students (e.g. Low Selection Model)

EPIS is also not attempting to create new ventures as an alternative to licensing university IP (Supportive Model), despite a large proportion of EPIS entrepreneurs possessing IP. Results from the survey indicate that 89% of EPIS entrepreneurs have generated IP rights directly or indirectly through involvement in EPIS. However, this IP has not been generated exclusively from or through the University of Edinburgh. Some IP has been generated by entrepreneurs without support from any university. Nevertheless, EPIS allows the entrepreneur to hold all IP. Finally, EPIS is not trading off between uses of research to generate contract research versus spinning off this research in a separate company (Incubator Model). Most EPIS entrepreneurs cannot be defined as university spin-outs nor have many been engaged previously in university contract research.

We suggest that EPIS demonstrates more similar characteristics to regional knowledge network model as proposed by Collinson and Gregson (2003). Figure 1 characterises EPIS as a 'pipeline' representing a 'natural selection' process as EPIS entrepreneurs develop their business plans and either successfully exit as trading businesses or fail to exit successfully (or fail soon after exit).

Figure 1: EPIS as a Regional Knowledge Network



The stages shown in Figure 1 represent roles and activities undertaken by EPIS, as described below:
Stage 1: EPIS contributes to entrepreneurial capacity building by being part of the SE effort to stimulate an overall degree of interaction and networking amongst prospective entrepreneurs, academics, technology transfer personnel, intellectual property rights (IPR) experts, investors, business services providers, professional managers, technical specialists etc. at the regional level (Scottish Enterprise, 2008). The aim is to maximise regional 'connectivity' to improve the level of interactions likely to lead to successful formation of new businesses in the region and throughout Scotland.

Stage 2: EPIS filters particular business propositions for hands-on development and 'mentoring' from academic hosts and business mentors. In this role, EPIS relies on a second local network of associated 'experts' which they coordinate and co-opt to advise on the technology transfer and new business potential presented by the entrepreneur, filtering the most promising for further attention, and engaging to directly assist the entrepreneur in their personal development and that of the business.

Stage 3: EPIS entrepreneurs engage in advanced business development with 'natural selection' occurring as entrepreneurs become self awareness of the viability of their business. For those EPIS companies trading, the market will discriminate between high and low potential EPIS companies, although the short EPIS time period may constrain the level of evidence required to convince an entrepreneur that their business is viable or not. The role of mentors, engagement with the local network and market conditions will also provide signals to the entrepreneur on how others perceive the viability of the business. The level of additional support being secured by the entrepreneur may also contribute evidence supporting or questioning the viability of the business, although each EPIS entrepreneur is free to interpret this evidence.

EPIS Performance

Initial Targets

A number of performance targets were established for the EPIS scheme 2004-10 by Scottish Enterprise (SE). Table 5 identifies performance up to October 2009, with one year remaining in the scheme.

Table 5: Progress to EPIS Performance Targets (2004-10)

	Assists	High Growth Potential Start-Ups	Business-Academic Collaborations
Target	155	36	13
Achievement	278	50	6
% Achievement	181%	139%	48%

Results show that EPIS has already over-achieved on its original programme targets (2004-10) for 'assisting' technology start-ups and supporting high growth potential start-ups but is below the target for stimulating business academic collaborations (assists are described as 'over 2 hours of business support beyond EPIS covering both leavers and rejected applicants').

Survey results indicate that 89% of respondents have generated IP rights directly or indirectly through involvement in EPIS. However, EPIS targeted performance shows a 48% return on business-academic collaborations. Findings are inconclusive regarding the impact of EPIS on facilitating technology transfer between business and academia given the data and require further analysis.

Aggregate Performance Assessment

We suggest an inherent weakness in simple impact measures as shown in Table 5, as little understanding of the value of intervention or value for money can be extrapolated. We establish an aggregate performance assessment of EPIS to consider the 'value-for-money' of the scheme (Rothaermel and Thursby, 2005a). The five measures - total funds obtained by companies, total private investment obtained (angel or VC), developed R&D capacity, total IP generated and level of failure or graduation - are compared with total cost related to EPIS. We apply a simple efficiency ratio, which considers the extent to which inputs (cost of EPIS) have led to aggregate performance, as suggested by the five measures. EPIS is fully funded to year-end 2010 and has received funding of £1.48 million for its 6 years of operations from Scottish Enterprise and from European Research Development Funds. We present each of the five measures below:

1. Table 6 identifies the level of total funding attributed to EPIS companies. Excluding direct funding from SE and ERDF to EPIS, a total of £4,520,634 million has been raised by EPIS

companies, with 72% from private sources and 27% from public sector sources, which includes other types of grant support from Scottish Enterprise. Applying a simple efficiency ratio that compares the cost of EPIS (£1,447,368) with total funds raised, we identify a leverage ratio of 1: 3.12 suggesting a high return from EPIS. We suggest that, given the direct role played by EPIS in linking entrepreneurs with other sources of public funds (£1,245,800), that an efficiency ratio that compares EPIS costs with public sector investment raised is more accurate a measure of intervention efficiency. This produces a ratio of 1: 0.86.

Table 6: Total Funds Obtained by EPIS Companies (n=38)

Sources of Funding	Funding
Debt funding (excluding EPIS loan)	£426,334
Equity funding	£2,848,500
Total Private Sector Funding	£3,274,834
SE funding (including ERDF) to support EPIS	£1,447,368
Wider public sector support	£1,245,800
Total Public Sector Funding	£2,693,168

2. A total of £3,274,834 has been raised from private investment (both debt and equity). Applying an efficiency ratio that compares the cost of EPIS with total private investment, we identify a leverage ratio of 1:2.26, suggesting a good return from EPIS. However, we take caution in overstating the efficiency of EPIS in assisting their companies in raising private investment, given the difficulty in attributing such activity solely to EPIS, using existing data.

3. Table 7 identifies R&D expenditure by EPIS companies from the survey. While there appears to be a significant increase in expenditure in recent years, we are cautious in suggesting a sustainable upward trend, given that, from year to year, different technologies may be more or less R&D intensive, as EPIS is not biased towards particular technology sectors. However, given the early stage nature of EPIS companies, such expenditure suggests a high average R&D capacity, and an efficiency ratio of 1:1.79.

Table 7: R&D Expenditure by EPIS Companies (n=38)

Year	Expenditure
2005	£104,750
2006	£81,110
2007	£829,750
2008	£1,575,800
TOTAL	£2,591,410

4. Table 8 identifies the intellectual property (IP) that has been developed by EPIS entrepreneurs, with 89% of the survey sample holding IP rights. One of the selection criteria of EPIS is the application of a new technology or existing technology to solve a business problem; therefore, we expect, but cannot confirm from existing data, that a number of EPIS entrepreneurs would already possess IP when entering EPIS. Further study is required to ascertain the level of IP generated exclusively during the 12 month period. However, survey results from Table 3 identify protection of IP amongst the top three benefits attributed to EPIS, suggesting a positive impact of EPIS on IP.

Table 8: IP Taken Out by EPIS Companies (n=38)

Type	Number
Patents	13
Trademarks	12
Registered Designs	9

5. Data gathered from EPIS show that over 90 per cent of EPIS entrepreneurs set up a viable trading company within a year of starting the programme. A small proportion of entrepreneurs already arrive at EPIS with a trading company. We suggest that a low level of identified failure of companies while enrolled in EPIS is related to the provision of critical resources such a rent and loans. Further data are required to establish the fate of EPIS entrepreneurs and

companies following graduation. The creation of 47 additional jobs from survey data suggests a modest contribution of EPIS to increasing employment (average of 1.24 employees per respondent), but this requires further study.

DISCUSSION

In this study, we investigated the phenomenon of the university pre incubator, drawing upon a case analysis of the Edinburgh Pre Incubator Scheme (EPIS). In particular, we assessed the EPIS model of pre incubation, the impact of EPIS on pre incubator entrepreneurs, the contribution of EPIS to regional entrepreneurial capacity building and EPIS value for money.

We suggested that the model represented by EPIS does not fit any of the distinct university business incubator (UBI) models identified in the literature (Clarysse et al, 2005; Rothaermel and Thursby, 2005(a),(b)). We suggested that the scheme's strategic rationale, selection criteria, support elements and mentoring process are more characteristic of a regional knowledge network (Collinson and Gregson, 2003). Like regional knowledge networks, EPIS is founded on a perception of 'coordination failure' within the regional innovation system, where access to academic knowledge and facilities, business mentoring and investment represent significant barriers to business creation and development.

We found that although EPIS entrepreneurs must demonstrate a need for proximity to academic knowledge and facilities to further develop their IP (89% of survey respondents were identified as possessing IP rights), more traditional incubator resources (i.e. loan and free rent) were rated as more important by entrepreneurs than academic or business mentoring support. However, a majority of EPIS entrepreneurs (53%) identified that they would not have established their company without EPIS. In interpreting these findings, we refer to the small size and early-stage profile of EPIS entrepreneurs in the sample to suggest that resource endowments critical to business creation or survival – i.e. free rent, loans and access to specialised equipment – are more important in initially attracting entrepreneurs to EPIS than more intangible business mentoring and other forms of public support.

We suggest that the risk of business failure is directly reduced for the 'winners' - those selected for EPIS - by access to critical resource endowments and indirectly reduced by a perception of validation of their business plan by EPIS selectors. We postulate that less uncertainty regarding the business concept allows EPIS entrepreneurs to more readily absorb and benefit from mentoring, depending on the quality of the matching process intermediated by EPIS and the quality of entrepreneur-mentor relationships themselves.

In contrast to other UBI models, we found that the primary value of the university pre incubator model represented by EPIS is in developing regional entrepreneurial talent (i.e. Edinburgh and Lothians) rather than transferring technology or developing companies. The focus of attention is the entrepreneur rather than the new venture and the emphasis on personal development during the pre incubation period demonstrates a deliberate intermediation between entrepreneurial capacity building and the commercialisation process.

Findings identify a favourable 'aggregate performance assessment' of EPIS. This compares the cost to run EPIS (£1.5million) with aggregated survey results that include: total investment (£4.5million); developed R&D capacity (value of £2.6million); and intellectual property (13 patents, 12 trademarks, 9 registered designs). Simple efficiency ratios comparing the cost (inputs) of EPIS with benefits (outputs) suggest a positive 'value-for-money' performance of EPIS. This suggestion is supported by evidence of a wide range of benefits attributed to EPIS.

We identify a combination of factors contributing to favourable EPIS performance: strong commitment from key stakeholders on the need for intervention (e.g. University, Scottish Enterprise); perceived fit with other regional and university-based support initiatives; commercial credibility of EPIS management team; creation of highly supportive pre incubator environment; separate identify and physical space from university technology transfer operations; access to critical resource endowments (i.e. interest-free loan, rent-free premises, specialised equipment access); and early evidence of tangible benefits to entrepreneurs attributed to EPIS (e.g. favourable initial evaluation of EPIS by Scientific Generics 2006).

Limitations and Future Research

One limitation of the study is reliance on a single point of data for the survey. Because the EPIS entrepreneur is the focus of support, data are reliant on that entrepreneur, which may not be appropriate when generating data on the company. Another limitation is that outcomes of repeated interactions of the EPIS entrepreneur with other support mechanisms and the development of external collaborations have not been tracked. Indeed, the dynamic nature of relationships is assumed. Given that the entrepreneur is interacting amongst other support initiatives in the region and outside as well, establishing the value of EPIS in comparison to other programmes would further validate EPIS impact on regional entrepreneurial capacity building.

We do not have accurate data on the success and failure rate of EPIS entrepreneurs upon graduation from EPIS (e.g. 90 per cent of EPIS entrepreneurs set up a company during EPIS). There are a number of possible scenarios, with the entrepreneur continuing with the company or not. If the company fails, the entrepreneur may decide to try again or not. We suggest that the EPIS experience enables the entrepreneur to utilise their enhanced entrepreneurial capacity in a direct entrepreneurial context, or as an intrepreneur/entrepreneurial manager should they join another company. Arguable, regional entrepreneurial capacity and the stock of entrepreneurial resources (actual and latent) are enhanced - as even the individual who ceases to run his/her business may return to the new venture arena at a later stage. However, in this study, we cannot confirm the level of entrepreneurial capacity building directly attributable to EPIS or discuss potential spill-over effects. We also do not have accurate data on the level and extent of EPIS graduates entering other university or local business incubators. This will be the focus of future research.

We do not have accurate date on the extent of technology transfer occurring between EPIS entrepreneurs and the University of Edinburgh or between any other institutions. The technology transfer targets identified when examining EPIS performance reveals little of the extent of knowledge flows between the university and EPIS. Future research will seek to ascertain technology transfer effects and business knowledge flow effects by engaging a sample of EPIS entrepreneurs and academic and business mentors. We also acknowledge the time lag between interventions and benefit generation associated with EPIS (as with many intervention programmes) and suggest that it is too early to assess the full impact and value for money of the EPIS intervention with one year remaining in the scheme. Benefits reported by active or recently graduated respondents will reflect near-immediate effects.

In summary, we endeavour to address existing gaps in the current study of EPIS and to refine our approach to include longitudinal data capture, with the intention of extending analysis to examine university business incubators and related models.

Implications for Public Policy

One area of public policy concern relates to the potential cessation of funding for EPIS after 2010. The results presented in this study seem to indicate that EPIS is generating a wide range of benefits for entrepreneurs and contributing to longer-term regional economic development through nearer-term entrepreneurial capacity building. However, we suggest that the market failure rationale underpinning EPIS (and other Scottish Enterprise funded programmes) is tenuous without more tangible evidence of impact on economic development, despite evidence suggesting EPIS efficiency and value for money. For the University of Edinburgh, more evidence of technology transfer success may be a requirement. A potential trade-off in focusing more on company performance or technology transfer may be to weaken entrepreneurial capacity building and the role of EPIS as a unique form of entrepreneurial apprenticeship in Scotland.

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