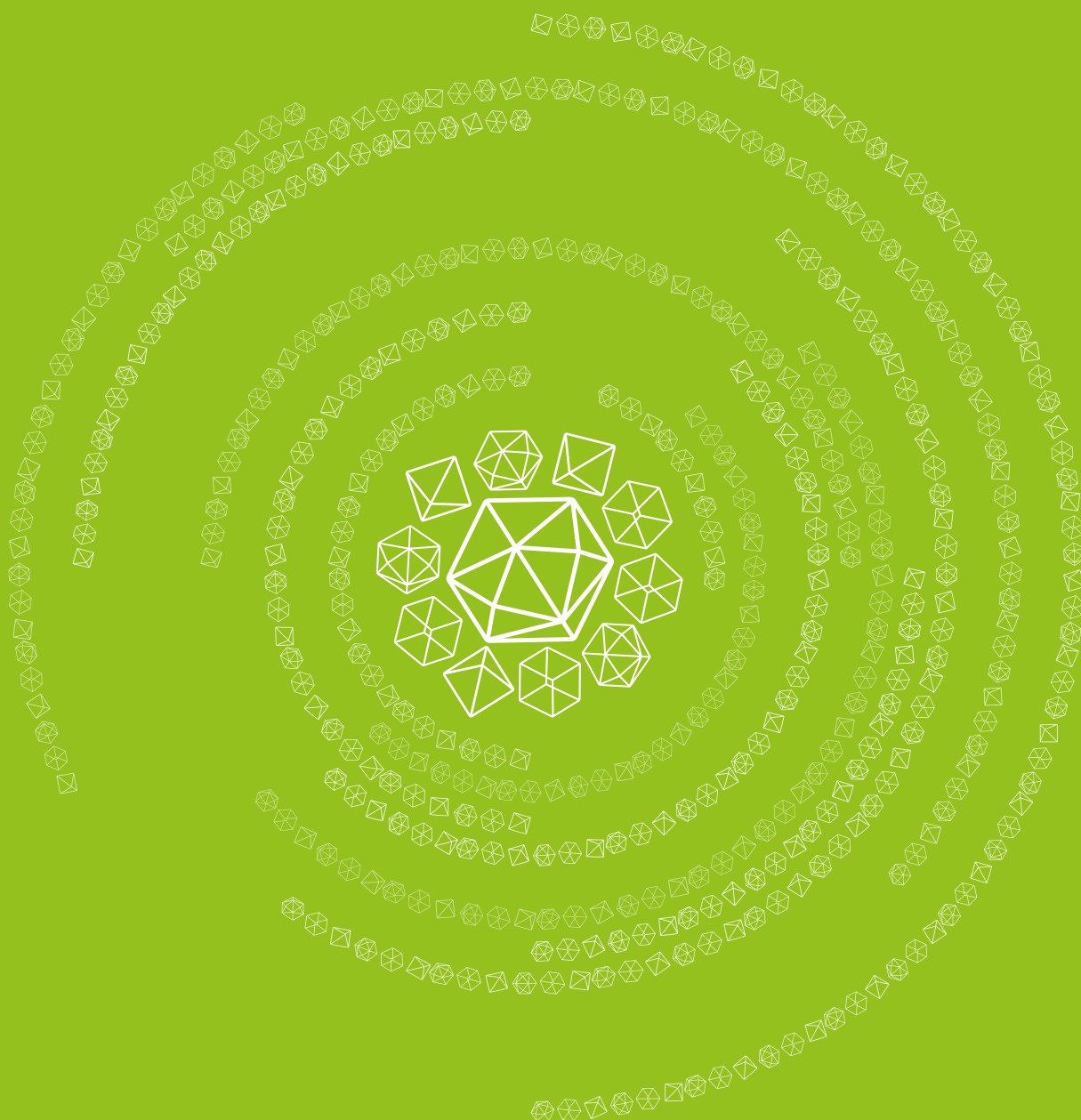


Incubation for Growth

A review of the impact of business incubation
on new ventures with high growth potential

Nicola J. Dee, Finbarr Livesey, David Gill and Tim Minshall



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Part I: Introduction

1.1 Overview of the research

The Government has put high-growth, innovative businesses at the heart of its economic agenda, and is focusing policy on how to back the big businesses of tomorrow. The aim of this research was to provide: *“a thorough and focused literature review on business incubation.”* The purpose of which was to identify models of incubation that have the greatest impact on the mission of building high-growth, innovative firms. This involved:

- Mapping the range of existing models relevant to firms with high-growth potential.
- Clarifying ‘state-of-the-art’ (models, interventions, design principles) in business incubation across the public and private sectors.
- Gathering, analysing and synthesising existing work (quantitative and qualitative) on the impact of incubation.

While the research was focused on the impact of incubation on tenants, we also examined the broader economic impact of business incubation.

1.2 Approach

Business incubation includes a variety of mechanisms and objectives as described. We have focused our work on business incubation designed to impact high-growth innovative businesses, and business incubators with physical space. We have organised the report based on a review of the academic business incubation literature, with additions from

industry reports. We have found significant limitations in the business incubation literature which has led us to include, where possible, literature relating more generally to innovation and entrepreneurial activity.

There has been much confusion regarding the definition and impact of incubation. Following the publication of two in-depth reviews of research on incubators, (Hackett and Dilts 2004b; Phan, Siegel *et al.* 2005), we have focused on reviewing literature published during the last ten years. A larger window for review would not have been possible within the budget constraints.

1.3 Structure of the report

Much of the literature on business incubation has inconsistent, and at times, conflicting messages. We have sought to explain why this has occurred, in addition to attempts to resolve some of these difficulties. The structure of the report is as follows:

Summary of findings: a high-level view of findings.

Research background: including a review of existing recognised models of business incubation, and more details on our approach.

A top line view: aggregate view on the impact of the business incubation industry.

Understanding the impact of business incubation on new ventures: expected outcomes and tools of incubation.

Matching process: creating value by matching incubator services to the needs of firms.

The incubator business model: while we provide some guidance, further research is needed.

Concluding remarks

Appendices: further information and findings.

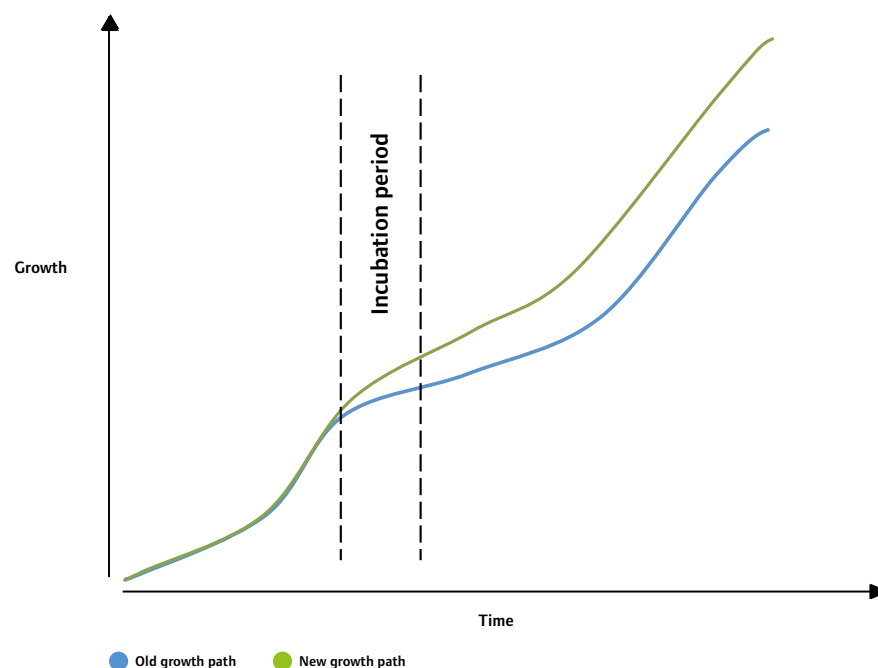
Part 2: Summary of findings

1. Hackett, S. M. and Dilts, D.M. (2004b) A Systematic Review of Business Incubation Research. 'Journal of Technology Transfer.' 29: 55-82.

Business incubators have proliferated since their emergence over 50 years ago. Over this time business incubation has evolved to include a range of incubation practices. Nonetheless business incubation can deliver critical value to tenants. Contrasting early definitions of incubation where survival of tenants was emphasised, we define incubation as *"...a shared office-space facility that seeks to provide its incubatees with a strategic, value-adding intervention system of monitoring and business assistance."*¹ Our key findings follow the structure of the report.

The proliferation of business incubation over the last 50 years has resulted in diversification of terminology used and types of incubation offered. To help overcome this problem we compared business incubation with two activities sometimes confused with incubation – equity financing and professional services firms. For example, though not as intensive for venture capitalists, incubators implement an entry selection process for tenants. Perhaps more importantly incubators often have a very mixed revenue stream and incentives as a result, strongly

Figure 1: Theoretical impact of an incubator on the irregular growth path of an individual tenant



encourage peer-to-peer networking, address multiple needs of new ventures without prioritising just one, and offer continual exposure to the incubation environment and services.

Absolute measures of incubation are impractical, but performance indicators are useful. Given the relatively small number of studies and the lack of comparability between them, any conclusions should be treated as indicative at best.

The UK has approximately 300 business incubators supporting around 12,000 businesses (UKBI). Estimates of the *direct impact* of business incubation by industry associations² include between 25-40 supported businesses and between 44-91 jobs per incubator. Many incubators (~60 per cent) also have outreach programmes to support businesses not resident in the incubator.

Indirect incubator effects, e.g. additional jobs and wealth generation from providing products/services to incubator and incubatees, globally range between 0.48-1.5 times the direct impacts of incubation.

Few studies capture the full impact of business incubation, for example taking a measure of incubation impact over the incubation period rather than longer term, and ignoring entrepreneurial learning and subsequent venturesome activity as a result of business failure. Job creation, while a popular metric used to evaluate incubation, is not generally considered a useful measure of incubator value. An emphasis on job creation also contradicts the advice of many investors who are acutely aware of the need to control spending by investee firms, which often means delaying recruitment. Further work is needed to develop appropriate performance indicators for incubation.

In practice, incubation can lead to several outcomes for new ventures. Incubation can impact new ventures through modifying or accelerating the entrepreneurial process of business development. But while incubators have been associated with business acceleration of incubatees, this same process can lead to 'life support' which extends the time to business failure. A period of high risk can confront incubatees when leaving the support of an incubator.

Selecting firms with potential for high growth is an uncertain process. A portfolio approach

mitigates the risk associated with relying on the performance of a single firm. Across a portfolio of incubator tenants around 23 per cent identify the incubator as important to business performance.³ Over 60 per cent identify the incubator as critical, while just under 17 per cent regard the incubator as unimportant to performance.

Incubators influence new firms by:

- Lending credibility through association, and through shared (and therefore affordable) access to professional facilities and an identifiable and flexible incubation space.
- Offering business support and coaching which are often subsidised e.g. strategic insights, market research etc.
- Providing access to additional resources and talent e.g. finance, legal help.

The incubator draws on its own staff, external consultants, and its existing entrepreneurial support network to provide business support. Peer-to-peer networking is also encouraged.

Matching incubator services to the needs of firms is important. New venture activity and business support needs vary between regions, industries, prior entrepreneurial experience and so on.

Incubators with links to universities are associated with technology firms with higher growth potential, but not all universities have an entrepreneurial culture or are surrounded by a supportive business environment. In addition to technology and facilities, people are a main contribution of universities to entrepreneurial activity.

Rather than cater to all firms, most business incubators have a selection/screening process to target a particular group of firms. This screening process is imperfect, but can be improved through the use of multiple screening dimensions.⁴ Nonetheless a selection process can only be imposed if the incubator can afford to turn away potential tenants.

Tenants seem to become dissatisfied with incubator support when the incubation programme is predetermined rather than re-evaluated depending on the changing needs of tenants. The entrepreneurial support mechanisms also fluctuate, with incubators able to offer some continuity.

2. Membership schemes incentivise a broad view of incubation to include as many members as possible.

3. CSES (2002) 'Benchmarking of Business Incubators,' Sevenoaks: Centre for Strategy and Evaluation Services.

4. Aerts, K., Matthyssens, P. et al. (2007) Critical role and screening practices of European business incubators. 'Technovation,' 27: 254-267.

As incubators become more embedded in a region they tend to become more specialised. A word of caution – while many try and emulate incubation strategies from Boston, Southern California (US) or Cambridge (UK), these regions are also considered atypical and likened to ‘regional incubators’ owing to the amount and maturity of entrepreneurial activity and infrastructure.

Even incubators with similar objectives can have different business models. Business models have changed over time. Since 2005 there has been a reported increase in the cost per job created each year in business incubation in Europe. Some incubators now offer equity finance, and some equity investors offer incubation, with an unclear distinction between both. The challenge for incubators and their funding bodies is to capture some of the value created for incubatees. Generating revenue from services when clients are resource constrained is often not possible without subsidies from public bodies. Corporate funded incubators typically require a strong strategic fit of incubatees with the corporation, which is not appropriate for all ventures. Incubators with mixed funding may encounter principal-agent problems as they attempt to meet multiple objectives.

Capturing value through taking equity in clients introduces delays in revenue and can cause the incubator to behave more like an equity investor by prioritising short-term financial returns rather than longer-term performance. The literature offers little insight on whether incubators could generate better returns for early-stage investments than pure equity investors. Already early-stage investments are associated with poor returns in Europe, especially compared to the US. Further research is needed to understand the strengths and weaknesses of business models for different contexts.

In summary, the evidence we have reviewed indicates business incubation is a valuable tool as part of an entrepreneurial support infrastructure. Incubators deliver the most value when able to respond and adapt to the needs of new ventures. We realise some of our conclusions regarding how business incubation should be monitored challenge some existing norms in this domain. However, the lack of comparability between studies demonstrates how important it is to improve the quality of metrics. Even so any measure of incubation is likely to be incomplete. The impact of incubation on incubatees should extend

beyond the incubation period and incubator environment, though measuring this impact could become onerous and time consuming.

While we recognise the variety of business models used and the continuing evolution of the industry, we nevertheless conclude that further research is required for the fundamentals of incubation models – a topic largely neglected in the extant literature – to be properly understood.

Part 3: Research background

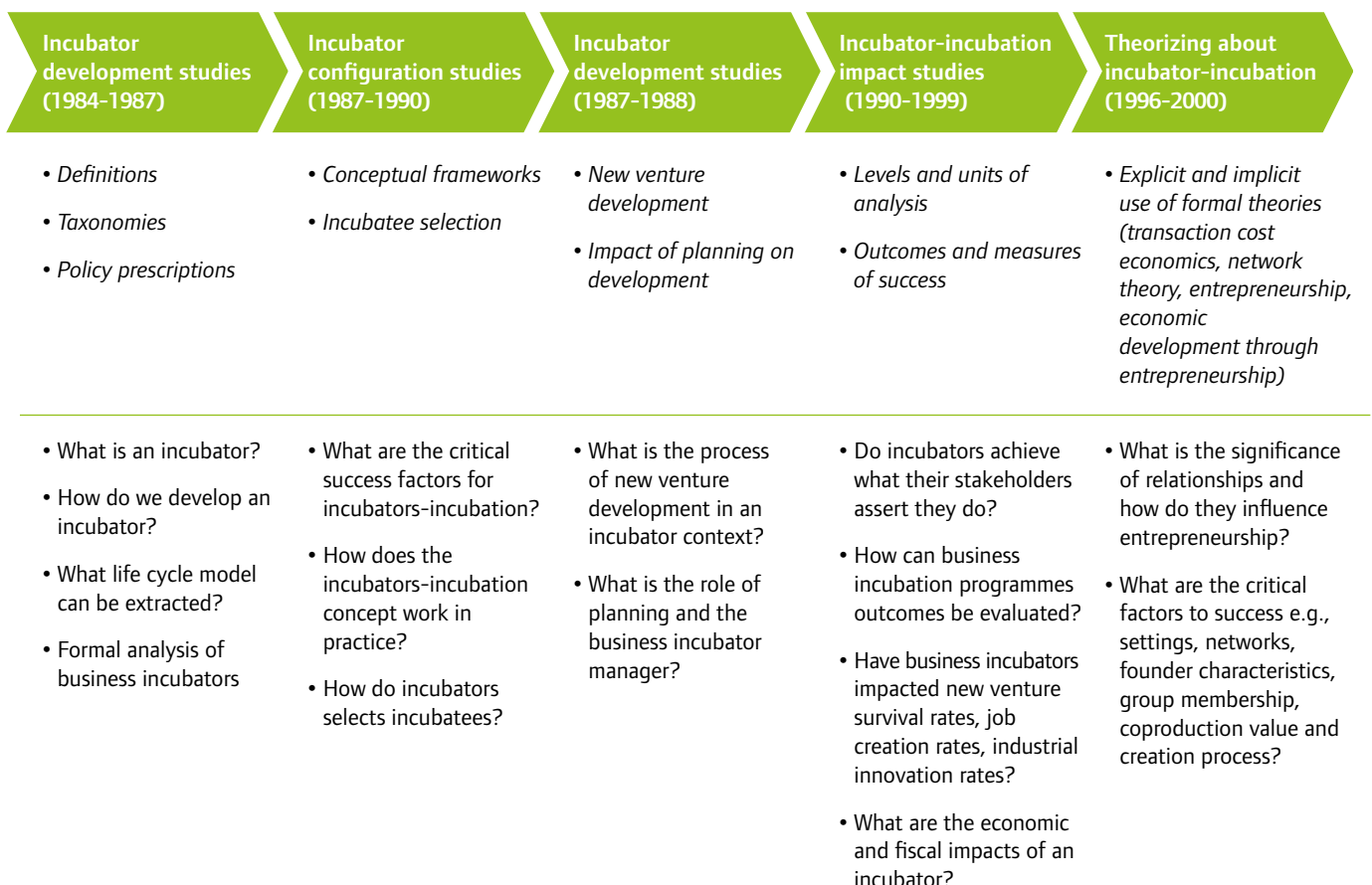
5. For example the Bayh-Dole Act 1980 decreased the uncertainty associated with commercialising federally funded basic research and intellectual property rights protection become increasingly recognised (Hackett and Dilts 2004b).

6. For an example of commentary on internet incubators, see: <http://www.strategy-business.com/article/11071?gko=a2013>

Since the first recognised incubator established in Batavia, New York in 1959, there was a slow diffusion of incubator programmes in the 1960s/70s. Incubator diffusion increased significantly in the 1980s/90s (Figure 3) in conjunction with increased attention and clarity on the commercialisation process of research⁵ (Hackett and Dilts 2004b). The establishment of industry organisations like the US National Business Incubation Association (NBIA established in 1984) and the United Kingdom

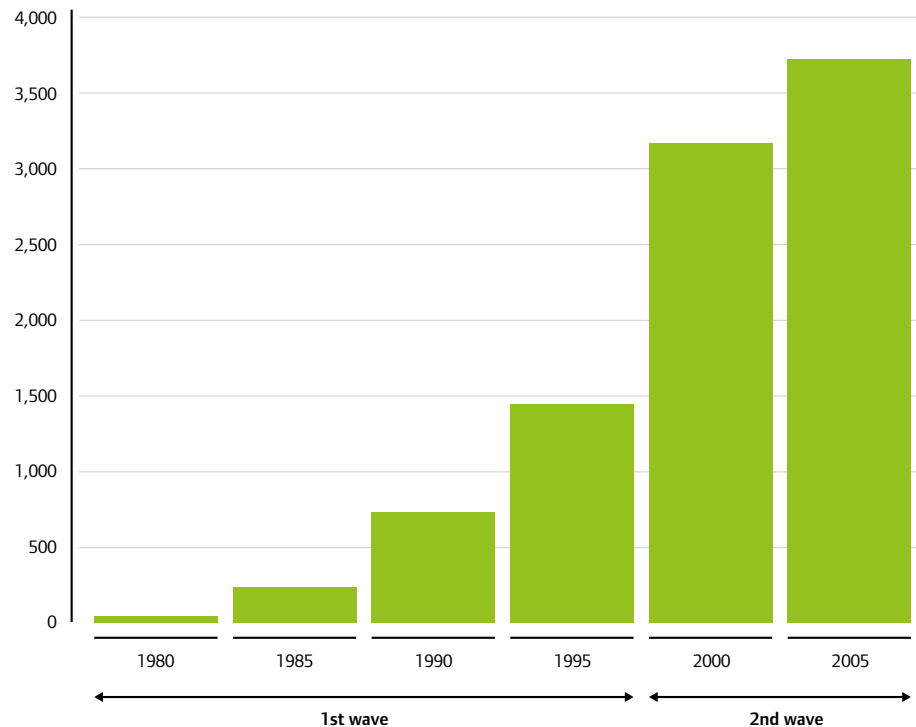
Business Incubation (UKBI established in 1998), led to increased interest in how to measure and report incubator performance. Academic contributions soon grew and have continued to evolve to this day (for a summary of contributions see Hackett and Dilts 2004b and Phan, Siegel *et al.* 2005) (Table 1). While many for-profit incubators closed when the dotcom bubble burst, incubation has nonetheless prevailed as part of a wider innovation system (Hackett and Dilts 2004b).⁶

Figure 2: Overview of themes and research questions incubator-incubation literature



Source: Hackett and Dilts 2004b.

Figure 3: Growth of the worldwide incubator industry



Source: Barrow 2001.

Since the 1980s business incubators have become a popular policy instrument to foster entrepreneurship, innovation, and regional development (OECD 1997; CSES 2002). Incubators are not the only potential instrument for achieving these goals, nor can the presence of an incubator alone secure them (Phan, Siegel *et al.* 2005; Connell and Probert 2010; Hussler, Picard *et al.* 2010). Nonetheless the continued growth in the number of business incubators worldwide demonstrates their perceived value. With the proliferation of business incubation activities over the last 50 years has come diversification in the terminology used and type of incubation activities offered.

3.1 Objectives of incubation

Two main rationales for incubation have emerged. The first view regards incubation as a way of addressing market failures, which limit the ability of small high-tech start-ups to overcome uncertainty and obstacles associated with the early stages of firm development (OECD 1997; Phan, Siegel *et al.* 2005). Market failures stem from the relatively high costs and risks associated with providing support to high-tech start-up companies. Private sector institutions are unwilling to absorb the

costs and risks if the commercial value of the technology being exploited is too uncertain as is often the case with early-stage ventures. The second view regards incubation as a catalyst to accelerate the entrepreneurial process systematically, thereby institutionalising the support of ventures with potential for high growth (Hansen, Chesbrough *et al.* 2000). In practice incubation has been associated with a variety of objectives (Allen and McCluskey 1990) (Table 1). Very often these objectives relate to the specific business environment (nationally and regionally) in which the incubator is located.

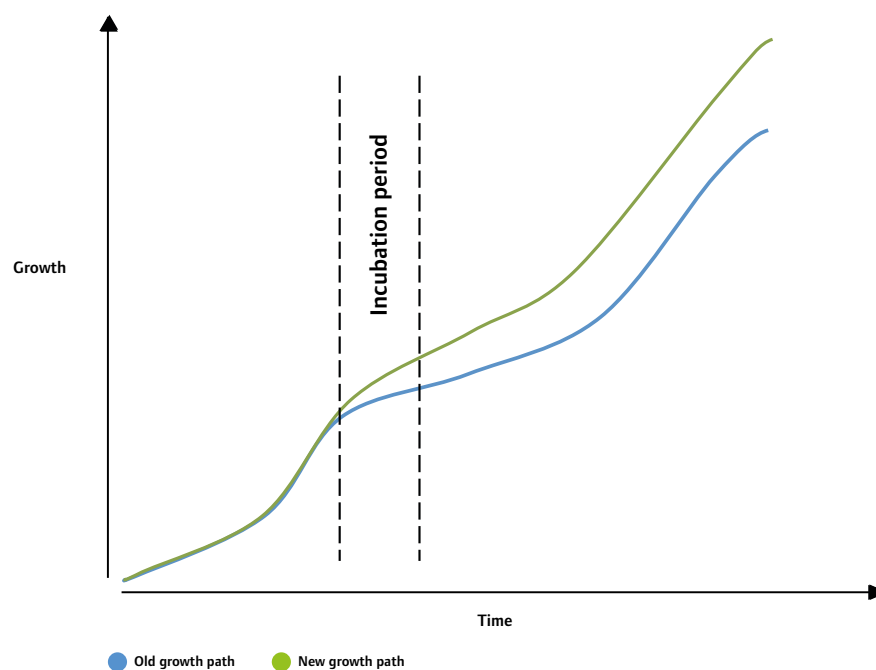
The primary incubator function has been described as increasing the chances of an incubatee firm surviving its formative years (Allen and Rahman 1985). Theoretically the incubator can also impact an individual tenant through improving its growth path, as illustrated in Figure 4. This impact can last beyond the incubation period. As a result incubation can fulfil many of the objectives described in Table 1, through enhancing growth in the productivity and employment of its tenants both during and after the incubation process, which in turn has an impact on the wider business environment. The rest of the literature review explores this idea in more detail to properly understand the impact of incubation.

Table 1: Incubation objectives

Primary objective	Secondary objective
Real estate appreciation	Create opportunity for technology transfer
Sell proprietary services to tenant	Create investment opportunity
Job creation	Generate sustainable income for the organisation
Positive statement of entrepreneurial potential	Diversify economic base
Faculty-Industry collaboration	Bolster tax base
Commercialise university research	Complement existing programmes
Capitalise investment opportunity	Utilise vacant facilities
	Strengthen service and instructional mission
	Capitalist investment opportunity
	Create good will between institution and community
	Product development

Source: Allen and McCluskey 1990.

Figure 4: Theoretical impact of an incubator on the irregular growth path of an individual tenant



Source: Authors' own interpretation.

3.2 Typologies of incubators

Even incubators with similar objectives may have different typologies (Bergek and Norrman 2008). The literature remains unclear on how to organise typologies of incubators (Hackett and Dilts 2004b; Phan, Siegel *et al.* 2005). Terms like research park, technology innovation centre, science park, business incubator, accelerator have become interchangeable (Hackett and Dilts 2004b; Phan, Siegel *et al.* 2005).

This literature review focuses on studies exploring incubators that include physical space⁷ and business support interventions geared towards high-growth firms. We adopt the definition from Hackett and Dilts (2004b) where business incubation is defined as:

“...a shared office-space facility that seeks to provide its incubatees with a strategic, value-adding intervention system of monitoring and business assistance.”

This contrasts earlier definitions of incubation where survival of tenants is emphasised (Allen and Rahman 1985). Survivability is a limited measure of how a firm is performing, and is a necessary but insufficient condition for success. If success is defined as *“the achievement of something desired; planned or attempted”* (Oxford English Dictionary 2010) then entrepreneurs in pursuit of high growth may consider survival, without growth, a failure.

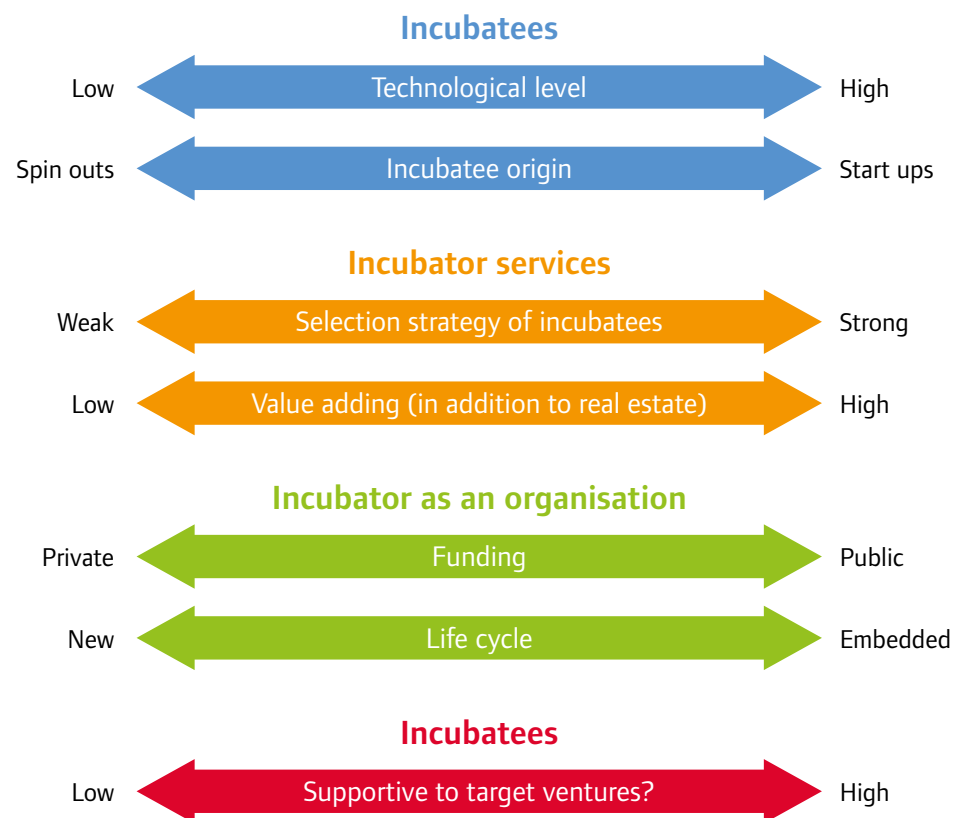
It is recognised that business incubators can create value for a variety of stakeholders but they also depend on a variety of stakeholders to have a viable business model. Hackett and Dilts identify value creation between incubatees, incubators and the community⁸ (2004b). Building on this we have identified perspectives in the incubation literature clustered around several thematic axes (Figure 5). These axes have been organised around different levels of analysis and are discussed in more depth throughout the report. Figure 5

7. There are mixed views on whether ‘virtual incubators’, i.e. ‘incubators without walls’, are incubators at all (Bearse 1998 cited in Hackett and Dilts 2004). There has been a rise in a variety of ‘virtual incubators’ and acceleration programmes as incubator activities have diversified. This study focuses on incubators with physical space, a space which has been likened to a ‘clubhouse’. While space is necessary but non-sufficient for these incubators, it also has convening power which is enhanced when the space is designed for business incubation. Anecdotal it has been suggested that physical space encourages more face-to-face interactions, which build a greater level of trust than can be achieved online. This trust encourages more meaningful interactions and exchanges of knowledge, and being part of the space increases the frequency of such interactions.

8. The term ‘community’ refers to the business environment surrounding the incubator.

9. For further information about these axes, please refer to the rest of this report. Spin-outs refer to businesses officially spinning out of the university environment, where as start-ups are any type of new business. A start-up may refer to an unofficial business which spun-out of the university, which is why the axis is presented as a continuum.

Figure 5: Illustration of the range of business incubation perspectives through reference to thematic axes representing different levels of analysis⁹



Source: Authors' own work.

is designed to illustrate the potential range of business incubation perspectives but may not be exhaustive.

10. Professional services firms have some selection process for clients.

In attempts to engage with those interested in 'incubation', the term has been loosely applied to various activities at different units of analysis. Increasingly organisations involved with the support of entrepreneurial activity risk being referred to as 'incubators', with some extending the term to unusually entrepreneurial regions (Phan, Siegel *et al.* 2005). Some venture capitalists who offer higher than average business support activities have also been termed incubators, particularly in the US. This confusion between investors, professional services firms offering business support, and incubators has prompted some comparative studies (Hsu 2007; Aaboen

2009). We have built on these to produce a top-line comparison between incubation, venture capital and professional services firms to identify whether incubation is unique (Table 2). For example, though not as intensive as for venture capitalists, the implementation of a selection process for tenants seems important in incubation.¹⁰ In addition to business assistance, the aggregation and interaction of incubatees co-located inside the incubator has been identified as unique to incubation (Hackett and Dilts 2004b). Table 2 supports this and suggests the distinctive features of incubation are a very mixed revenue stream, strong encouragement of peer-to-peer networking, addressing multiple needs of new ventures without prioritising just one, and offering continual exposure to the incubation environment and services.

Table 2: Identifying the uniqueness of incubation

	Venture capital	Professional services firms	Incubation
Deal flow/clients	Wide search processes, sometimes regional or industry specific. Before securing a client there is intensive due diligence	Often bid for projects	Receive applications from ventures that are subject to a selection process e.g. incubator branding encourages self-selection or selection criteria is imposed on potential tenants
Main revenue stream	Returns on investment in ventures	Billable hours	Mixed revenue between rental income and other public and private sources (e.g. 1)
Primarily addresses what market need?	Need for equity finance to fund high growth	Address a knowledge gap in clients	Access to space, knowledge, resources, via staff, programmes and networks
Peer-to-peer networking?	Usually limited	Usually restricted	Actively encouraged and facilitated through a shared space (typically physical space but also possible in an online space)
Time scales	Usually seek an exit 3-5 years after investment, but interaction with ventures is episodic	Depends on a project by project basis, but typically months not years	Typically 3-5 years (anchor tenants are often longer) with a mix of episodic and continuous interventions but continual exposure to incubation environment
Target firms	Typically addresses a narrower range of firms than incubators, and at a later stage	Broader range of firms, not typically restricted to new ventures	Typically addresses a broader range of firms than investors, and usually at an earlier stage than Venture Capitalists

Source: Authors' own analysis with reference to Aaboen 2009, Hsu 2007, Hackett and Dilts 2004.

Part 4: Evidence on the impact of business incubation

11. While these studies attempt to benchmark incubator performance, their main methodology is an *in situ* assessment.

There is no standard methodology for measuring incubator performance, which makes comparisons between studies challenging (Phan, Siegel *et al.* 2005) (Appendix A). Many incubators are non-profit which renders the usual economic analysis challenging. Even those incubators identified as private often have public support for programmes they run. It is difficult to distinguish between firm growth that would occur in the absence of incubation, and additional growth as a result of incubation. To collect data many studies survey incubator managers as a central point of contact, this is useful but limited as they cannot accurately represent the views of incubatees. A summary of approaches is offered in Table 3, but few studies have uncovered meaningful categorisation processes linking relevant factors to specific contexts. As a result many findings have limited generalisability.

4.1 Incubation industry reports

Associations of the business incubator industry frequently assess the impact of business

incubators and offer estimates of aggregate performance. Organisations such as the US National Business Incubation Association are membership-based, which incentivises the inclusion of as many members as is reasonably possible, as is evident from the lack of screening of new members. As a result it is difficult to build a high degree of confidence around the homogeneity of their data sets.

Most incubators remain either wholly or partly publicly funded. In the competition to attract public funds many incubators need to constantly demonstrate ‘success’, which can lead to over-reporting successes and under-reporting failures especially when self-reporting (Hackett and Diltz 2004b). We propose a cautious view of the following incubator industry data:

- In 2005 alone, the NBIA estimates that North American incubators (~1,100) assisted more than 27,000 start-up companies that provided full-time employment for more than 100,000 workers and generated annual revenue of more than \$17 billion (based on extrapolations from survey data) (Knopp 2007).

Table 3: Review of research methodologies used to assess incubator performance

Approach	Method	Examples
Control-group concept	Pairing firms, on and off site	(Lindelof and Lofsten 2002; Siegel, Westhead <i>et al.</i> 2003b; Dettwiler, Lindelof <i>et al.</i> 2006; Amezcua 2010)
Benchmarking	Surveys, categorisation, interviews, self-reporting	(CSES 2002; Knopp 2007; UKBI 2009) ¹¹
<i>In situ</i> assessments, before and after	Surveys, case studies	(Grimaldi and Grandi 2005; Bergek and Norrman 2008; Patton, Warren <i>et al.</i> 2009)

- Business incubators in the EU – which now number around 900 – make a significant contribution to job and wealth creation. Some 40,000 new (net) jobs are generated each year by incubators (CSES 2002).
- The UK has a well established network of approximately 300 business incubators that support over 12,000 high-growth technology businesses in sectors such as biomedical, IT and the creative industries (UKBI, 2010).¹²

While these industry reports are likely to have an optimistic view in promotion of their industries, they indicate strong activity linked to business incubation. The range reported is between 25–40 supported businesses per incubator, and between 44–91 jobs created per year per incubator.¹³ But these figures typically include a mix of technology and other types of incubators. Job creation remains a limited but popular measure used to evaluate incubator performance (CSES 2002; Frontline 2002; SQWConsulting 2008).¹⁴ Yet new ventures will often try to reduce their fixed costs as they operate in conditions of uncertainty. Venture investors are acutely aware of the need to control spending by investee firms, which often means in practice delaying recruitment of full-time employees (FTEs) as long as possible and instead preferring the use of flexible contract workers and consultants. This can lead to conflicting goals as incubators try to satisfy the needs of public bodies through supporting job creation, but also the needs of investors by discouraging incubatees taking on additional risk through recruiting FTEs.

4.2 Quantitative academic studies

Despite the growth in literature on incubation, few studies have applied a robust evaluative approach to assessing the economic contributions of incubators. Many quantitative academic studies attempting to evaluate the impact of incubators on populations of firms have more conservative results than industry studies, and often contradictory findings. Furthermore some of these studies focus on science parks as opposed to business incubators as few studies have access to meaningful quantitative datasets for business incubation alone, which makes comparisons challenging. For example an analysis of a longitudinal UK data set of on- and off-science park matched firms, including two surveys in 1986 and 1992, shows a higher survival rate among firms on parks with a higher education

institute (72 per cent) than without (53 per cent), insignificant difference between closure rates, and growth in employment concentrated in the hands of a few businesses, while mean employment growth rates were similar (Siegel, Westhead *et al.* 2003a). In our review of studies using more recent data sets, we found few contributions offering additional insights. Chen's (2009) study of Taiwanese incubators found no direct effect on new venture performance as a result of incubation, whereas Rothaermel and Thursby (2005) showed incubated firms were significantly less likely to experience outright failure. Lindelof and Lofsten (2002) discovered no difference in profitability between on- and off-park firms, but the off-park sample had significantly lower growth in employment and sales turnover. Making sense of such findings requires scrutiny of the research designs employed and their limitations (Appendix B). For example Rothaermel and Thursby (2005) used a single incubator study which is a useful exploratory contribution to incubation research but with limits to generalisability.

This set of academic studies highlights the difficulty in answering what at first looks like a straightforward question – do incubators have a positive impact? As the outcomes of incubation may take many years to become apparent, as a company develops its markets and scales its production, 'success' varies from whether incubated ventures survive longer or have significant growth whilst being incubated. Many different approaches have been taken in significantly different time periods and contexts (Appendix A & B). Whilst there are no highly negative outcomes, the positive outcomes are based around survival (in the case of Rothaermel and Thursby 2005) or higher employment growth (Lindelof and Lofsten 2002). Aside from direct measures of success for incubated firms, the empirical evidence would suggest that incubatees who interact with the incubator (both in terms of other companies and support staff) have stronger learning (Scillitoe and Chakrabarti 2010), while incubators who screen against a balanced set of indicators will have lower failure rates (Aerts, Matthyssens *et al.* 2007).

Taken together the studies are indicative of the approaches that may work, however given the relatively small number of studies and the lack of comparability between studies any conclusions should be treated as indicative at best.

12. See: <http://www.publications.parliament.uk/pa/cm201011/cmselect/cmsctech/writrev/innovation/m16.htm>

13. The US EPA recently evaluated the cost of jobs in various industries, and concluded that business incubation was the most cost effective job creation mechanism. Again, we recommend examining the methodology (source: [http://www.eda.gov/PDF/EDACons Impact StudyVolume1FINAL.pdf](http://www.eda.gov/PDF/EDAConsImpactStudyVolume1FINAL.pdf))

14. Examples drawn from the assessment of business incubation by public bodies include requirements to measure core outputs. Drawing on real examples, these are often identified as number of jobs created, number of jobs safeguarded, number of businesses supported/assisted to improve performance. Each output claim has to have full documentation, which is challenging with new ventures that very rarely have automated systems to generate the required 'evidence'. One such source of funding for incubation withdrew some funding in order to pay a part-time manager to ensure the paper trail was complete.

4.3 Impact of incubation on the wider business environment

Incubators are capable of extending their services beyond their community of incubatees, and incubatees extend their business beyond the walls of the incubator. When combined with a perspective of the incubation period generally being shorter than the life cycle of a firm, the impact of an incubator on the wider business environment is typically greater than any common measure recognises. While these business incubation effects can create considerable value in the wider business environment, they can be challenging to monitor. Wider impacts of business incubation beyond their direct affect on tenants include:

- **Incubation outreach** – The NBIA noted in 2006 a slight upward trend in the services being offered by incubators to entrepreneurs who do not reside within the incubator. They can extend their reach through assisting nascent entrepreneurs pre-incubation and supporting post-incubation entrepreneurs (Knopp 2007). UKBI recently estimated that 60 per cent of incubators operate what they term as ‘outreach’ services that support and advise companies outside the incubator.¹⁵
- **Indirect effects** – For example displacement of non-incubated firms with incubated firms, or additional jobs and wealth generation from supplying goods and services to incubator and tenants, or increased local spending from employee income of incubated firms (CSES 2002). A European study estimated a ratio of 1:1.5 for direct:indirect job creation from incubatees (CSES 2002). Another study suggests more conservative indirect effects with multipliers between 0.48 and 0.84 for the number of indirect jobs created from direct jobs from two incubators (Markley and McNamara 1996).
- **Entrepreneurial learning** – New venture failure is often documented as the end of an entrepreneurial process, but it frequently spawns other opportunities which entrepreneurs are in a better position to pursue after learning from failure¹⁶ – “If asked about the chief product of some of these firms, one might reply ‘entrepreneurs’.” (Cooper, 1971 p.2 cited in Garnsey and Heffernan 2005b). For example, even though Acorn Computers no longer exists, it was a fertile ground for entrepreneurial learning, and its founders and employees used their

experience to establish many new firms (Figure 6).

In addition to the indirect effects described, an incubator can become a representative of entrepreneurs, offering a single point of contact for those wishing to engage with new ventures. With the rapid fluctuations typical in a population of new ventures, this can be a valuable source of information on entrepreneurial activity which can be communicated more widely, for example to public bodies and government.

4.4 Absolute measures of incubation are impractical, but performance indicators are useful

While monitoring incubator activity is generally considered useful by incubators and their stakeholders, it can also become cumbersome and erode the ability of the incubator to perform its core functions. One study identified that incubator managers were ‘less effective’ when distracted from their core activities by excess monitoring or the need to secure funds for the business incubator (Rice 2002). The 2006 NBIA survey team believe the length of the survey¹⁷ was to blame for their lowest response rate since their surveys began.

An alternative approach was taken by the Swedish VINNKUBATOR programme (now InnovationsBron¹⁸) where they asked Fokus Analysis to develop an online assessment tool in collaboration with incubators. The tool was to be of use to incubators for monitoring their own performance, but also enabled a centralised collection of data for review by public bodies. This approach seems to have been well received, and data is regularly collected. Nonetheless surveys and monitoring are very unlikely to measure all activities or outputs of business incubators, and attempts to would likely be cumbersome and time consuming. The literature advocates the use of longitudinal data to explore incubation, so practical data¹⁹ collection must be considered a priority in addition to collecting appropriate data to indicate incubator trends.

15. See: <http://www.ukbi.co.uk/about-ukbi/business-incubation.aspx>

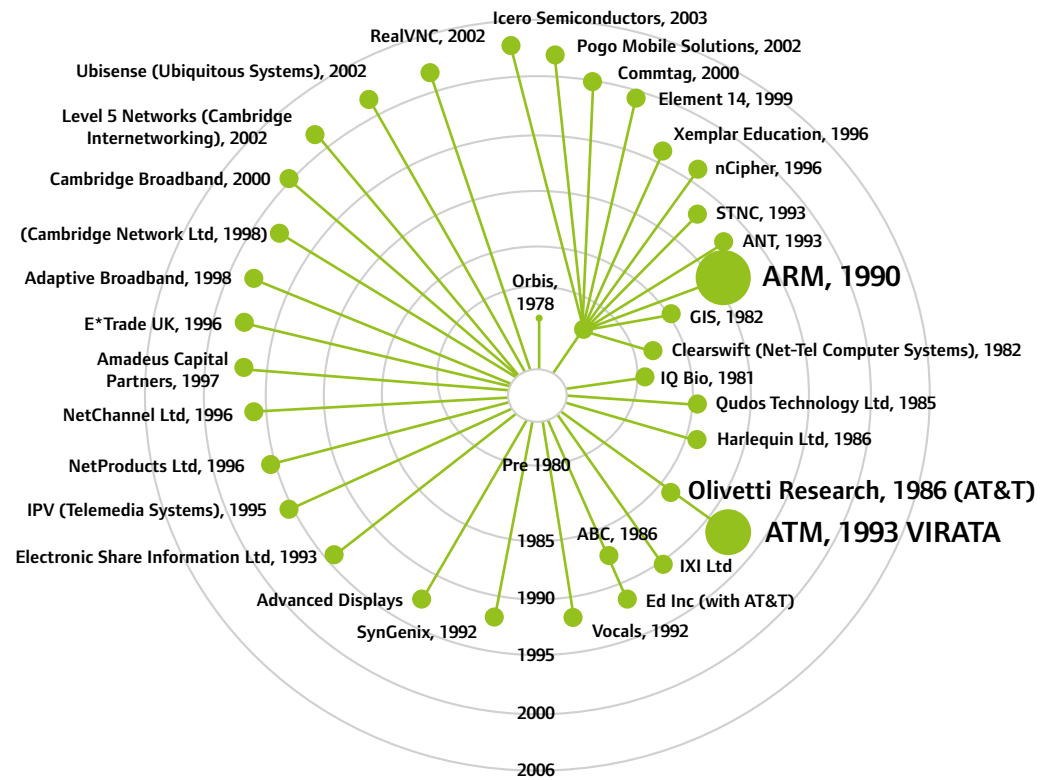
16. One documented example of this is Acorn Computers which was founded in 1979 in Cambridge, UK. After explosive growth in demand for Acorn microcomputers there was a sudden slump in consumer demand in 1984. The company only survived its over-commitment to suppliers through acquisition by Olivetti. Acorn was wound up in 1999, with Olivetti benefitting from shares in ARM. Whether Acorn is judged in its own right as a success or failure is only part of the story as it was a valuable environment in which many local entrepreneurs and managers gained experience, which helped produce other ventures (Garnsey and Heffernan 2005b).

17. The survey included 31 multi-part questions requiring over 200 answers.

18. Information on the Fokus Analysis can be found at www.innovationsbron.se

19. For example see Hackett and Dilts 2004.

Figure 6: New firms started by founders and employees of Acorn Computers



Source: Garnsey and Heffernan 2005b.

Part 5: Understanding the impact of business incubation on new ventures

As described earlier, regardless of an incubator's specified objective, the incubator's main lever with which to achieve its objective is through its impact on clients i.e. new ventures. We explore this direct impact on new ventures in more detail.

5.1 New venture outcomes as a result of business incubation

Measuring the performance of new ventures remains a challenge to researchers worldwide. While established businesses are typically assessed in terms of share-value or gross profit, new ventures rarely have either. Therefore assessing the impact of incubators is complicated by the lack of consensus on how to measure the performance of early-stage firms. Furthermore, the incubation period is typically shorter than the life cycle of a firm, so assessing firm performance during the incubation period misses longer-term effects. Due to the irregularity of most firm growth paths (Garney and Heffernan 2005a), estimating firm performance had incubation been absent proves challenging.

Hackett and Dilts propose an application of real options to incubation in an attempt to offer a robust way of assessing incubator value and managing capital investments (2004a). A real options approach, originally used in corporate finance, applies option valuation techniques to capital budgeting decisions, so creating options for when to make, abandon, expand or contract a capital investment. Five options are described under 'initial outcomes' (Table 4). That practice is less pure than theory is implicitly acknowledged by Hackett and Dilts, "However, facilitating the survival of incubatees

or containing the cost of failure of the options to the sunk cost of creating the option minus any remaining option value, and reporting these successes, can result in the renewal of annual operating subsidies, a very important upside without which many incubators would close." (2004a p.51 emphasis added). In short, real options theory provides valuable theoretical insight into incubation practice. But since incubatee options cannot be priced accurately until they are realised or expire (too many uncertainties prevail for accurate quantification), options theory is insightful rather than universally true. David Gill, manager of St John's Innovation Centre, offers thoughts on the application of real options to an operational incubation environment, showing the value and limits of its application (Box 1).

As recognised in the real options framework, incubation doesn't always lead to better outcomes for incubatees. While supporters of incubation suggest the process can help shield incubatees from competitive forces of the external environment and increase the likelihood of short-term survival, others contend that this same process can weaken a firm's ability to compete and survive when graduating out of the incubator (Amezcu 2010). In evolutionary theory a firm will fail if it develops routines and competencies that are misaligned to the competitive selection regime of the business environment (Aldrich 1999). A recent US study has found incubated firms outperform their peers in terms of employment and sales growth, but fail sooner (Amezcu 2010). Few studies explore post-incubator performance, and yet 'graduation is easy, post-graduation survival may not be' (Schwartz 2010).²⁰ A study of German incubators found a period of high risk confronts graduates within their first three years after graduation

20. 'The shock came after leaving the incubator in realising what actually needed to be done to exist in your own premises.' (UKBI 2009 p.40).

Table 4: Real options framework

Antecedents	Inputs	Activities	Outputs	Initial outcomes	Intermediate outcomes	Long term outcomes
Pre-venture initiative activities	Entrepreneurs			1. Incubatee is surviving and growing profitably		
Community support for entrepreneurship	Enabling technologies/ innovations (including incubator)	Incubation: New venture development + new product development + selection + monitoring and business assistance + resource munificence	Incubated companies	2. Incubatee is surviving and growing but not yet profitable	Viable/becoming viable companies	
Exogenous conduct of basic research	Critical technologies/ innovations			3. Incubatee is surviving but not growing and not profitable	Dead dying companies	
Events increasing individual entrepreneurial orientation				4. Incubatee operations terminated while still in the incubator: losses minimised		
Incubator feasibility study				5. Incubatee operations terminated in incubator: large losses		

Source: Hackett and Dilts 2004a.

Figure 7: Growth impact of the misalignment of the incubation and business environment (representation of ‘life-support’ e.g. Schwartz 2009)

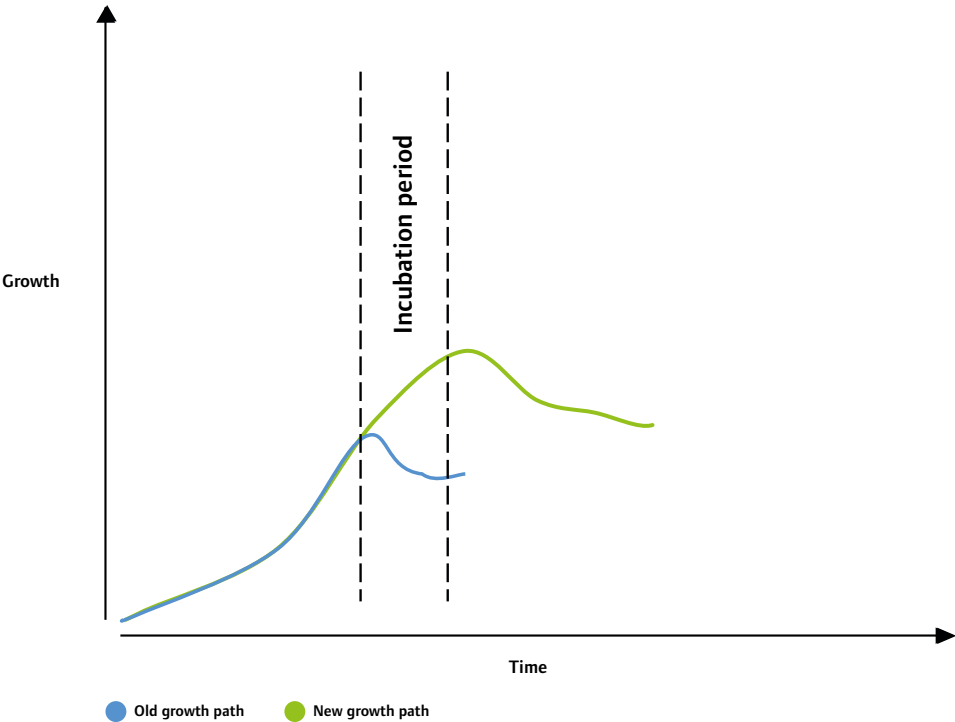
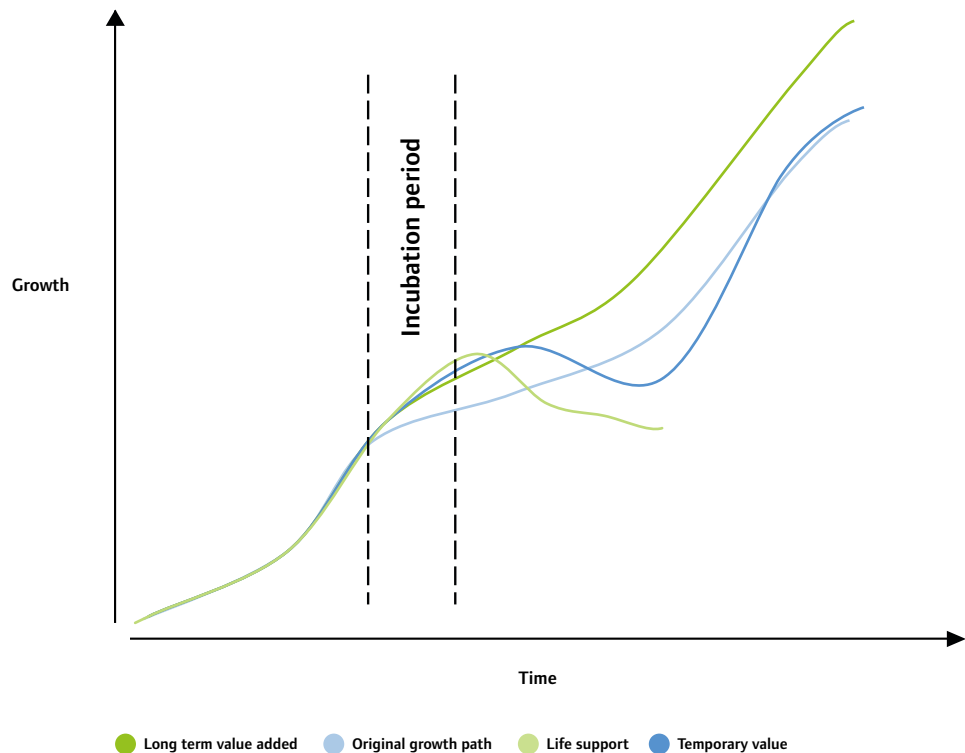


Figure 8: Illustration of potential growth scenarios for incubatees as a result of incubation



21. New organisations usually have limited credibility that restricts the acquisition of resources. Liabilities of newness are well-recognised for founding organisations in the literature (Stinchcombe 1965).

where around 20 per cent of graduates do not survive (Schwartz 2009). They suggest this originates from extended 'life support' of some incubatees who should have perhaps been more closely monitored. This 'life-support' of incubatees is represented in Figure 7. Beyond the first three years after graduation there is a high probability of durable establishment of the graduate (Schwartz 2009).

Another risk of incubation is that the impact is very temporary. The outcomes of incubation discussed are illustrated in Figure 8. The impact of an incubator overall will depend on the portfolio of incubatees and the impact of the incubator across the portfolio. How much an incubator can impact new ventures depends on the incubation tools available, in addition to characteristics of the new venture.

5.2 How incubators influence outcomes in new venture performance

It is useful to distinguish between the potential benefits to incubator tenants, and how these benefits are delivered by the incubator. For the former it has been suggested that incubators provide benefits to incubatees along four broad

dimensions: (1) development of credibility,²¹ (2) shortening of the entrepreneurial learning curve, (3) quicker solution of problems, and (4) access to an entrepreneurial network (Smilor 1987). To examine this further we sought input from research in entrepreneurship which draws on more established work on this subject than in the business incubation literature.

A conceptual framework for the business model, or entrepreneurial process, of new firms has been developed by Garnsey (Stam and Garnsey 2005; Dee 2008) (Figure 9). This helps elucidate the ways an incubator could influence the trajectory of firm development. Every firm 'customises' the model taking account of their own resource base and perceived opportunities. New firms tend to be more focused on business ideas and gaining the resources needed to build a productive and commercial base, while more established firms focus on value creation and capture. Incubation can impact various aspects of the entrepreneurial process, from strategic input to the business model, to modifying or accelerating the entrepreneurial process through access to resource providers, entrepreneurial learning from peers, access to customers, advice on intellectual property rights to improve value capture, etc.

Box 1: Real options from the perspective of an incubator manager – David Gill, St John's Innovation Centre, Cambridge UK

The Hackett and Dilts real options framework lists five potential outcomes to the incubation process and suggest that outcome 4 (operations of the incubatee are terminated, with losses thereby minimized) is a success and outcome 3 (an incubatee becomes part of the 'living dead', to borrow a term from venture capital) a failure, is insightful in describing some of the filtering functions of incubators (and would be true of a venture fund or incubator operating on the venture investment model) but may not apply in all incubation circumstances. That practice is less pure than theory is implicitly acknowledged by Hackett and Dilts.

Most subsidy-providers would not operate within the options framework and would instinctively prefer an option 3 outcome to an option 4 outcome. Subsidy-providers are likely to be public authorities who will use 'proxy' measures of success, such as number of jobs created, or investment attracted, or survival rates *n* number of years after the company left the incubator. Funding sources generally rely on intermediate outcomes at least as much as they use the hard measures of real growth and profitability.

Part of the reason is down to timeframes. While the authors are right to say that 'incubators are not the all-powerful innovation hatcheries capable of incubating and taking public *"infinitely scalable, dot-com e-business start-ups"* less than a year after entering the incubator', option theory does not take fully into account the potentially elastic timescales involved where incubation is concerned – a crucial difference when incubation (other than short-life accelerator programmes) is contrasted with a ten-year fixed-life limited partnership, common in venture capital.

Tenants may quite legitimately linger on in a physical incubator, often justifiably taking longer to bring projects to fruition than originally envisaged. Their best ideas can be the ones that grow out of their original proposal and which need to go through numerous iterations before becoming a 'killer app'.

Another fundamental difference between the VC option model (relatively purist) and the incubator option model (much more pragmatic) is that VC funds have partners or shareholders, whereas incubators usually have multiple stakeholders. VCs operate a pretty clear 'shareholder' business model (their 'shareholders' are usually 'limited partners' for tax purposes) but almost all incubators are much more reliant on having to please a range of 'stakeholders' – even where an owner applies commercial targets.

A venture investor is 100 per cent reliant on getting the portfolio right – 'managing real options'. The VC's success is ultimately dependent on selling its cashed-in options for many multiples of the original option price, and wise VCs spend as little time as possible on the living dead. But the incubator manager has several sources of income – rent, grants, public or private consulting, conferencing and other services, maybe share options as well – and so also numerous constituencies to please, whose interests may not always be obviously reconcilable.

A shrewd incubator manager will team and ladle different sources of income to cross-subsidise different activities, something pure real-options theory does not allow for. This is legitimate in terms of fulfilling a mandate of supporting growth firms because of the high degree of uncertainty involved in taking on a new client. Success depends on the ability and experience of the incubator team, who often act with limited information and so must rely on judgment as much as formulae. The 'black box' cannot be entirely dispensed with.

The authors acknowledge that resources *per se* are not enough if there is no accompanying selection process. However, 'selection' takes place at multiple intervals during (also before and after) the relationship and not just up front. Selection is not just about dealing with existing tenants either, it also involves long-term relationships with individuals who move

out but may move back in, their advisers and investors – something very hard to put a price on, and so value as an option.

In short, real options theory provides valuable theoretical insight into incubation practice. It helps provide a framework to deal with the uncertainties inherent in incubation. But since incubatee options cannot be priced accurately until they are realised or expire (too many uncertainties prevail for accurate quantification), options theory is insightful rather than universally true.

The implication for policy purposes is not that all incubators should be run as short-term accelerators rewarded with equity kickers like a VC, but that subsidy providers would benefit from being more sophisticated in measuring success and less reliant on proxy measures such as numbers of jobs created in a short space of time.

David Gill (St John's Innovation Centre and IfM) started his career in investment banking with Chase Investment Bank, moving to Greenwell Montagu in 1988, from where he joined the corporate finance department of Midland Bank plc, specialising in advising smaller growth companies. After the acquisition of Midland by HSBC he became Head of the Innovation & Technology Unit for the UK bank. He was a director of ETCapital, a specialist technology seed-fund investor, before being appointed MD of SJIC. In 2004-5 he was a Sloan Fellow at the Stanford Graduate School of Business. He was an undergraduate at Magdalene College and was called to the Bar by the Middle Temple.

Figure 9: The entrepreneurial process

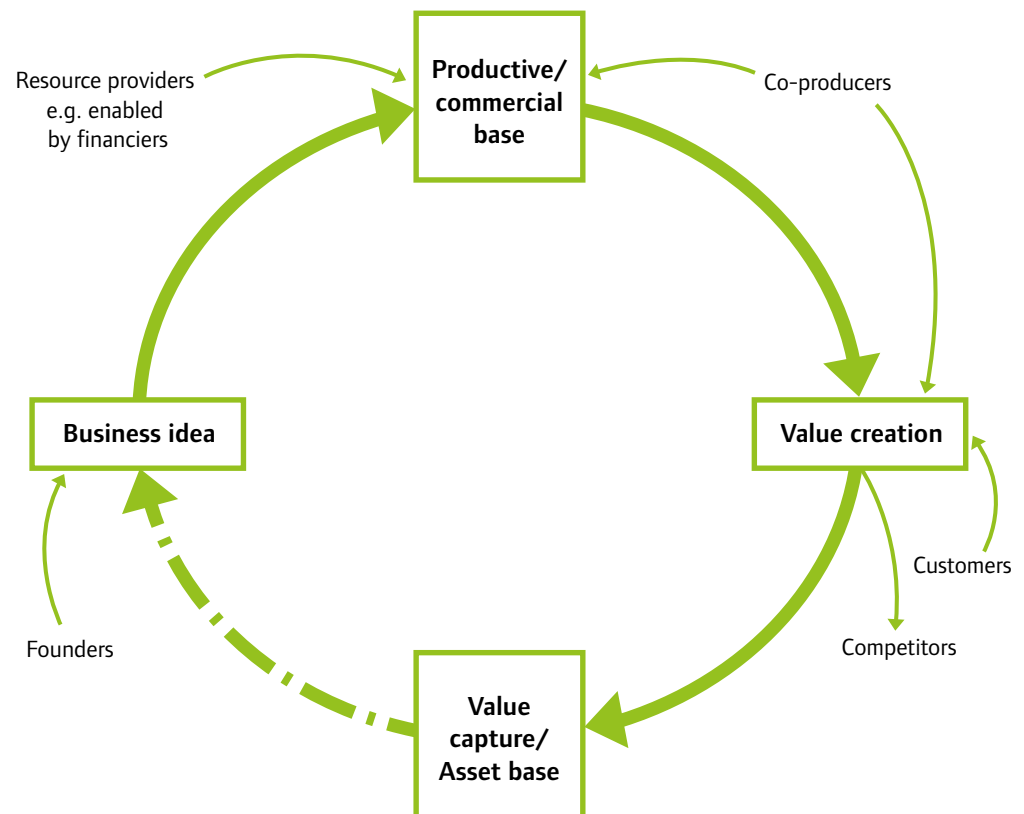
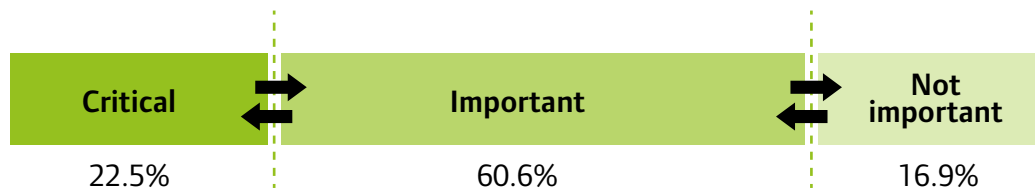


Figure 10: Additionality – importance of incubator to company performance (modified from CSES 2002). Arrows represent the ability of firms to move categories.



As a result of insights into the entrepreneurial process, we contrast Smilor (1987) and suggest the key benefits to entrepreneurs of being in an incubation environment are to modify or accelerate the entrepreneurial process. This is achieved through the development of credibility, shortening of the entrepreneurial learning curve, quicker solution of problems and access to an entrepreneurial network.

As we are focused on incubation for firms with potential for high growth, we now offer a perspective on these kinds of firms before turning to how incubators deliver value.

5.2.1 High-growth firms and a portfolio approach

A thorough explanation of high-growth firms (HGFs) goes beyond the scope of this work. Drawing on our own and others work we suggest high-growth firms share the following characteristics:

- There remains a lack of consensus on how to measure the performance of early-stage firms, especially pre-revenue (Garnsey and Heffernan 2005a).
- Firms increasingly source knowledge from a variety of sources, not just the science base (Huggins, Izushi *et al.* 2010).
- Firms with high-growth episodes are disproportionately important to the emergence of industries, job creation and economic wealth (Acs, Parsons *et al.* 2008; Garnsey and Mohr 2010).
- High-growth firms are a small percentage of all new enterprises, but face distinctive problems (Anyadike-Danes, Bonner *et al.* 2009).
- Firms rarely experience continuous growth, discontinuous high-growth episodes are more common (Garnsey and Heffernan 2005a).

- High-growth episodes usually result from a combination of internal firm factors and external factors in the business environment (Penrose 1959).

It is recognised that opportunities for 'high growth' are typically associated with uncertainty, as obvious opportunities for all leads to rapid exploitation which reduces the scope for 'entrepreneurial rents'. As a result of uncertainty (e.g. technological, market, regulatory), selecting firms with potential for high growth is also an uncertain process liable to errors:

"...inventions can occur at any time, with different importance and at varying rhythms. Not all of them become innovations and not all innovations diffuse widely. In fact, the world of the technically feasible is always much greater than that of the economically profitable, and this, in turn, is much greater than that of the socially acceptable." (Perez 2004) p.219

If high-growth firms do share the characteristics described above, then incubators are being asked to add value to an entity in a state of uncertainty. A portfolio approach mitigates the risk associated with relying on a singular firm's performance in conditions of heightened uncertainty.²³ The portfolio of tenants in an incubator fall into three broad groups: those for whom incubator support is critical to improving firm performance, those whose development would likely occur with or without incubator support, and those for whom the support is important (Figure 10).²² Assessing when an incubatee needs critical help as opposed to life support requires experience by the incubator manager. Affecting outcomes in new venture performance depends on the tools of incubation available.

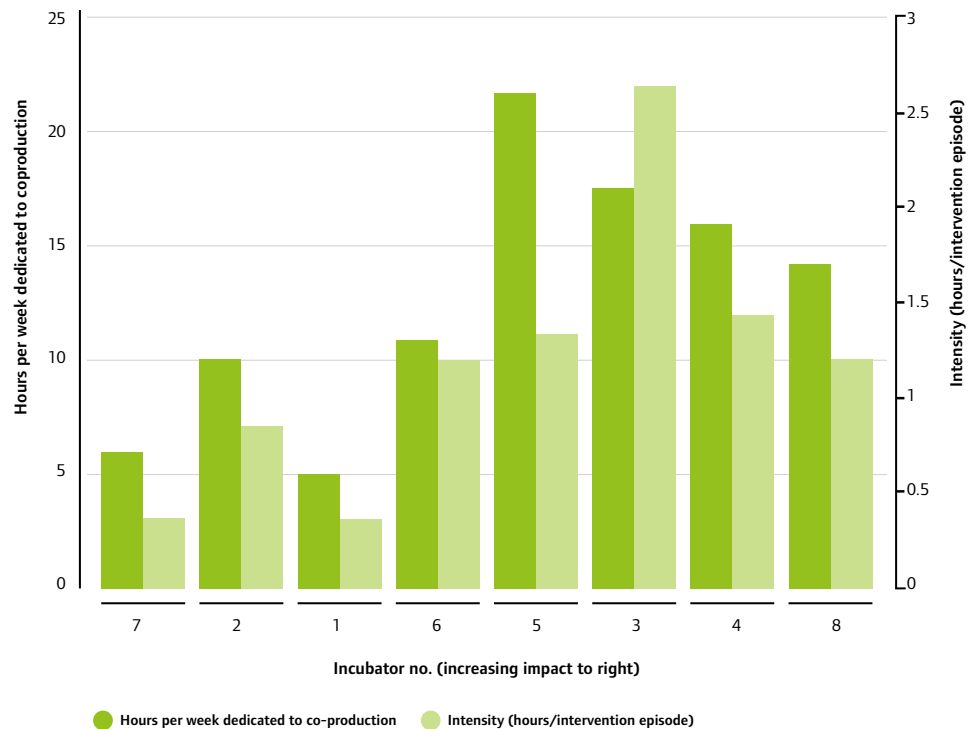
5.2.2 Delivery of valued services

The incubator building and facilities can themselves be valued by entrepreneurs,

22. Venture investors also take a portfolio approach for similar reasons. Fund managers accept that 'lemons ripen before plums' and do not seek to prolong the existence of those companies that fail early; nor do they expend time or money on the 'living dead', those companies in the portfolio that neither thrive nor fail.

23. Anecdotal evidence suggests incubator managers refer to these three groups as: those who are unlikely to succeed regardless of help; those who are likely to succeed regardless of help; and those for whom help makes a significant difference for a chance of success.

Figure 11: Link between counselling and incubator impact (amended)



Source: Rice 2002.

24. For example, in a survey of incubator services focused on business assistance and networks, over a third of respondents attributed major value to rent breaks (43 per cent), business connections outside the incubator (41 per cent) and government grants and loans (38 per cent) (Mian 1996).

especially if designed for business incubation. The building address has been considered an advantage to business for 79.6 per cent of respondents in a UK survey (UKBI 2009). Incubatees preferred the incubator to be clearly identifiable, which is aided by clear physical boundaries around the incubator, for example having a separate entrance (UKBI 2009). The 'look and feel' of the incubation space can imply the quality of tenants and services it delivers. Resource providers can be wary of dealing with new ventures lacking credibility and legitimacy (Bhidé 2000). The incubator lends credibility and legitimacy through association with the venture. Shared facilities enable incubatees to use professional facilities (e.g. meeting rooms, reception, ICT etc.) without the burden of being wholly responsible for their cost. Incubation space can also be designed to encourage peer-to-peer networking through the provision of communal spaces, such as common rooms and canteens, located in visible and accessible areas. Early studies of incubation emphasised facilities and administrative services, with more recent contributions emphasising the importance of business support and networks (Hansen, Chesbrough *et al.* 2000; Hackett and Dilts 2004b).

The incubator delivers services and provides access to resources and networks typically via its own incubator staff and external consultants. Typical incubator services and resources reflect the needs of the entrepreneurial process (as shown in Figure 9). For example strategic input to the business model, access to resources including capital, organisational and recruitment support to build the productive and commercial base, access to technical facilities, advice on capturing value from innovation through intellectual property rights, and so on (Mian 1996; Hackett and Dilts 2004b; Grimaldi and Grandi 2005; Patton, Warren *et al.* 2009).²⁴ These services can be delivered in varying degrees of quality, quantity and intensity. For example counselling is a critical function of many business incubators. A study of eight incubators in which incubator managers were questioned, in addition to tenants nominated by the incubator managers, indicated that better performing incubators had proactive crisis intervention and proactive development intervention (Rice 2002). While an analysis of the type of counselling according to whether it was episodic reactive, episodic proactive, or continuous proactive seemed to support the idea that proactive interventions

in incubatees generated more positive results (Figure 11), other studies suggest the 'best' incubatees (which were linked to high-growth episodes) were also those least likely to demand help from the business incubator.

In addition to direct counselling and business services delivered through the incubator, the incubator often acts as a mediator between the entrepreneur and other resources and networks. It has been suggested that 'better incubators' offer an extensive network of powerful business connections that can be transformative to the development of its tenants (Hansen, Chesbrough *et al.* 2000). If an incubatee lacks its own access to relevant entrepreneurial networks this can be highly valued (Bergek and Norrman 2008). Networks play a central role in the emergence and growth of successful firms (Hite and Hesterly 2001). When firms lack credibility the role of a mediator to provide access to networks can be invaluable. It is suggested that as firms become more established, their networks become more calculated to fit the increased quantity and scope of resource needs (Hite and Hesterly 2001). The incubator can also offer institutional mediation e.g. for access to public grants and programmes (Bergek and Norrman 2008).

It has been suggested that incubators vary along three dimensions: selection strategies, business support, mediation (which also depends on the regional technological innovation system) (Bergek and Norrman 2008). Bergek and Norrman (2008) propose that incubators fall into five different categories where best practice will vary between categories, though further work is needed. A key finding was that even incubators with the same objectives can have different delivery mechanisms that are equally effective (Bergek and Norrman 2008). A similar attempt to categorise different incubators found two broad types even though many of the incubators in the study exhibited features of both types (Grimaldi and Grandi 2005). Mian developed an 'integrative framework' accounting for various possible stakeholders such as a university, the entrepreneur, incubator management and community, but did not weight their relative importance according to different modes and objectives of incubation (1997). So while the literature strongly supports the existence of different approaches to incubation, no clear categories exist from which to assess best practice within similar cohorts of incubators.

5.3 Incubation can have a positive and critical impact on new ventures

We have shown that business incubation can lead to a variety of outcomes in new ventures, and determining which ventures could have high-growth episodes is subject to uncertainty. Nonetheless incubation can have a critical affect on improving the performance of new ventures (Figure 10). While attempts have been made to discover best practice in business incubation, it is also recognised that a variety of incubation models exist. In short, organising incubation to deliver maximum value from tenants is contingent upon the internal situation (including tenants) in the incubator and external business environment which we now explore in more detail.

Part 6: Matching incubator services to the changing needs of firms

The entrepreneurial process (Figure 9) is fundamental to technological change, and yet is sometimes treated as a 'black box' in the innovation management literature (Jaffe, Newell *et al.* 2001). Yet it is this entrepreneurial process within the firm which builds a commercial structure around an innovation with the aim of creating and capturing value (Stam and Garnsey 2005). The incubation process needs to support the entrepreneurial process through matching incubator services to the changing needs of firms.

Demand for different types of incubator services varies according to the changing needs of new ventures

6.1 New venture activity and business support needs vary between regions

Regions can be associated with particular kinds of new ventures as a result of specific regional competences, resources and culture as documented in literature on clusters. Many technology incubators are for example located near universities, and universities sponsored some of the first incubators in the United States. Universities can boost the number of new firms appropriate for incubation via spin-outs²⁵ and unofficial start-ups. A recent study from the Cambridge cluster found unofficial start-ups to outnumber spin-outs (Figure 12) (Garnsey and Mohr 2010). In addition to universities, research institutes and technology intermediaries can also be valued sources of start-ups (Connell and Probert 2010).

Universities and other research institutions can offer access to advanced technology laboratories, equipment and other research

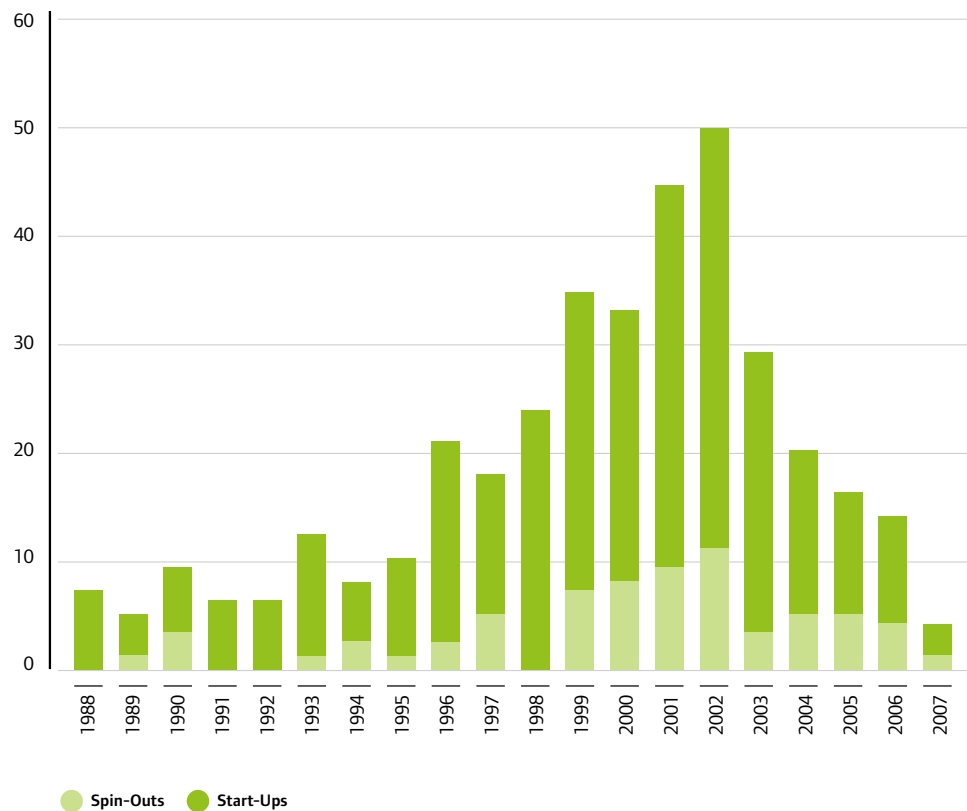
and technical resources, but also offer access to 'talent' such as faculty, staff and students (Phillips 2002; Koh, Koh *et al.* 2005). In a review of incubator studies, universities have been identified as a key factor in the success of incubators (Hackett and Dilts 2004b; Phan, Siegel *et al.* 2005). However, it is suggested that the role of universities should be more than just geographic proximity (Ratinho and Henriques 2010), and should include formal and informal exchange relationships with the incubator (Rothschild and Darr 2005). It is argued that people are the main contribution of universities to firms rather than specific technologies, and that a 'people-centric' approach to the innovation process should be emphasised (Allott 2006; Connell and Probert 2010).

A study of spin-out activity and entrepreneurial support strategies found three models (low selective model, supportive model, incubator model) largely dependent on the entrepreneurial orientation and support structures of the university and region.²⁶ As not all universities have a cultural fit with entrepreneurial endeavour, the 'low selective model' is involved in changing this culture and often works with university researchers at the end of their contracts on very early-stage ideas requiring much support. Public funding is usually attracted due to the need for enterprise to create jobs in areas with high unemployment. A more 'supportive model' is similarly positioned but with more interventions like business plan competitions and a need for business support in specialised units e.g. incubators. The third 'incubator' model, typical of regions like Cambridge, UK where the university and region largely embrace entrepreneurial culture, are more focused on the support of ventures complementary

25. Academic spin-outs have been associated with lower failure rates if benefitting from a strong IP license and/or have a professor on senior management, but graduation from the incubator is also retarded (Rothaermel and Thursby 2005).

26. Clarysse, B. *et al.* (2005) Spinning out new ventures: a typology of incubation strategies from European research institutions. 'Journal of Business Venturing', 20: 183-216, p.194.

Figure 12: Spin-outs and start-ups from Cambridge University



Source: Garnsey and Mohr 2010.

to regional expertise and with a global commercialisation perspective. In this third model, venture capital funding is often essential to enable ventures to fully develop. To adopt a model without consideration of regional resources and competences risks failure, as often happens when regions expect to emulate activities in atypical regions like Silicon Valley or Cambridge, UK (Clarysse, Wright *et al.* 2005).

Similar results were found in incubator studies pre-2000. A significantly lower technological orientation was found to exist in incubatees at rural incubators in Germany (Sternberg *et al.* 1997 in Tamasy 2007). Luger and Goldstein (1991) propose that science parks in smaller regions (<100,000 residents) can overcome locational disadvantages through good leadership, good luck and good planning. However, evaluations of incubators located in East Germany in the 1990s suggest that incubators provided useful facilities such as rental space and telecommunications because these were poor elsewhere, but that business support services were of little significance (Sternberg *et al.* 1997 in Tamasy 2007). So

while, for example, incubator linkages with university are associated with technology firms with higher growth potential, the presence of a university is not sufficient for success.

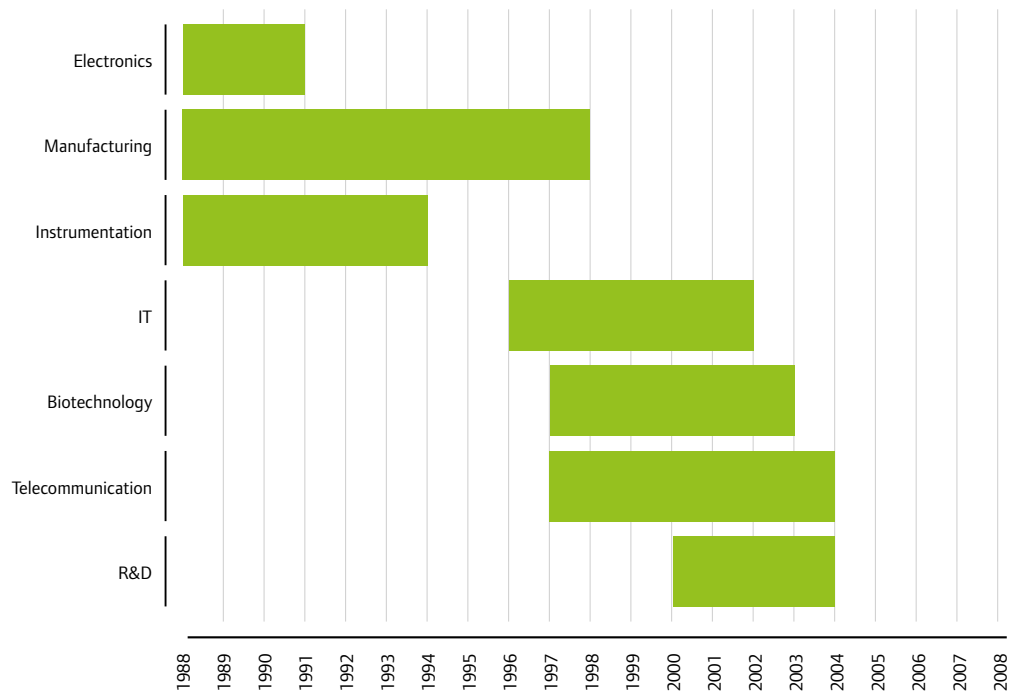
6.1.1 New venture activity and business support needs vary across industries

Firms face different challenges depending on the industry in which they operate, whether through capital requirements or because of the stage of industrial development (emerging versus mature industries) (Dee, Ford *et al.* 2008). Changes in the types of industries in which incubatees operate are important for managing the provision of incubator services. A recent study of high-growth firms in Cambridge showed the cluster was aided by entry waves of firms in different sectors (Figure 13) (Garnsey and Mohr 2010). Similar sectoral changes have been seen amongst incubator tenants (e.g. EBN-BIC Observatory).

6.1.2 New venture activity and business support needs vary depending on prior entrepreneurial experience

A recent study of St John's Innovation Centre shows entrepreneurs seek different

Figure 13: Entry waves of firms in different sectors in Cambridge



levels and kinds of services depending on their prior entrepreneurial experience (Figure 14). Companies without start-up experience sought the most support with functional skills e.g. marketing, IT, legal and government regulations in addition to market and opportunity understanding. Companies with start-up experience sought the most support in strategic information e.g. market and opportunities, customers, PR in addition to access to related R&D activity (Lacher 2011). Further research is needed to assess how generalisable these findings are to other incubators, and the implications of this for improving incubator performance. Nonetheless it is likely that entrepreneurs benefit from peer-to-peer networking due to the mix in entrepreneurial experience between peers.

6.2 Matching incubator services to the needs of tenants

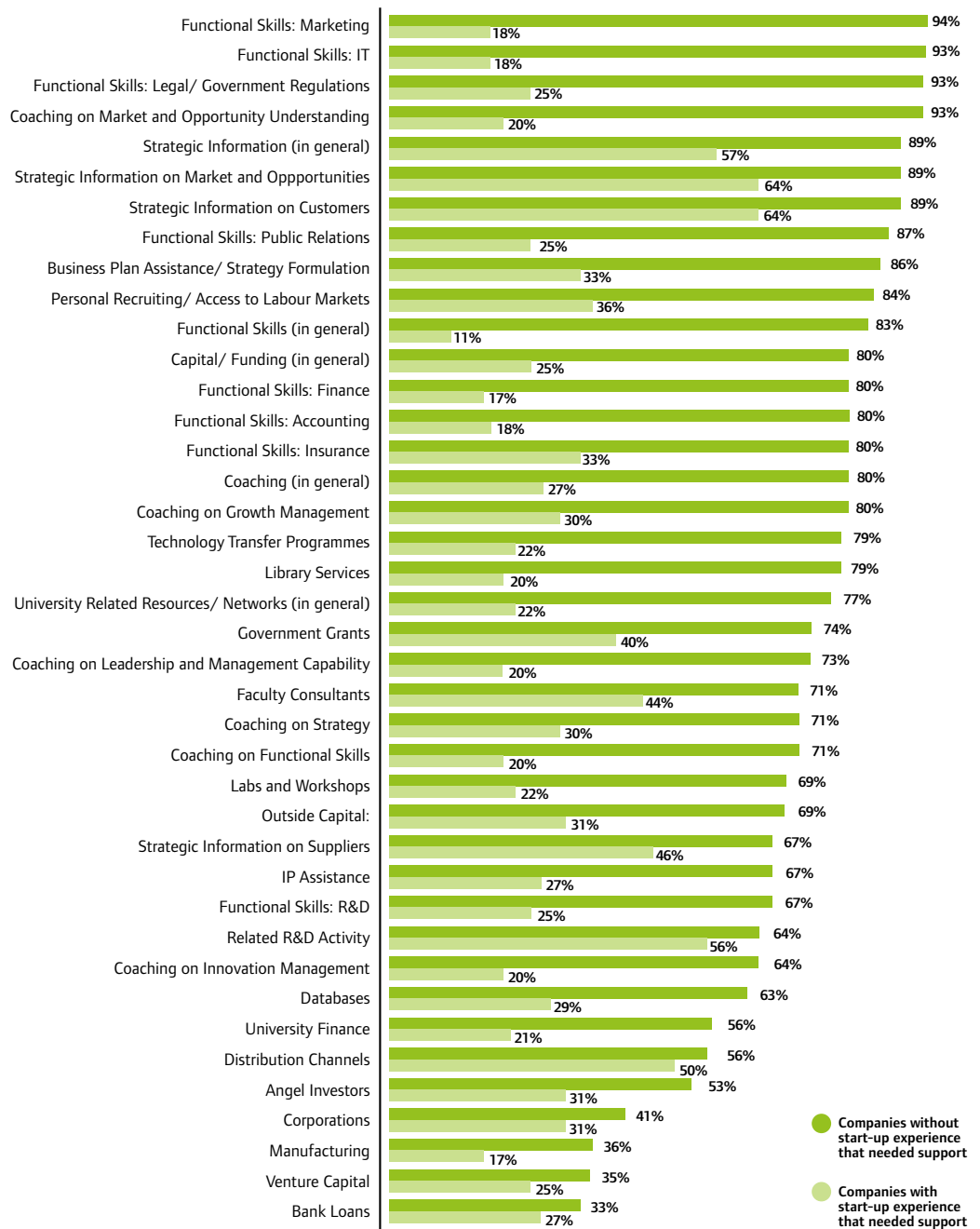
As shown, the business support needs of firms vary over time and across regions. An incubator's services should reflect the needs of their clients i.e. firms. Evidence suggests incubator services do vary and support enterprise for a variety of goals e.g. specific demographic groups (e.g. African-Americans, women), industries (e.g. fashion, food) or to stimulate enterprise in poor regions. The

dominant types of incubator programmes remain technology or mixed use, with 39 per cent of US programmes being classified as technology, 54 per cent as mixed-use (Knopp 2007). Another study reported 45 per cent of incubators as technology based with 36 per cent being mixed use from a survey of 78 incubators across 19 countries (Mubarak Al-Mubarak and Busler 2010). A US study found technology programmes to offer more intellectual property management compared to other programmes (Figure 15). More research is needed to understand how much specialisation is appropriate for different business incubation contexts. Typically a business incubator will introduce some kind of selection mechanism to potential tenants if it is to specialise, which we now discuss.

6.2.1 Selection processes of incubators

Rather than cater to all types of firms, most business incubators introduce a selection process to target a particular group of firms. There seems to be agreement among researchers that selection is an important incubator management task (Hackett and Dilts 2004b; Bergek and Norrman 2008). In Europe 97 per cent of incubators use a set of screening factors to evaluate potential tenants (Aerts, Matthyssens *et al.* 2007). Implementing appropriate selection processes for entry into an incubator enables a better 'fit' between the services it provides and the

Figure 14: Comparison of services sought by companies with and without start-up experience at St John's Innovation Centre, Cambridge UK

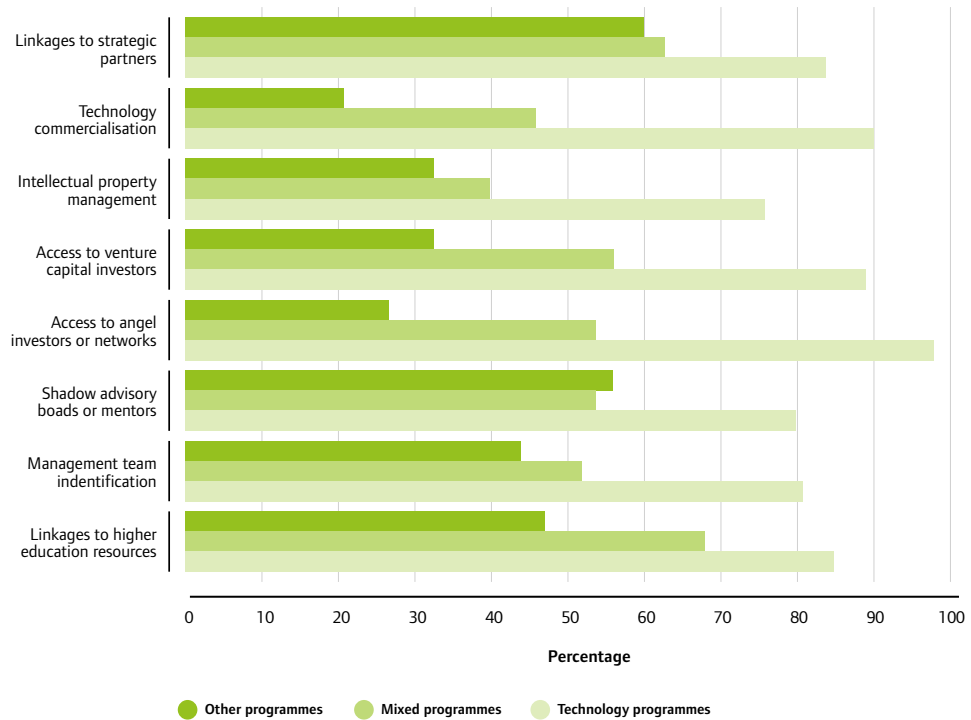


Source: Lacher 2011.

needs of tenants. It is a task subject to errors owing to the challenge of distinguishing between the potential of entrepreneurs operating with different types of uncertainty (e.g. technological, market, regulatory etc.). It has been argued that this is reason enough to let as many entrepreneurs try as is reasonably possible since 'important qualities, for instance if the person is coachable, are not possible to fully detect at a screening meeting' (Aaboen 2009 p.661).

Selection processes can be broadly split into those focused mainly on the idea or those focused primarily on the entrepreneur or team (Bergek and Norrman 2008) (Box 2). Another study exploring the link between screening practices and incubator performance suggests a significantly positive relationship between tenant failure and the S-index i.e. a high concentration on one screening dimension (financial factors, team or market) (Aerts, Matthyssens *et al.* 2007). This implies screening processes should include a variety

Figure 15: Percentage of incubators that offer these services across different programmes



Source: Knopp 2007.

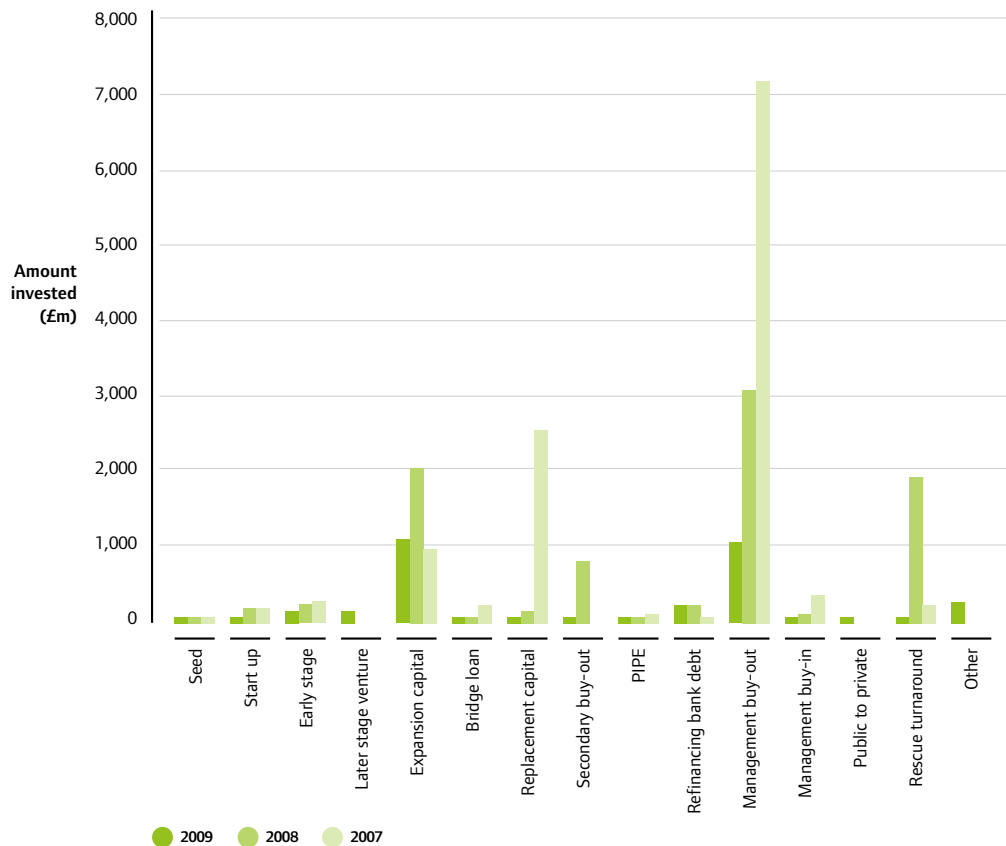
Box 2: Selection strategies

Selection strategies	Survival of the fittest	Picking the winners
Idea-focused selection	The portfolio will presumably consist of a quite large number of idea owners (or upcoming entrepreneurs) with immature ideas related to a broad spectrum of fields.	Results in a highly niched portfolio of thoroughly screened ideas within a quite narrow technological area – often sprung from the research of highly ranked universities.
Entrepreneur-focused selection	The resulting portfolio will be diversified, and consist of entrepreneurs/teams with strong driving forces representing a broad set of ventures.	The portfolio consists of a few handpicked and carefully evaluated entrepreneurs, commonly with ideas coupled to the research areas of a nearby university.

Out of the incubators studied (16 Swedish VINNKUBATOR incubators) six were focused on the entrepreneur, seven on the idea with three having equal emphasis on both. Most had an emphasis on ‘picking the winners’ but also had pre-incubation processes with a qualification process of ideas. Only one had a survival of the fittest approach where around 40 per cent of candidates were accepted, though this incubator also had a significantly higher number of incubatees. Other incubators had a rejection rate of around 80 per cent. (*Research Methodology involved screening incubator applications for the VINNKUBATOR programme which has limitations*). (Bergek and Norrman 2008)

Source: Bergek and Norrman 2008 p.24.

Figure 16: UK Investment by financing stage



Source: BVCA.

of factors. An alternative approach is taken by organisations like St John's Innovation Centre that carefully position their brand to enable ventures to self-select if they think the facilities and services are matched to their needs. Like a venture capital investor, incubators need deal flow. A selection process can only be imposed if the business incubator can afford to turn away potential tenants. Many incubators rely on rental income as part of their revenue stream and so need to fill capacity.

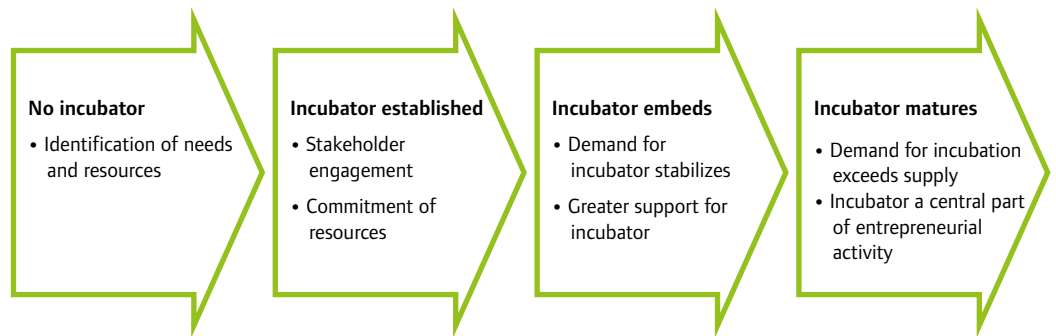
6.2.2 Graduation process

Graduating firms out of incubators creates room for new incubatees. While some incubators retain 'anchor tenants', many have a policy for firm graduations. However surveys indicate this is rarely strongly enforced (CSES 2002). It has been suggested that more proactive monitoring of incubatees during incubation may enable interventions to support business closures rather than prolonging time to closure (Schwartz 2009). But firm closure still remains a challenging decision to be made by founders.

6.2.3 Continuity during fluctuations in entrepreneurial support mechanisms

In addition to the changing needs of entrepreneurs who request support from incubators, incubators must also remain engaged with fluctuations in entrepreneurial support mechanisms. For example, we have recently seen a switch from regional development agencies to a centralised Technology Strategy Board for the administration of grants for new firm development in the UK. In addition to changes in public support mechanisms, the private sector also varies over time as shown by the dramatic differences in the amount of equity finance available through venture capitalists over the last three years (Figure 16). The incubation environment offers an opportunity to reduce the search costs involved in staying up to date with entrepreneurial support mechanisms through access to incubation staff and peers. Incubators are able to help tenants transition between different approaches and capacities of varying entrepreneurial support mechanisms.

Figure 17: Life cycle of incubator



Source: Adapted from Aaboen 2009.

27. Madeira Tecnopolo's incubation programme is a cause of tenant dissatisfaction. Companies are admitted after winning an award that entitles them to a year's business incubation services, but the services are rigid and often inappropriate for the firms. In the same study the Sogist Incubator was criticised for locking tenants into a one year lease which reverted to shareholding capital on the agreement of both parties. Successful companies did not agree to this while unsuccessful tenants needed an increase in capital. As a result Sogist has not acquired any shares. (Ratinho and Henriques 2010).

28. For example: 'Brazilian industry associations utilised the incubator to expand clusters of low-tech firms while municipalities, universities and industrial associations combined the objectives of the high- and low-tech incubators in a mixed format. Public universities and political groups with social objective invented the incubator for cooperatives as a means of combating poverty.' P.412 Etzkowitz, H., Manoel Carvalho de Mello, J. *et al.* (2005). Towards 'meta-innovation' in Brazil: The evolution of the incubator and the emergence of a triple helix. 'Research Policy', 34: 411-424.

6.3 Without 'fit' there is failure

Tenants seem to become dissatisfied with incubator support when the incubators programme is predetermined rather than re-evaluated depending on the changing needs of tenants (Ratinho and Henriques 2010).²⁷ A prescriptive strategy enforced through rigid monitoring can erode the ability to apply lessons learnt and adapt to changing conditions (Teece, Pisano *et al.* 1997). A critical function of incubators seems to be the ability to learn and adapt to the changing needs of their tenants:

'It is important for us to stress the usefulness of a variety of different incubators adhering to different incubating models, whose rationale lies behind the existence of companies with different business models and with different requirements.' (Grimaldi and Grandi 2005) p.119

Similarly it is important to take account of regional differences when establishing incubators.²⁸ For example while many try and emulate incubation strategies from Boston or Southern California (US) or Cambridge (UK), these regions are also considered atypical and likened to 'regional incubators' owing to the amount of entrepreneurial activity and infrastructure (Clarysse, Wright *et al.* 2005).

In recent years, both funds and incubators have been used as policy tools for regional development, especially the fostering of innovation or the commercialisation of research. What was recently written of incubation: "public sector venture capital is unable to create entrepreneurial regions and [...] a regionally-based model of public sector venture capital is ineffective because it lacks scale. A new approach for venture capital-deficient regions

is therefore required which gives greater emphasis to the demand side [...] The key policy question is whether public sector venture capital is an effective means of achieving regional development. Emerging evidence is not encouraging." (Mason and Perrakis 2009) pp1, 24. Similarly placing an incubator in a region does not guarantee it will have suitable tenants to incubate nor attract sufficient support or resources from the local business environment. Neither venture funds nor business incubators on their own can create an entrepreneurial or innovative ecosystem. To be successful they must work with a wide range of other actors, from research institutions to (serial) entrepreneurs to specialist advisers, grant-providers, angel investors and many more.

Even within an entrepreneurial region it can take time for incubators to become embedded in the local business environment. The life cycle of an incubator starts when its establishment is proposed (Allen 1988; Aaboen 2009). Once built, the incubator aims to achieve full occupancy and stable demand for space, finally reaching a stage of more demand for space than it can service and becoming a centre of entrepreneurial gravity in the community (Allen 1988; Hackett and Dilts 2004b) (Figure 17). Initially a young incubator is more likely to suffer from insufficient demand for its services and fail to reach a critical mass of its target clients (Tamasy 2007). As an incubator becomes more embedded and known, the recruitment of new tenants should become easier and with more potential tenants to choose from the more selective the incubator can be (Aaboen 2009). As an incubator develops it should build knowledge and networks that increasingly meet the needs of tenants in combination with the resources and opportunities associated with the local business environment. This can lead to increasing specialisation by the incubator.

Part 7: The incubator business model

While it has been possible to provide some indication of income and expense by incubators and key business model variables, we find further research is needed to understand the financial implications of different models.

Experimentation with business incubation models continues. Some incubators offer equity finance, and some equity investors offer incubation, with an unclear distinction between both. There is anecdotal evidence that some incubators are much more industry-focused than others, and try to develop a portfolio of complementary incubatees who are actively encouraged to collaborate. Others are building on existing relationships from prior successful ventures to organise incubation-like activities that centre around bringing together individual's with partially developed ventures that are able to 'plug in to' the entrepreneurs/incubator managers existing networks and resources.²⁹ Whether these activities improve the business model or financial returns of business incubation remains unclear.

As described in the previous section, learning, adaptation and flexibility are key to ensuring an incubator meets the needs of its clients. As the business environment changes, so does the business model of the incubator. We examine data relating to incubator business models in more detail, which while limited, offers some useful insights. For example both the EBN-BIC and NBIA networks suggest the operating costs of incubators per job created have increased over the last few years (Figure 18). However it is likely this phenomena is linked to a variety of issues unrelated to the quality of incubation services.

7.1 Capacity ratio

Space occupied as a percentage of total rental space available has been termed the capacity ratio (Rice 2002). While incubators need to be a certain size to generate rental revenue sufficient to sustain activities (Knopp 2007), the reality is incubators come in a range of sizes (Figure 19). Anecdotally, a 2006 report by the US NBIA reported that the key to running an incubator with a small space is to have multiple external revenue streams and to not count on any one single stream to underpin the success of the incubator's business model (Knopp 2007).

7.2 Stakeholders not shareholders

The majority of existing incubators have mixed revenue sources and as a result deal with a variety of stakeholders. For example in contrast to professional services firms who secure revenue through billable hours, often publicly funded programmes – a major source of income for many incubators – have fixed fees (Aaboen 2009). With multiple stakeholders come principal-agent problems, where priorities can become biased or conflicted.

7.2.1 Incubator revenue

There are four main sources of revenue for business incubators: rent from tenants, fees from providing business support services to tenants and others, sharing in client successes through equity or royalty agreements, and sponsorship from public or private sources (Figure 20 and Figure 21). Most incubators have mixed income from a variety of sources, which can cause principal-agent problems. In the US anchor tenants (businesses that do not

29. Rocket Internet was set up in 2007 by the European Founders Fund and has since 'produced' ventures (mainly internet) worth more than \$300 million. (Examples of successful exits are: StudiVZ, a copycat of Facebook, sold for \$110 million in 2007 or CityDeal, a copycat of Groupon, recently sold for \$210 million in 2010). See: <http://www.rocket-internet.de/?lang=en> Another example of a similar initiative is <http://hackfwd.com>

Figure 18: EBN BIC 2009 Observatory

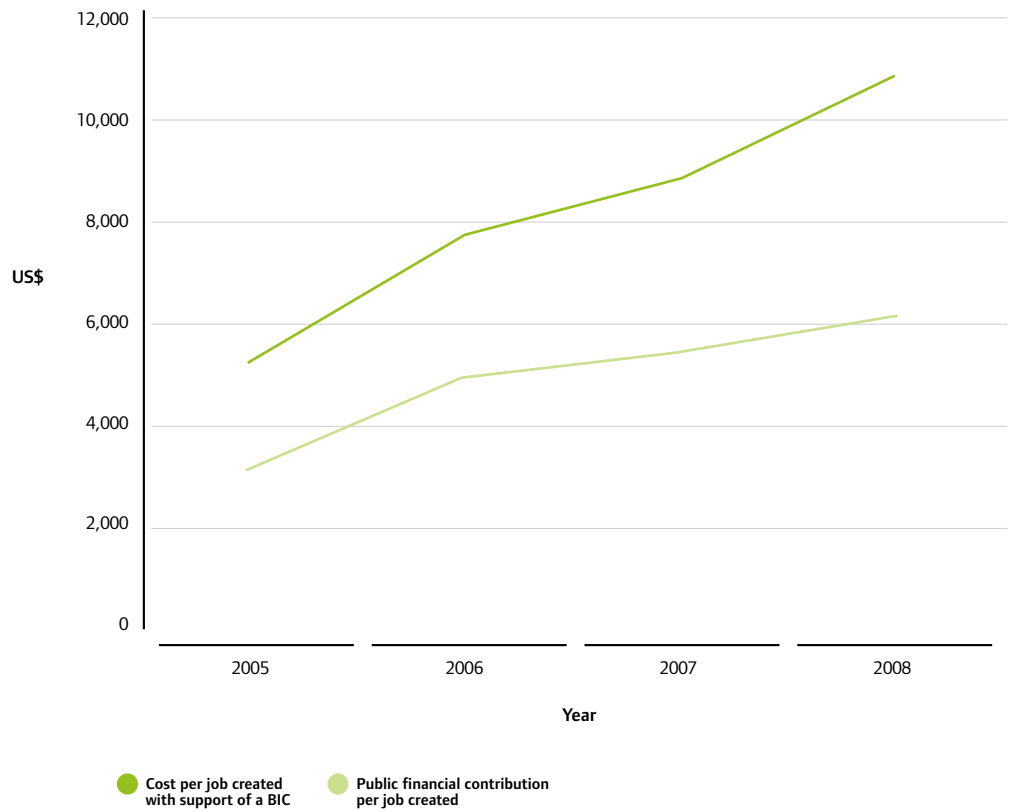
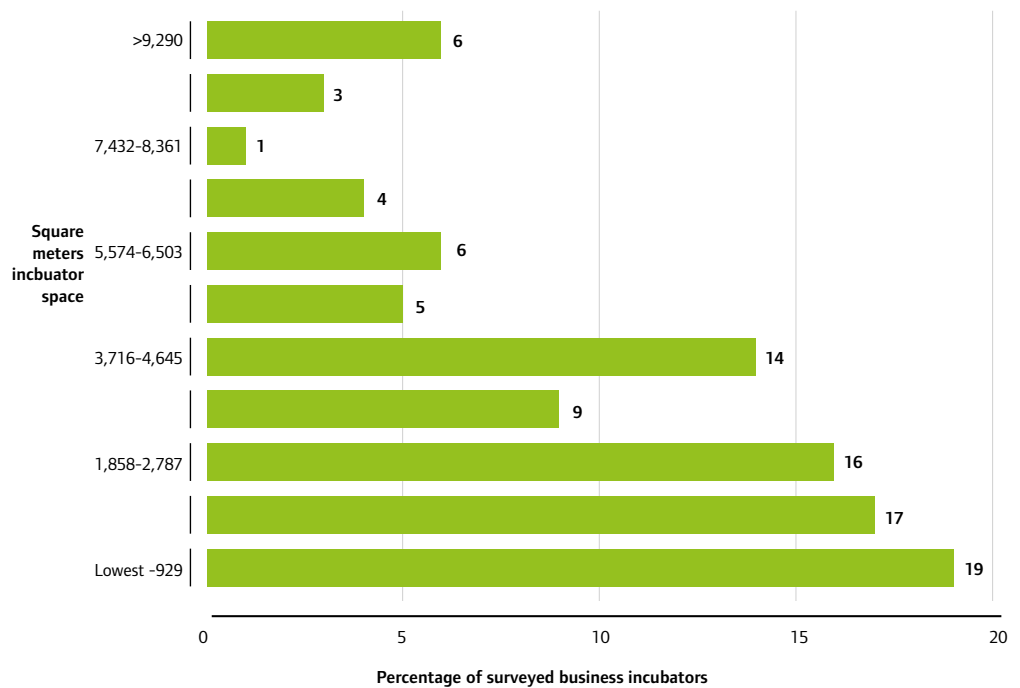
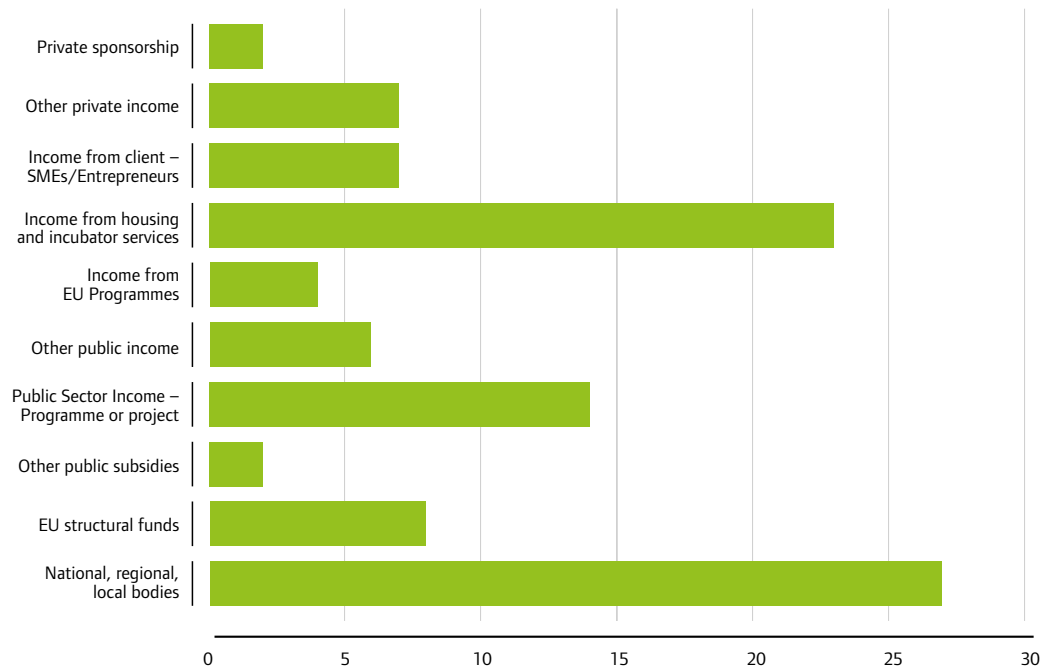


Figure 19: Incubator square meter space (converted from square feet)



Source: NBIA 2006.

Figure 20: Composition of income of European EBN-BICs in 2008



Source: Observatory 2009.

Figure 21: Composition of income of NBIA US incubators (technology and non-technology incubators)

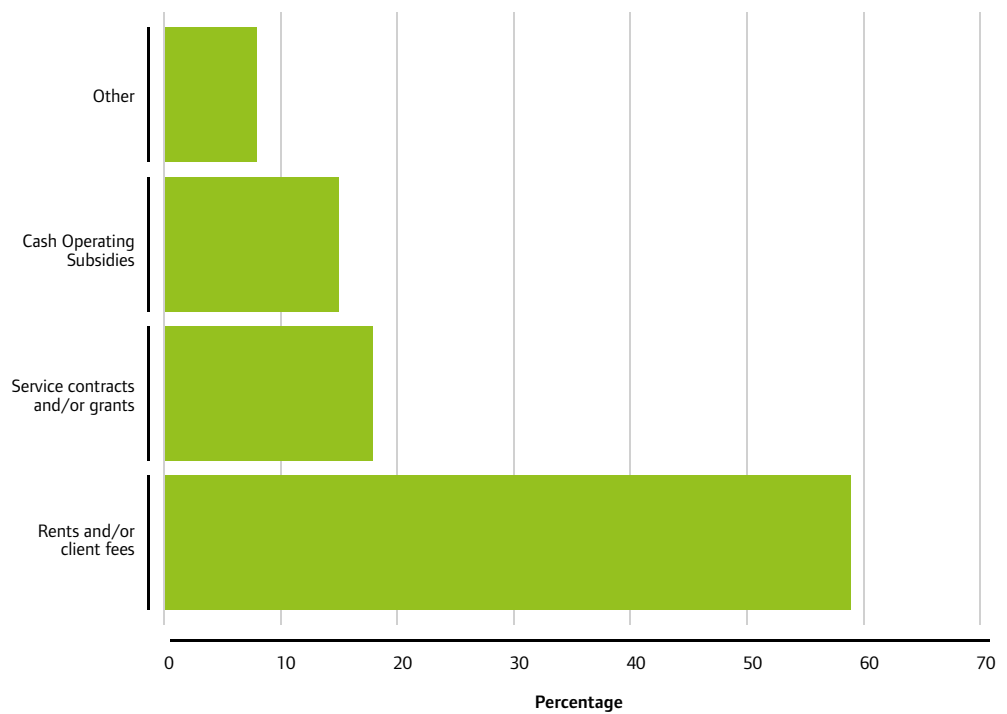
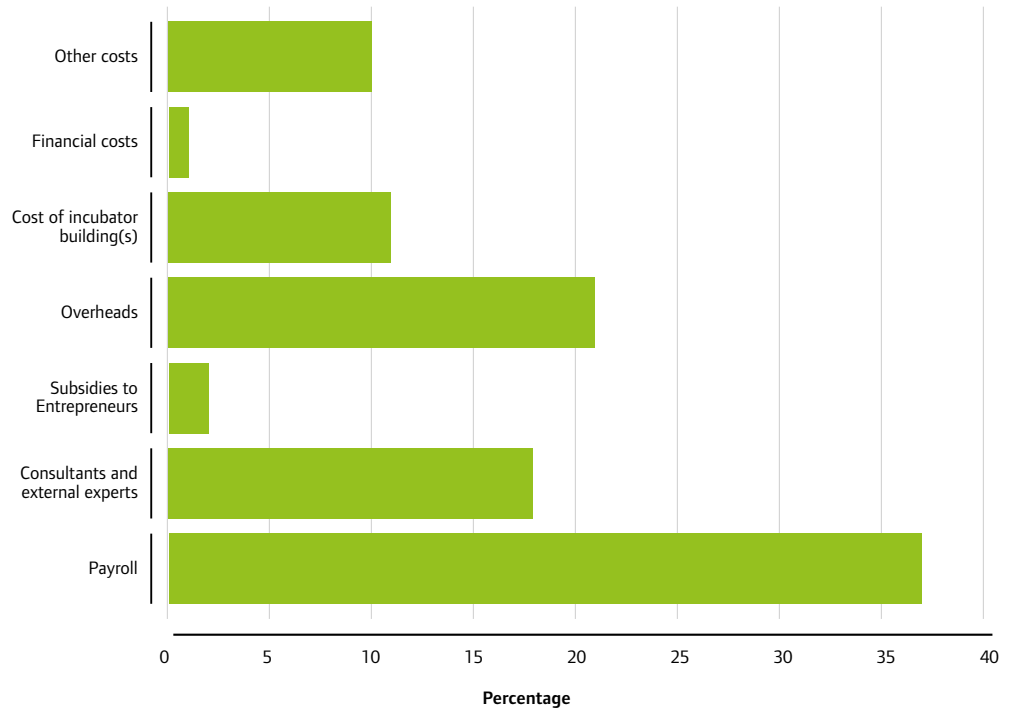
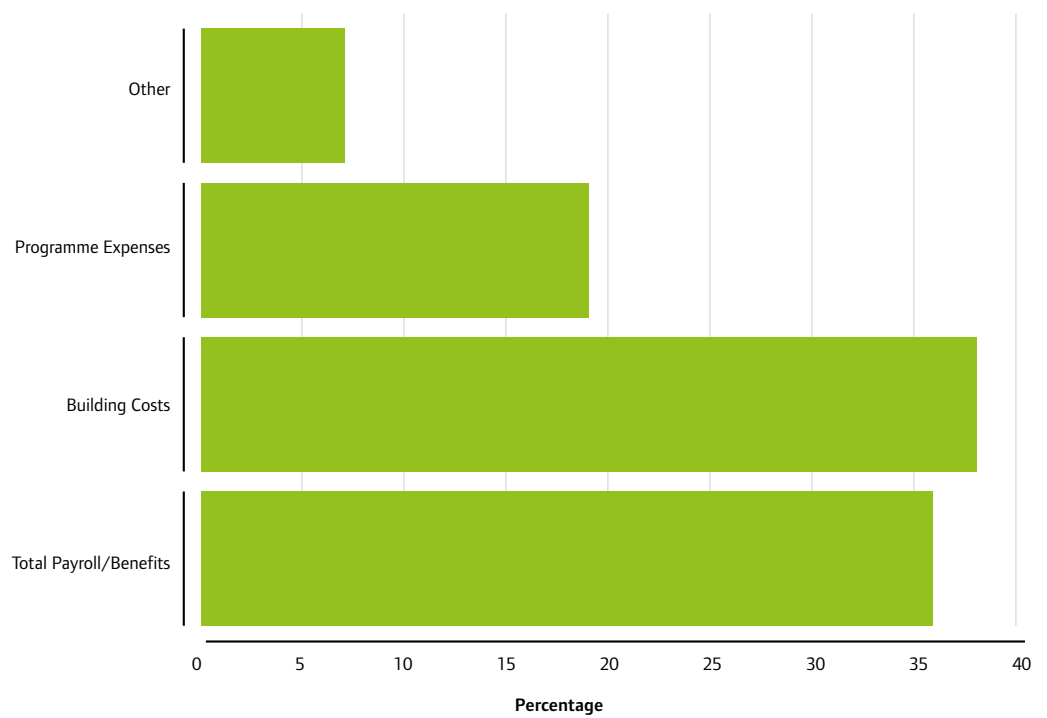


Figure 22: Average European incubator expenses



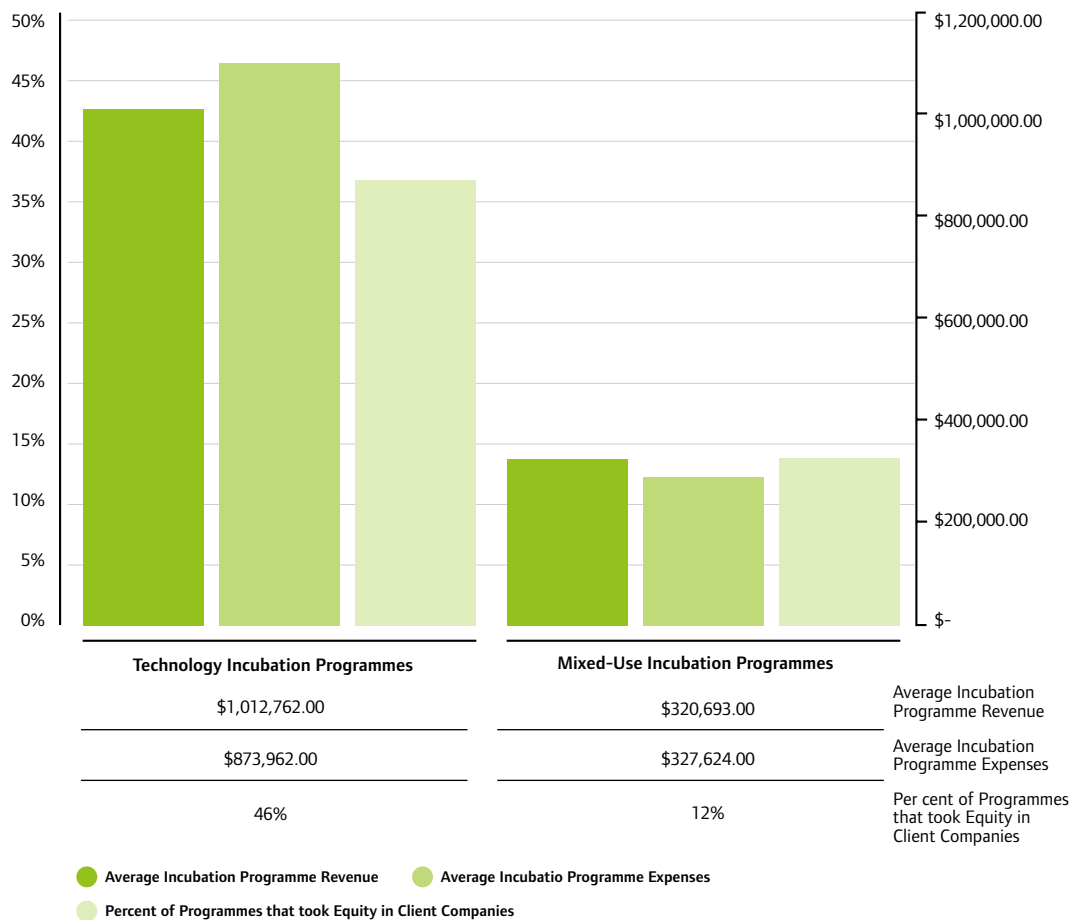
Source: EBN-BIC 2009.

Figure 23: Average incubator expenses in the US



Source: NBIA 2006.

Figure 24: Comparison of technology incubation programmes versus mixed-use in terms of revenue, expenses and equity



Source: NBIA 2006.

receive incubation services but remain in the incubator facility) can provide a stable revenue stream and experienced mentors (Knopp 2007).

Corporate funded incubators can reduce the reliance on a mixed revenue stream, but will require incubatees which fit with the goals of the corporation. We have not explored corporate incubation in depth, as this applies to a specific sub-set of incubators. These incubators tend to have particular goals such as providing an environment for the nurture of ideas unable to thrive within the corporate environment, or to attract in new ideas from outside the corporate (Ford, Garnsey *et al.* 2010, Ford and Probert 2010). Strategic alignment with the corporate is often critical, as is separating corporate decision making from incubator decision making.

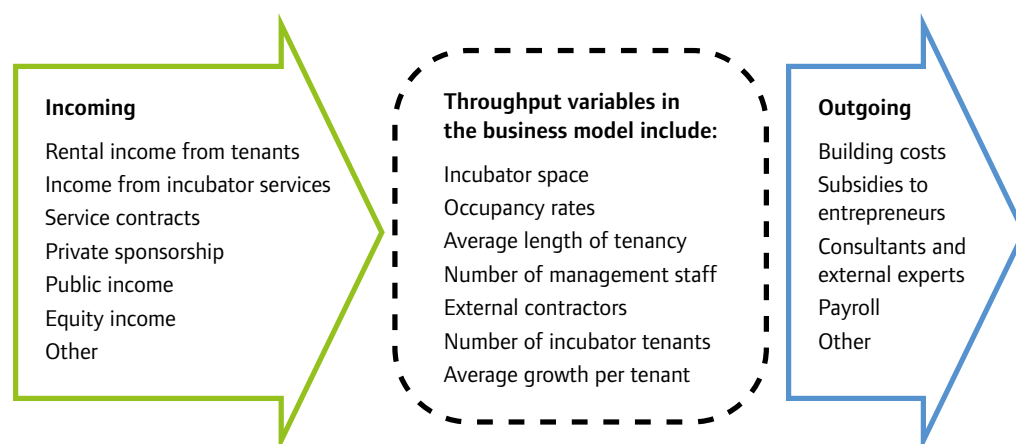
During the dotcom speculative bubble there was a surge in the establishment of for-profit incubators. These incubators were largely based

on a venture capital model with the addition of facilities, physical space and support services. Dave Wright from the Aberdeen Group estimated that 37 such incubators existed in the US in January 1998, growing to 400 by July 2000 (Wiggins and Gibson 2003). Few now remain (those that survived revised their business models and/or selection criteria), and those who achieved IPOs suffered huge losses in share value after the crash.

7.2.2 Incubator expenditure

There is some guidance on expected incubator costs (Figure 22 and Figure 23). The expense of payroll for incubator staff seems comparable across the NBIA and EBN-BIC. However, there is a lack of information explaining differences between expenses and the ranges expected. The higher reliance of the NBIA group on building costs could be due to the inclusion of 'incubators' who focus predominantly on real estate compared to the EBN-BIC network.

Figure 25: Illustration of key variables in the business models of business incubators (more info in Appendix C)



7.3 Technology business incubators

The NBIA offers the most information regarding the difference between technology, and mixed or non-technology incubation programmes, and suggest the cost of technology incubation to be higher than other incubator programmes (Figure 24). However another study contradicts this finding suggesting costs per job created are similar between technology and non-technology incubators (Phillips 2002). Some of the differences in revenues and expenses are likely due to incubators taking equity stakes, but more research is needed.

7.3.1 Equity stakes

The literature gives little insight into whether business incubators could generate better returns for early-stage investments than other kinds of investors. Early-stage investments typically have poor returns compared to other types of equity investment, and European internal rates of return are lower than in the US (Figure 16 p.31) (BVCA 2009). In the US nearly half (46 per cent) of technology incubators reported taking equity in some or all of their tenants (23 per cent in all clients, 23 per cent in selected ones). In these incubators investors are usually an integral part of operations (Knopp 2007). On closer scrutiny of the 'incubators' identified by organisations like the NBIA, some have also been referred to as 'investors' and are motivated by financial returns on investment.³⁰ As organisations like the NBIA are membership-based it is perhaps not surprising to see a broad range of members. These types of equity investments are likely to face similar problems as other early-stage investments (Gill, Minshall *et al.* 2007; Dee and Minshall 2011).

7.4 Further research is needed on business models

The previous chapters discussed how business incubators can, but do not always, add value to new ventures. For incubators the challenge is capturing some of this value. Generating revenue from services when clients are resource constrained is often not sustainable without subsidies from public bodies. This impacts value capture from renting space and supplying business support services. Capturing value through taking equity in clients introduces delays in revenue, and can cause the incubator to behave more like an equity investor by prioritising short-term financial returns rather than longer-term performance (Hsu 2007; Dee and Minshall 2011). Alternatively relying on mixed income from public and private sectors can lead to 'principal-agent' problems as incubators try to respond to multiple-objectives.

A summary of business model characteristics of business incubators is in Appendix C (p.44) and is summarised in Figure 25. Appendix C provides a snapshot comparing business incubation studies across countries³¹ to identify average performance of incubators. However, this includes a range of locations and activities and so does not offer guidance for the 'best' incubator, just a reference point as incubators vary widely. Further research is needed to understand the appropriateness of business models for different contexts.

30. As an example, the Internet Capital Group (ICG) was established in 1996 as a leader in the tech boom. While identified by some as an incubator (Wiggins and Gibson 2003), it also provides 'patient capital'. It is an example of an organisation that has been classified as both an investor and incubator, though it uses the same core business model as many investors. See: www.icg.com

31. While countries can change, as seen in Israel's transformation to a global innovation leader, the tools used extend beyond incubation.

Part 8: Concluding remarks

This project arose from a call from NESTA for a literature review of ‘what works’ in incubation and acceleration of high-growth firms. Conclusions cluster around four broad themes:

1. Business incubators can provide value to both entrepreneurs and regions

Incubation can impact new ventures through modifying or accelerating the entrepreneurial process of business development. Incubators can add value to new ventures by lending credibility through association and access to: shared (and therefore affordable) professional facilities; business support and coaching; additional resources and networks (internal and external). Essential to this process is for the incubator to respond to the needs of ventures, needs which change frequently.

Behaviour and adaptability are heavily influenced by targets and rewards. As with resolving issues of identifying appropriate performance indicators, ensuring that incubators can respond to the changing needs of entrepreneurs requires creative thinking, with considerable practitioner input. Incubator managers are less effective when distracted from their core activities by excess monitoring or the need to secure funds for the business incubator, but without some performance indicators managers cannot analyse and improve outcomes. The approach taken in Sweden (which has a large and well-resourced incubator programme) has been to develop an online assessment tool in *collaboration with incubators*. The tool is of use to incubators for monitoring their own performance and so demonstrating value provided, but also enables a centralised collection of data for review by public bodies.

Developing appropriate high-level objectives will oblige funding authorities and incubator managers alike to consider more carefully the purposes for which incubation exists (“*What is incubation for? Why invest in incubators? Value for whom?*”). Many popular incubation metrics favour short-term results at the expense of the longer-term creation of value. For example a popular metric is job creation, but this contrasts the views of venture investors who are acutely aware of the need to control spending by investee firms (which may also be incubated), which often means delaying recruitment as long as possible. Longer term, the challenge for incubators is to help develop a relatively small number of high-growth, internationally competitive companies, even if these companies realise their success after incubation.

As the incubator industry matures, its collective understanding of its core purpose becomes more sophisticated. If in 1985 “*the universal purpose of an incubator [was] to increase the chances of an incubatee firm surviving its formative years*” [Allen and Rahman 1985] by 2007 the definition recognised the need to add value: “*we define business incubator as a shared office space facility that seeks to provide its incubatees [...] with a strategic, value-adding intervention system of monitoring and business assistance.*” [Hackett and Dilts 2007].

Implicit in adding value are time, cost, professional expertise and other resources. As with a venture portfolio, it is fair to consider whether survival of incubatees alone, or the creation of jobs, is an appropriate return on such investment. As one serial incubator manager put it, “*if you want jobs, set up a call centre.*”

2. Absolute measures of incubation are impractical, but performance indicators are useful

Lack of consensus on how to measure the performance of new ventures complicates the measurement of incubation – as does lack of consensus on the definition of an incubator. Measures of survivability are often used, but graduating from an incubator is not a measure of business success, and maintaining longitudinal data is often impractical. An absolute measure of incubation is unrealistic, and would likely be onerous and distracting. But performance indicators are valued, especially when developed in conjunction with incubators.

Such indicators help managers to move beyond the 'black box' approach to incubation – reliant mainly on the tacit skill of the incubator team in deploying limited resources in a given infrastructure – by providing insight into what works and how improvement is possible.

Incubator industry representative bodies in several countries exhibit similar behaviours in making ambitious claims for the results achieved by their members, using measures such as numbers of businesses assisted, numbers of jobs provided by client firms and post-incubation survival rates. Since the great majority of incubators depend in whole or in part on public funding to run training and/or advisory programmes (one of the key differentiators between incubators and managed workspace), such 'spin' is unsurprising.

However, the sometimes unrealistic relationship between funding authorities and incubator centres exacerbates the problems inherent in gathering useful performance data on a consistent basis, data from which greater insight into the effectiveness of incubators (from building design to staff recruitment to programme delivery) can be derived and which can serve as a basis for continuous improvement. Simplicity and relevance matter more than comprehensiveness. Staying in touch with former incubatees is important but is unlikely to be completely successful with larger, older incubators, the short-term fix of social networking notwithstanding.

3. 'Fit' with the local business environment is critical

Incubator failures tend to be associated with the adoption of strategies inappropriate for

the local business environment; for instance, incubators tasked with supporting high-growth firms must be in a region associated with growth ventures. This typically involves strong technical expertise in addition to an entrepreneurial culture.

In needing to fit with its business environment, an incubator once more has much in common with a venture fund. In recent years, both funds and incubators have been used as policy tools for regional development, especially the fostering of innovation or the commercialisation of research. What was recently written of venture capital may also be said of incubation: *"public sector venture capital is unable to create entrepreneurial regions and [...] a regionally-based model of public sector venture capital is ineffective because it lacks scale. A new approach for venture capital-deficient regions is therefore required which gives greater emphasis to the demand-side [...] The key policy question is whether public sector venture capital is an effective means of achieving regional development. Emerging evidence is not encouraging."* [Mason and Pierrakis 2009, pp1, 24].

Neither venture funds nor business incubators on their own can create an entrepreneurial or innovative ecosystem; either, to be successful, needs to work with a wide-range of other actors, from research institutions to (serial) entrepreneurs to specialist advisers, grant-providers, angel investors and many more.

4. Many incubator business models depend on multiple stakeholders

While equity financing has been associated with around half of technology incubators in the US, questions remain regarding how these are categorised as some are also identified as investors. More typically incubators draw on finance from multiple stakeholders – public and private. With this mix of stakeholders can arise principal-agent problems.

One relatively recent conceptual framework proposed to help critical decision making by incubator managers is real options theory. This framework suggests that of five potential outcomes to the incubation process, 'outcome 4' (the operations of the incubatee are terminated, with losses thereby minimized) is a success and 'outcome 3' (an incubatee becomes part of the 'living dead', to borrow the venture capital term again) is a failure.

However, most subsidy-providers do not operate within an options framework and instinctively prefer company survival without growth to early closure of unpromising companies. Funding sources generally rely on intermediate outcomes (jobs, survival) at least as much as they use the hard measures of real growth and profitability.

Here incubation diverges from venture funding. Unlike finance managers reliant on realizing an investment portfolio at a significant profit, incubator managers have several sources of income – rent, grants, public or private consulting, conferencing and other services, share options – and so also numerous constituencies to please, whose interests may not always be obviously reconcilable. Part of the craft of the incubator management team is to understand such conflicts and resolve them so far as possible, while retaining ‘negative capability’ – an ability to improvise and live with the doubts and uncertainties inherent in an entrepreneurial environment.

Fund-based incubators aside, completely privately resourced incubators will always be the exception because they cannot monetize the externalities they produce. While the number and variety of ‘virtual incubators’ and acceleration programmes have grown, incubators with physical space – a space which has been likened to a ‘clubhouse’ – retain a convening power which is enhanced when the space is designed for business incubation, including having its own front door and open meeting areas.

After the remarkable spate of centre construction during the past decade in the UK, it is not surprising if the focus now is on programmes rather than buildings, on revenue rather than capital funding.³² But incubator centres remain as ‘bearers of normative order’ – systems of rules and common expectations. The specific needs of new firms and the programmes to help them (with the associated income) may all change every few years along with the staff; however, the incubator as building and institution provides the necessary stability within which these other changes can take place.

Incubators to flourish must adapt, but they also provide the continuity within which the conflicting and evolving demands of their disparate stakeholders can be resolved over time.

32. See, for instance, Department for Business, Innovation and Skills. (2011) ‘Bigger Better Business.’ pp9-10. A support package previously referred to as Growth Hubs and designed to assist high-potential SMEs, has been rebranded ‘business coaching for growth’, though the programmes also include investment readiness and other services commonly supplied by incubators. See: <http://www.bis.gov.uk/assets/biscore/enterprise/docs/b/11-zko515-bigger-better-business-helping-small-firms.pdf>

Appendix A: Performance indicators for business incubation

Table 5: Summary of measures used to assess the performance of incubators

Categories of performance measures	Literature	Organisa- tional level			Addressed stakeholder				
		Community level	Incubator level	Incubatee level	Entrepreneur	Investors	Employees	University	Government
Performance measures referring to the tenant company									
Tenant firms’ survivability	Allen and Levine 1986, Hisrich and Smilor 1988, Allen and McCluskey 1990, Mian 1997, Westhead 1997, European Commission 2002, Hacket and Dilts 2004, Knoop 2007, UKBI 2009, Amezcua 2010				■	■	■	■	■
Tenant firms’ sales growth (%)	Mian 1997, Allen and Levine (1986), Hisrich and Smilor (1988), Dettwiler <i>et al.</i> 2006, Lindelof and Lofsten 2002, Amezcua (2010), European Commission (2002), Chen (2009), Philips 2002				■	■	■	■	■
Tenant firms’ employment growth (%)	Allen and McCluskey 1990, Mian 1997, Udell 1990, Colombo <i>et al.</i> 2002, Dettwiler <i>et al.</i> 2006, Lindelof and Lofsten 2002, Amezcua (2010), European Commission (2002)				■		■	■	■
Tenant firms’ profit growth (%)	Mian 1997, Chen (2009)				■	■	■		■
Tenant firms’ profitability growth (%)	Dettwiler <i>et al.</i> 2006, Lindelof and Lofsten 2002, Chen (2009)				■	■	■		■
Tenant firms finance raised (\$)	Colombo <i>et al.</i> 2002				■	■			
Tenant firms’ taxes growth (%)	Mian 1997								■
Tenant firms’ export growth (%)	Mian 1997								■
Tenant firms innovative capability									
> Input measures									
Tenant firms’ number of scientists and engineers	Westhead 1997, Colombo <i>et al.</i> 2002, Siegel <i>et al.</i> 2003				■	■		■	■
Tenant firms’ R&D expenditure (\$)	Westhead 1997, Siegel <i>et al.</i> 2003				■	■		■	■
> Output measures									
Tenant firms number of patents	Udell 1990, Westhead 1997, Bearse 1998, Colombo <i>et al.</i> 2002, Philips 2002, Siegel <i>et al.</i> 2003				■	■		■	■
Tenant firms number of copyrights	Colombo 2002, Siegel <i>et al.</i> 2003				■	■		■	■
Tenant firms’ number of products/services launched (per year)	Westhead 1997				■	■			■
Incubatee outcome state	Hacket & Dilts (2004)								
The incubatee is surviving and growing profitably					■	■	■	■	■
The incubatee is surviving and is growing and is on path towards profitability					■	■	■	■	■

Categories of performance measures	Literature	Organisa- tional level			Addressed stakeholder				
		Community level	Incubator level	Incubatee level	Entrepreneur	Investors	Employees	University	Government
The incubatee is surviving but is not growing and is not profitable or is only marginally profitable					■	■	■	■	■
Incubatee operations were terminated while still in the incubator but losses were minimised					■	■	■	■	■
Incubatee operations were terminated while still in the incubator and losses were large					■	■	■	■	■
Start-up exit options	Hacket & Dilts (2004)				■			■	
Performance measures referring to the incubator (Programme)									
Incubator space	CSES 2002, Knoop 2006, UKBI 2009				■				■
Incubator occupancy rate	Allen & McCluskey 1990, European Commission 2002, UKBI (2009), Allen 1985, Campbell 1988, Allen and Rehman 1985, Smilor 1987				■			■	■
Average length of tenancy	CSES 2002				■			■	■
Average capital investment cost	CSES 2002, Knoop 2006				■				■
Proportion of revenue from public subsidies	CSES 2002, Knoop 2007								■
Number of incubator tenants	CSES 2002, Knoop 2006, UKBI 2010								
Presence of a complementing research park facility (yes/no)	Mian 1997				■				■
Share of operational budget supported through internal sources	CSES 2002, Knoop 2006, UKBI 2010								■
Level of funding received from key donors including state, industry, university	Mian 1997, Allen 1985, Rice 1993, CSES 2002, Knoop 2006, UKBI 2009				■	■	■	■	■
Development of incubator in life cycle	Allen 1988, Shermann and Chappel 1998				■	■	■	■	■
Graduation rate (graduates per year)	Allen and McCluskey 1990, Mian 1997, Udell 1990, European Commission (2002)								■
New firms created (per year)	Udell 1990,				■	■	■	■	■
Ratio of incubator staff: tenants	CSES 2002				■	■			
Proportion of management time advising clients	CSES 2002, Knoop 2007				■	■			
Cost per job (gross)	CSES 2002								■
Other Performance Measures (Associated with the Surrounding Region/University etc.)									
Contributions to sponsoring university's mission									
Salience of technology-based clientele (%)							■		
Impact on university's teaching and research (positive/negative)								■	
Training in entrepreneurial skills – student, faculty (#)					■			■	■

Categories of performance measures	Literature	Organisa- tional level			Addressed stakeholder				
		Community level	Incubator level	Incubatee level	Entrepreneur	Investors	Employees	University	Government
Students/graduates hired by tenants as employees (#)	Mian 1997								
Consulting relationships between university faculty and tenants (#)									
Impact on university's prestige/public image									
Impact on enrollments, donations, property value, equity/royalty income (#, \$)									
Entrepreneurs originating from the university community (#)	Mian 1997								
Entrepreneurs serving as faculty researchers (#)	Mian 1997								

Table 6: Effectiveness of management policies and practices (effectiveness approach)

Categories of performance measures	Literature	Organisa- tional level			Addressed stakeholder				
		Community level	Incubator level	Incubatee level	Entrepreneur	Investors	Employees	University	Government
Goals, structure and governance									
A technology/small business center is operational (yes/no)	Allen and Levine 1986, Smilor 1987, Mian 1997				■	■			
Presence of complementary R&D institutions nearby (yes/no)	Shermann and Chappell 1998				■	■			
Extend of realisation of the stated goals	Mian 1997				■	■	■		■
Management team and staff (quality of support)					■	■	■	■	■
Incubatee Selection Process	Kuratko and LaFollette 1987, Merrifield 1987, Bergek and Norrman 2008				■			■	■
Financing and capitalisation									
Funding sources and support made available to tenants					■	■		■	■
Operational policies									
Entry/selection policy	Allen 1985, Campbell 1988, Allen and Levine 1986, Smilor 1987				■			■	■
Exit/graduation policy	Allen 1985, Campbell 1988,				■			■	■
Tenant performance review					■	■	■		■
Favorable patent/intellectual property policies developed by university					■	■		■	

Table 7: Services and their perceived value added

Categories of performance measures	Literature	Organisa- tional level			Addressed stakeholder				
		Community level	Incubator level	Incubatee level	Entrepreneur	Investors	Employees	University	Government
Office space	European Commission (2002)				■	■			
Shared office services/infrastructure	Mian 1997, Mian 1997, Hisrich and Smilor 1988, Allen 1985, Dettwiler <i>et al.</i> 2006, European Commission (2002), Rice (2002)				■	■			
Business assistance	Mian, 1996, Bergek and Norrman 2008, European Commission (2002), Rice (2002)				■	■			
Internal incubator network formation	Lichtenstein 1992, Dettwiler <i>et al.</i> 2006, European Commission (2002)				■	■			
Incubator industry network and incubator support services network	Smilor 1987, Mian 1996, Hansen <i>et al.</i> 2000, Nowak and Grantham, 2000, Dettwiler <i>et al.</i> 2006, European Commission (2002), Rice (2002)				■	■			
Incubator manager – incubatee relationships	Autio and Kloftson 1998, Fry 1987, Rice 2002, Shermann 1999, Udell 1990, Rice (2002)				■	■			

Appendix B: Review of quantitative academic contributions

Author	Year	Country	Focus (incubator or firms)	Time period	Hypotheses/questions	Results	Comments
Rothaermel, Thursby	2005	USA	Single incubator study including 79 firms	1998-2003	That a university link (IP or a link to faculty) will decrease the likelihood of new venture failure but will also retard graduation from an incubator.	p. 1083 "... We find that a venture founded explicitly to commercialise a technology of the incubator-sponsoring university is significantly less likely to experience outright failure ... However we fail to find support for the hypothesis off retarded graduation ..."	Not a direct piece of work looking at the performance of incubators per se, rather looking at whether having links to a university which sponsors an incubator has impacts. Unclear whether the impacts are long term positive, and also difficult to generalise from one incubator study.
Aerts <i>et al.</i>	2007	European Union	Screening practices of European incubators based on a survey of 107 incubators	2003	Are screening practices of incubators linked to tenant performance, measured as company failure?	Built a screening index using three part model from Lumpkin and Ireland (1988) – financial, team, market and scored it as a Herfindal index from 0 to 1. Order of importance is market, team, then financial for the respondents. P.263 "...shows a significantly positive relationship between tenant failure rate and the S index. This means a high concentration on one screening dimension ... is related to a higher failure rate."	Much of the article is descriptive with this analysis piece in the middle. Not a very large sample (as data loss takes the N to 95 or lower in most models).
Chen	2009	Taiwan	122 new ventures	Not stated	Broad study attempting to capture various impacts on new venture performance of which incubators is one. Two relevant hypotheses – Incubator support positively moderates the effect of market scope on the performance of new ventures, and incubator support negatively moderates the effect of technology breadth and commercialisation speed on the performance of new ventures	p.99 "... Both incubator and venture capital supports do not have direct effect on ..." new venture performance.	While other measures are based on 7 point Likert scales, the incubator support construct is a categorical variable with two values – 1 for a venture that has incubator support and 0 if not. This is a very rough measure and cannot unpick differences between incubators.

Author	Year	Country	Focus (incubator or firms)	Time period	Hypotheses/ questions	Results	Comments
Schwartz, Hornych	2010	Germany	150 firms located in 26 German BIs	2008	Compares the impact of specialised versus non-specialised incubators to test the levels of interaction in the incubator and the likelihood of academic linkages	p.489 "The results do not support the presumption that specialisation strategies are conducive to incubator-internal networking." p.489 Specialised business incubator (SBI) firms tend to have more academic-industry linkages compared to diversified business incubator (DBI) firms.	The regression analysis has low explained variance and so this paper does not appear to provide significant input on whether incubators should be specialised or diversified.
Scillitoe, Chakrabarti	2010	Finland, USA	Firm level perspective based on a web survey of 42 companies, 28 US and 14 Finnish	2000-2004	The main hypothesis is that higher rates of contact between the incubator management and incubatees improves the quality of the business and technical support provided, specifically the learning of buyer preferences and improving technical know how.	Overall, stronger more frequent counselling contact improves incubatee learning of buyer preferences, whereas technical know how is increased through networking rather than through counselling.	Very narrow in its scope of internal effects on companies in two very specific ways.
Lindelof, Lofsten	2002	Sweden	Comparison of NTBFs on and off science parks, it appears there are 273 firms on park and 300 off park in the sample	1999	Tested a number of hypotheses, looking for differences between the on-park and off-park NTBFs including sales, employment, profitability and growth	p.147 "Differences between firms in the two groups (on and off park) are apparent with regard to state sales (turnovers) and employment (number of employees). There was no significant difference with regard to profitability." p.150 "NTBFs in the off-park sample have a significantly lower growth of employment and a lower growth of sales turnover."	Not clear whether the differences are attributable to higher rates of advanced degrees in on-park firms, or the extra management support provided.
Dettwiler <i>et al.</i>	2006	Sweden	10 science parks in Sweden, 273 on-park firms and 300 off park	1999	Investigates whether facilities management on and off park is important	Results are mainly comparative, i.e. Not statistical, but show different rankings for items such as proximity to universities for the samples	This paper reuses the sample from the 2002 Lindelof and Hofsten paper, but does not appear to move that analysis significantly forward

Author	Year	Country	Focus (incubator or firms)	Time period	Hypotheses/ questions	Results	Comments
Mian	1996	USA	10 university based technology business incubators, 47 responses from 150 tenant companies contacted	Not stated	The paper attempts to assess the 'value-added contributions' of university technology business incubators, where value added refers to the specific ways that an incubator enhances the ability of its tenants to survive and grow	See table 2 for summary of value added contributions. Further tables provide descriptive statistics on frequency of use and importance to tenants. Overall, it appears the tenant firms find the UTBI environment to be positive	The analysis is mostly descriptive and so cannot provide more guidance than indicating that multiple services are positive to university incubated firms.
Mian	1997	USA	4 university incubators, 29 tenant firms		Performance model developed for assessing incubators based on performance, management policies, and services and their value added	Provides a framework for assessing incubators, but does not provide any further analysis of appropriate structure	

Appendix C: Reference points for incubator business model

Gaps in the table reflect that fact that not all studies examined the same performance measures. While this table is useful as a reference point, it is also important to recognise the range of values in many categories in addition to average values, as a key finding is that incubators can vary significantly.

Setting up and operating incubators (inputs)	EC 2000			NBIA 2002	NBIA 2006	EBN-BIC 2009	UKBI
	Average	Range					
Average capital investment cost	€3.7 million	€1.5 to €22 million					
Average operating costs	€480,000 per year	€50,000 to €1.8 million		\$354,657 (median \$180,000)	\$548,358 (median \$339,690, range \$7,000-\$5,359,931)		
			Average incubation programme revenue	\$362,530 (media \$192,500)	\$597,083 (median \$283,000, range \$14,000-\$5,469,951)		These categories were not the focus of this study.
Proportion of revenue from public subsidies	37%	0% to 100%	Incubators whose primary sponsor is either a nonprofit economic development organisation or government agency	31%	52% (just 8% had no sponsoring entity)	57%	
Incubator space (average)	3,000m ²	90m ² – 41,000m ²		4,366 m ²	3,437 m ² (range 149-19,974 m ²)	3,159 m ²	

Incubator functions (Processes)	EC 2000		Incubator functions (Processes)	NBIA 2002	NBIA 2006	EBN-BIC 2009	UKBI
	Average	Range					
Incubator occupancy rates	85%	9 –100%		75%	76% (range 72-88%)	78%	
Average length of tenancy	35 months	6 months – no maximum		35 months	33 months	36 months	
			Combined hours per week all paid incubation programme staff worked (MEDIAN)	55	58		7.9
Number of management staff	2.3 managers	1-5 managers		2.4 FTE	1.8 FTE		
Ratio of incubator staff: tenants	1: 14	1:2-1:64					
Proportion of management time advising clients	39%	5-80%					24% (range 10-60%)
			Number of outside service providers that regularly assisted clients	Similar to 2006	97% said outside service providers regularly assisted incubatees.	Insert	
			Number of incubators that take equity in tenants	24%	24% (10% in all tenants, 14% in selected tenants)		
Evaluating services and impacts (outcomes)	EC 2000						
	Average	Range					
Number of incubator tenants	24.7 firms	1-120 firms		22	25	30	
Survival rates of tenant firms	85%	65-100%				90%	
Average growth in tenant firm turnover	20% p.a. (2001)	5% to 100% p.a.					58%
			Incubators reporting at least one anchor tenant		29% (avg of 3 per incubator)		
Job creation – average jobs per tenant company	6.2 jobs per firm	1 to 120				~5	
Job creation – new graduate jobs per incubator per year	41 jobs per incubator	7 to 197					14.3 FTE per tenant over incubation period
Cost per job (gross)	€4,400	€124 to €29,602				€10,839	

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NESTA

1 Plough Place
London EC4A 1DE

research@nesta.org.uk
www.twitter.com/nesta_uk
www.facebook.com/nesta.uk

www.nesta.org.uk

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