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Abstract

Start-up incubators are one of a number of micropolicy interventions used by states to support their technology entrepreneurs. Since 2000, the number of incubators in the United States has almost trebled while that in Europe has more than doubled. This article outlines the challenges involved in attempting to evaluate the contribution of the higher education technology start-up incubator process. It advocates theory-based evaluation (TBE) methodology as a possible solution for effective evaluation (and policy learning) in complex research settings such as this, where a study is unable, for myriad reasons, to meet the stringent requirements of experimental research design. TBE delivers findings on the contribution of the multiple factors influencing a result, thus showing whether the incubation process made a contribution to an observed result and in what way. An exploratory case study is used in this article to illustrate how the proposed TBE approach could work.

Keywords

Enterprise support, entrepreneurship, start-up incubator, public policy, SMEs, theory-based evaluation

If a country is to grow and develop economically, its ability to nurture the development of young high-growth firms is perhaps the most important element in enterprise policy (Storey and Greene, 2010). However, Storey (1998) notes that, in general, there is a dearth of evidence to support ‘direct’ state intervention in firms with high growth potential. Indeed, in the case of state-funded Business Incubation Centres (BICs), there are ‘very real methodological problems in linking the provision of incubator support to subsequent economic outcomes’ (Storey and Greene, 2010: 450). As a result, there is a gulf between our understanding of the need for such entrepreneurship policies and of how such policies might be conceived and designed if needed (Karlsson and Andersson, 2009: 127). Furthermore, public money should be spent on entrepreneurship and small and medium-sized enterprise (SME) support, it is essential that rigorous evaluation of the contribution of these initiatives takes place to aid policy learning. Regardless, the evaluation of policy performance is important for public transparency and accountability; otherwise, a government can simply ‘set sketchy objectives’ and ‘claim that the target is anything it happens to hit’ (Mayne, 2012: 10).

This article therefore investigates how the contribution of the start-up incubation process to the co-production of knowledge, innovation and growth can be evaluated. The structure of this article is as follows. The next section is a literature review on ‘Supporting entrepreneurs and SMEs – policy rationale and policy context’. It is divided into nine subsections, which outline the theoretical and empirical literature and also the rationale and context for state intervention through incubators based in higher education (HE) institutions. This is followed by an illustrative case study of a national incubation programme – branded ‘New Frontiers’ – implemented through the Dublin Institute of Technology (DIT), which includes a subsection on the case research methodology employed in the evaluation of the incubation process. This article concludes with a discussion of the exploratory research findings and a recommendation for future research in the start-up incubator domain.

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Supporting entrepreneurs and SMEs – Policy rationale and context

Government policy aimed at supporting the development and growth of SMEs and entrepreneurs can be broadly categorized into macro- and micro-level policy measures. Micropolicies focus specifically on SMEs and entrepreneurs, while macropolicies ‘do not have SMEs or entrepreneurs as their primary focus’ (Storey and Greene, 2010: 407).

Macro-level policy

Macropolicies sit within a country’s institutional framework and generally include four key components: (i) macroeconomic stability and regulation, business climate, trade policy and FDI policy; (ii) policies on competition and monopoly; (iii) government economic agency (taxation, public services and expenditures, employment, contracting and social policy); and (iv) government economic strategy, planning and promotion, contribution to the knowledge economy, technology and innovation (Bennett, 2014: 17).

Macroeconomic policies are therefore aimed at improving the broader economic conditions through a plethora of policy measures and in myriad ways. Many of these policies can indirectly have positive or negative influences on SME and entrepreneurial development.

Micro-level policy

Micropolicies targeted at start-ups and entrepreneurs ‘are those which endeavour to support the start-up and growth of businesses by providing direct assistance to the individuals or businesses concerned’ (Bridge and O’Neill, 2013: 323). Such direct assistance or ‘intervention’ from the government is normally justified on the grounds of ‘market failure’; that is, where there are barriers to entry and exit, information imperfections, the presence of externalities (knowledge, network or learning spill-overs) and where willingness to pay does not reflect demand (Storey and Greene, 2010). In other words, the government must have a case to intervene in the market mechanism in order to make it work better (Storey and Greene, 2010: 381–385). One of the key issues in micropolicy intervention is whether a government can intervene cost-effectively, with market failure alone not a necessary or sufficient justification for intervention (Storey, 2008). This is compounded by a lack of empirical support for micropolicy intervention in the literature (Bannock, 2005; Bennett, 2014; Bridge et al., 2013; Davidsson et al., 2008; Storey and Greene, 2010). Storey (2008) remarks that this lack of theoretical or empirical support for micropolicy intervention is noteworthy also for the paucity of rigorous evaluation of these enterprise policies. Indeed, the OECD (2007) provides seven areas under which policy can be evaluated: rationale,

additionality, appropriateness, superiority, systemic efficiency, own efficiency and adaptive efficiency – arguing, however, that ‘at the core of evaluation is the concept of additionality’ (OECD, 2007: 16). ‘Additionality’ is thus an appropriate moniker for the attempts by researchers to try to quantify the impact or contribution of an intervention compared to a ‘counterfactual’ situation (Oldsman and Halberg, 2002).

Micropolicy instruments aimed at developing entrepreneurs and SMEs are broadly subsumed under the term ‘enterprise policy’. Enterprise policy is often then justified on the basis that it helps to stimulate and/or facilitate entrepreneurial activity, which in turn can provide key benefits to national economies such as job generation, innovation, productivity and growth. On an individual level, this support can also help entrepreneurs to develop their ‘utility’ function by increasing, for example, their satisfaction or income (Van Praag and Versloot, 2007). While rigorous and elaborate frameworks have been developed for evaluating enterprise policy (see OECD, 2004), these have proven difficult to implement in practice and therefore there is a dearth of empirical evidence to support or justify micropolicy intervention.

SME and entrepreneurship policy

Bridge and O’Neill (2013: 301) point out that ‘there is often confusion about what is meant by [SME and entrepreneurship] policies’ as there is ‘a lack of clear definitions of both words’. Storey (1998: 6) notes ‘the important distinction between [these terms] in which [SME policy] applies to existing enterprises whereas [entrepreneurship policy] relates to policies seeking to enhance the creation of such enterprises’.

SME policies are designed to stimulate the growth of already established small businesses ‘and tend to focus on the businesses and what will help them grow, not the entrepreneurs behind them’ (Bridge and O’Neill, 2013: 301). On the other hand, entrepreneurship policies are aimed at ‘encouraging and facilitating more people to create their own businesses’ and ‘are centred on people and on what will persuade or help them to start businesses’ (Bridge and O’Neill, 2013: 301).

In the context of publicly sponsored business start-up incubation, the distinction between enterprise and SME policy is even more unclear, considering that this support is aimed at helping to transform entrepreneurs into successful start-up companies. As a result, incubation programmes typically straddle both categories, providing a combination of support and services that fall within both camps.

Policy rationale for business start-up incubation

The rationale for business start-up incubators to target new technology and service-based firms (NTBFs) is that

'policy-makers view high-technology sectors as the main generators of potential high-growth firms or Gazelles' (Mason and Brown, 2013: 214). Start-up incubators are one of a number of micropolicy interventions with which states attempt – primarily through publicly funded HE institutions – to support technology entrepreneurs to develop and commercialize their innovations. Incubator numbers have grown globally from their first appearance in the United States in the 1950s (driven initially by urban renewal projects) to over 2300 in the United States and Europe currently. Since 2000, the number of incubators in the United States has almost trebled while that in Europe has more than doubled (Bruneel et al., 2012). This post-2000 growth has been driven primarily by *technology* start-up incubators, with these HE-based incubators seen as important conduits for developing knowledge economies and for local and regional economic growth (Etzkowitz et al., 2000; Link and Siegel, 2007).

Business incubators aim to stimulate and support entrepreneurs and start-ups (Grimaldi and Grandi, 2005: 111) through the provision of support that provides a 'safe harbour' for firms to develop their internal resources – the so-called 'buffering' – while also connecting them with external resources and networks – referred to as 'bridging' (Amezcuca et al., 2013: 1633). Buffering allows fledgling firms and entrepreneurs to isolate themselves from the environment for a defined period. This gives them space to engage in formational and developmental activities without having to confront directly 'general and specific environmental threats' (Amezcuca et al., 2013: 1633). Bridging, on the other hand, allows them to engage actively, rather than be isolated from their external environment, to build assets that will hopefully allow for the development of sustainable competitive advantage (Amezcuca et al., 2013: 1629) and company value creation (Davidsson et al., 2008).

Measuring incubator performance

Ramsden and Bennett (2005: 229) differentiate between objective 'hard' and subjective 'soft' performance (impact) criteria. The former refers to outcomes such as reduction in business costs, increase in business turnover and increase in business profitability, while the latter refers to outcomes such as the 'ability to cope with problems' and the 'ability to manage'. Voisey et al. (2006: 465) argue that business incubators must demonstrate their success in the quantitative terms of 'hard measures' as well as in 'soft benefits' such as increased business knowledge and skills, business awareness and client networking improvements. In parallel, the incubator must meet its own 'hard' targets as agreed with its key stakeholders. Stephens and Onofrei (2012) identified four additional hard measures of success (location/incubation space, success in entrepreneurial competitions, securing public funding and customer retention) and three additional soft measures (increased productivity due

to incubation structures, networking and a positive image associated with being on a recognized programme). These authors advocate 'a holistic approach to the measurement and evaluation of business incubation [...] utiliz[ing] hard and soft measures' (Stephens and Onofrei, 2012: 283).

Incubator performance measures have been widely discussed and the topic has generated debate among researchers. However, the literature has yet to arrive at even a broad consensus on what constitute appropriate measures of performance (Barbero et al., 2012: 891) beyond the general categories of 'hard' and 'soft'.

Isolating the contribution of business incubation

Business incubators purport to add value in a number of ways, but their main value proposition is to help new and fledgling ventures survive and grow in the early stages of operation (Hamdani, 2006: 17). Voisey et al. (2006: 459) suggest that the business incubation process creates value through the diagnosis of business needs, the selection and monitored application of business services, the provision of financing and providing access to the incubator network. Bruneel et al. (2012: 111) further describe the value proposition of incubators as having four key components: the existence of scale economies which reduce tenants' overhead costs (e.g. water, electricity, cleaning); the provision of services to which the firms would not otherwise have access during such early developmental stages (e.g. meeting rooms, reception services and private parking); a reduced burden of planning as firms do not have to put effort and time into managing such services; and the benefits that incubatees receive from the subsidy generating capacity of the business incubator. Hughes et al. (2007: 170) place the onus on the incubatee for deriving benefit from an incubation programme, taking the view that 'firms benefit from incubation to the extent that they behave in ways that enable them to seize network opportunities and make use of networked resources and knowledge', that is, by developing social capital.

It is therefore clear from the literature to date that not only is there little consensus around performance metrics, other than the need for 'hard' and 'soft' measures, but there is also some disagreement on the actual services and support that the typical technology incubator should provide. Evaluating the incubation process – and indeed the rationale for it – is therefore complex. The evaluation process is further complicated by the unit of analysis – the technology start-up – which, in the words of Blank (2010: 1), is 'an organization formed to search for a repeatable and scalable business model'. What co-produced outputs, outcomes and longer term impacts are stakeholders seeking from the incubation process? Can we find agreement on its role and contribution to societal value creation?

For any given outcome, therefore, a 'policy impact can be considered as the difference between the observed

Table 1. The COTE framework.

Component	Description
Clarity and coherence	The policy should be clear to those delivering and benefiting from it, and should be delivered in a 'unifying and mutually reinforcing' way by governments.
Objectives	Objectives of the policy, such as the creation of new firms or employment creation, should be clearly specified. According to Lenihan (2011: 330), a logic model outlining a theory of change for the programme should be mapped out to 'ensure from the outset that objectives are well specified, and that issues of opportunity cost regarding public funds are addressed'.
Targets	Measurable 'targets' reflecting the policy objectives should be specified, e.g. to increase the number of new firms by x% by 2016.
Evaluation	'Policy can only be considered to be effective if it passes the challenges of high level evaluation, but evaluation can only be undertaken when clear policy targets exist.' The OECD (2004: 16) emphasizes the importance of feedback in this process, stating that 'implementing evaluation as a process can be achieved, by feeding the results of evaluation back into the debate, once the evaluation is complete.' This helps to increase policy learning.

Source: Adapted from Storey (2008: 13–14).

Note: ToC: theory of change.

outcome with the intervention, and what would have happened without the intervention (the counterfactual)'; that is, the 'additionality' of the intervention (Storey, 2008: 16). In order to isolate the effects of public micropolicy instruments, such as technology incubation, and to determine incremental value creation (additionality), it is essential that such policies have measurable objectives and targets from the outset. Otherwise, they may produce unwanted effects. Storey and Greene (2010: 384–385) highlight two unintended consequences of government micropolicies such as incubation – 'deadweight', when a business would have set up even if the support had not been available, and 'displacement', when a new business displaces incumbents in the industry with no net economic benefit to the state.

The COTE framework

In June 2004, a background report prepared for the second OECD Conference of Ministers for SMEs set out the clarity/coherence, objectives, targets, evaluation (COTE) Framework, designed to ensure that 'all SME and Entrepreneurship policies and programmes [should] have clear objectives and targets' (OECD, 2004: 16). The components of the COTE Framework are outlined in Table 1.

Designing evaluation and performance measurement for incubators

Evaluation 'seeks to determine [...] the relevance, efficiency and effectiveness of an activity in terms of its objectives' (Papaconstantinou and Polt, 1997: 10). However, in

reality, effective programme evaluation is very difficult to achieve and 'only rarely, do we see the application of evaluation methodologies which address the effects of *selection* bias and incorporate appropriate counterfactual scenarios' (Lenihan et al., 2007: 313). Lenihan et al. (2007: 313) complain that, 'Too often, evaluation studies [of public policy instruments] do not get beyond first base because they focus on resource inputs and monitoring impacts of particular programmes, schemes and initiatives with little reference either to context or longer-term outcomes'. Stame (2010: 62) also does not provide comfort in this domain when he asserts that 'black box' or experimental forms of evaluation (where possible) are equally deficient because of the 'successionist theory of causality' on which experiments are based. They do not tell us *why* something changed, only that something *has* changed, thus making it difficult to say whether or not the change can be attributed to the programme.

Given its complex research setting and the multiple intervening variables before an outcome, it would appear that incubation programme evaluation is not particularly suited to the exacting requirements of a true experimental 'black box' impact evaluation requiring the establishment of counterfactuals, valid control groups and randomization. For this reason, and on the basis that 'strong theoretical underpinnings give rise to robust evaluation methodologies' (Lenihan, 2011: 330), theory-based evaluation (TBE) appears to be a more appropriate methodology for evaluating an incubation programme. Proponents of 'new' programme evaluation, such as Lenihan et al. (2007), are calling for new methodologies to be adopted by public

programme evaluators. Methodologies such as theory-based approaches map out a clear theory of change (ToC) (Weiss, 1995) and therefore allow for multiple or mixed research methodologies to be deployed within the broader framework (Funnell and Rogers, 2011). This methodological dexterity opens up the possibility for micropolicy instruments to be evaluated in a broadly consistent manner, as TBE involves examining the assumptions underlying a causal chain from inputs to outcomes and impact (White, 2009: 3) or contribution (Mayne, 2001, 2008, 2012).

Incubator evaluation metrics using TBE

Grappling with the complexity of the microintervention process, Lenihan (2011) suggests that 'new' enterprise policy interventions such as technology incubation programmes should encompass a wide array of evaluation metrics. She provides a list of 12 (hard and soft) policy evaluation metrics but does not provide guidance on how policy interventions can be evaluated against these metrics or empirical evidence of similar evaluations. McLaughlin and Jordan (2004: 7) propose that a logic model ToC is useful for designing evaluation and performance measurement as it focuses on the important elements of a programme and helps to identify what evaluation questions should be asked and what performance measures should be used. Lenihan (2011: 330) further notes that: 'well-constructed logic models can serve as ex-post measures to see whether objectives have been attained, enabling robust ex-post evaluations' that can ultimately feed back into future programme design.

TBE involves examining the assumptions underlying a causal chain from inputs to outcomes and impact (White, 2009: 3). The theory-driven method is based on the rationale that 'evaluation *should not* be dictated or driven by one particular [research] method' (Chen, 2015: 25) and that 'the success of a programme has to be judged not only by its results but also by its context' (Chen, 2015: 26).

Evaluating the technology incubation process using TBE

Five interrelated areas are generally evaluated by TBEs. These are detailed below.

Inputs are 'resources dedicated to or consumed by the program' (Chen, 2015: 60) and in the case of an incubator are aimed at 'developing a supportive environment by providing access to opportunities, resources and support services' (Stephens and Onfrei, 2012: 279). According to Hackett and Dilts (2004a: 43), 'a lack of inputs such as capable entrepreneurs [...] might go a long way toward explaining why many incubators perform so poorly'. The entrepreneurs themselves are also a fundamental input, while the opportunity cost of accepting one entrepreneur over another applicant can also be considered a negative

input. The incubation inputs will directly influence the level of activities that can be undertaken within an incubation programme. In addition, the characteristics of the participating entrepreneurs represent a further input into the process at the pre-start-up phase (Smallbone and Wyer, 2012; Storey, 1994; Storey and Greene, 2010).

Activities (processes) 'are what the program does with the inputs to fulfill its mission' (Chen, 2015: 60), and in an incubator include the professional services, opportunities and informal networking environment designed to 'facilitate knowledge and training' (Stephens and Onfrei, 2012: 279). The activities undertaken are designed to produce highly capable entrepreneurs and 'gazelles' – start-ups with high growth potential (Henrekson and Johansson, 2010). These activities will also influence the characteristics of the firm at start-up.

Outputs are the 'direct products of program activities' (Chen, 2015: 60) and primarily include the company, as ultimately the incubator 'is a manufacturer of new firms' (Hackett and Dilts, 2004a: 43), and also the graduating entrepreneur. The characteristics of the firm resulting from these activities will heavily influence its growth potential, which will be largely determined by the management strategies implemented after start-up (Storey and Greene, 2010).

Outcomes represent 'the benefits for participants during and after program activities' (Chen, 2015: 60) and will be heavily influenced by the success (or failure) of subsequent management strategies. The benefit to the individual participant will more likely be denoted by learning or 'soft' outcomes, while benefits for the firm will likely be indicated through 'hard' financial performance or employment growth. The management strategies adopted will also be heavily influenced by external environmental factors (Gibb and Davies, 1990).

Long-term impact is the ultimate impact of the technology incubation. This classically takes in the value creation from the particular incubation programme. Results available to date for incubation programmes are usually self-reported and therefore lack methodological rigour and/or reliable data. There is a need for independent evaluation of incubation programmes – particularly technology incubators. In the absence of reliable, independent empirical evidence, a herd mentality appears to have taken hold among policymakers worldwide in relation to technology incubators and science parks in particular.

An illustrative logic map and ToC for technology incubation is set out in Figure 1. The broken line in the figure represents a feedback loop and conveys how the logic model can serve as a highly effective ex post evaluation method by aiding policymakers in the 'classification of options for setting priorities and supporting effective allocation of resources' (Lenihan, 2011: 382). In other words, by monitoring the outcomes of the programme, it allows policymakers and programme coordinators to manipulate

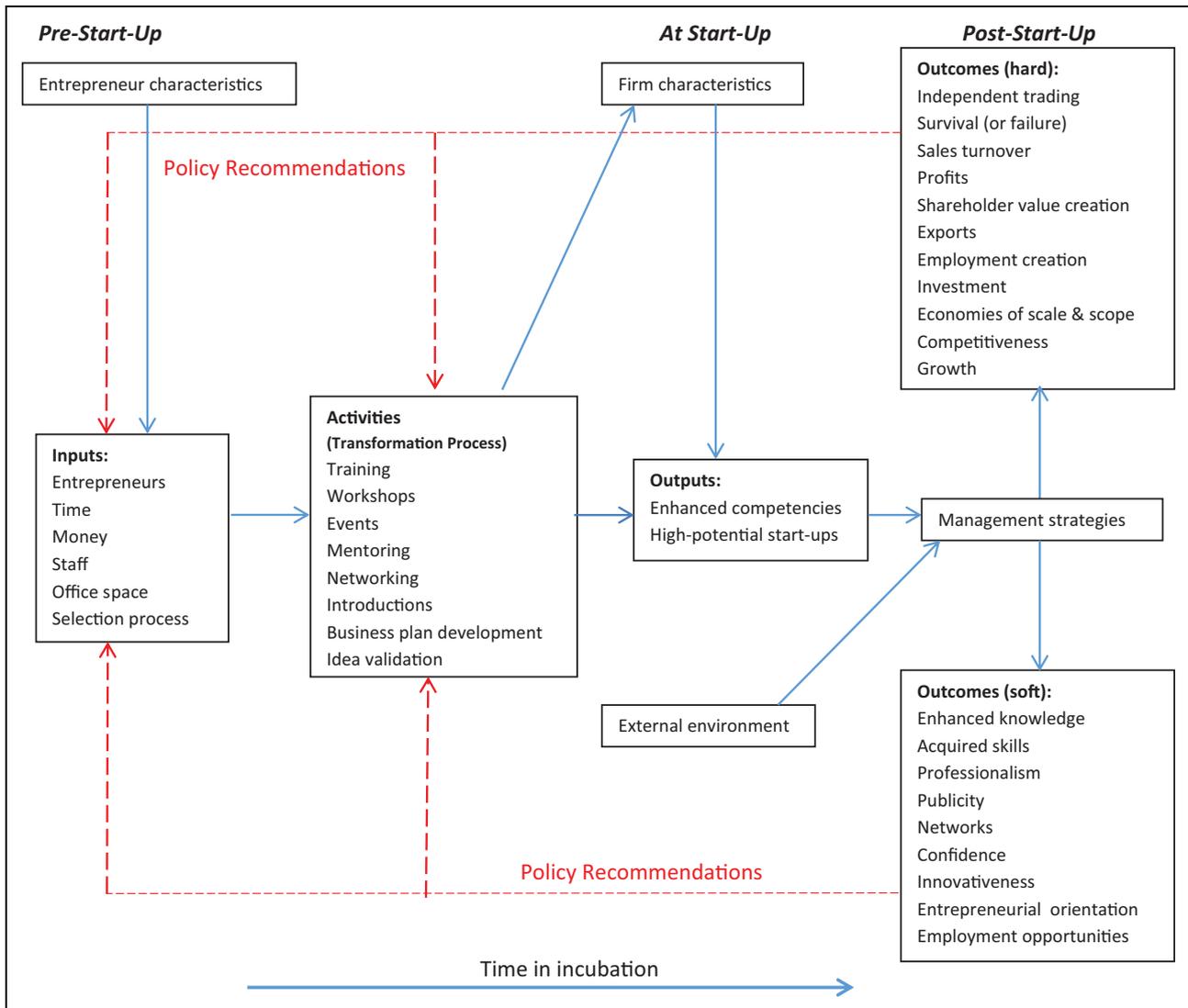


Figure 1. A logic model and ToC for business incubation.

Source: Buckley (2014: 4), Hackett and Dilts (2004a: 44), Lenihan (2011: 329), Smallbone and Wyr (2012), Storey and Greene (2010) and Voisey et al. (2006: 465). ToC: theory of change.

the inputs and activities in an attempt to achieve the desired outcomes for future programmes. If deadweight is a major concern for the programme evaluator, then a ‘control group’ (of non-incubator participants with a similar profile) can be established to compare and contrast the outputs and outcomes over a common period. Similarly, when possible displacement issues are identified, incubatee support can be evaluated in the context of the sectoral structures existing in the state. Small open states tend to directly support *export-oriented* firms only to try to minimize the effects of displacement.

Research methodology

In adopting a TBE methodology, it was determined that a case-based research approach was most appropriate given the data available, the time frame within which the

research was to be conducted and the technology incubator cohort size. This section outlines the methodological approach and details the individual stages in the research process from the development of theory, selection of cases and design of research protocols to the conducting of case studies and drafting of individual case reports for cross-case analysis.

Case study research method

A case study is a method for developing a complete understanding of a process, programme, event or activity (Martinson and O’Brien, 2010: 163). Yin provides a more elaborate ‘two-fold technical definition’ that focuses first on the scope, followed by the technical characteristics of a case study:

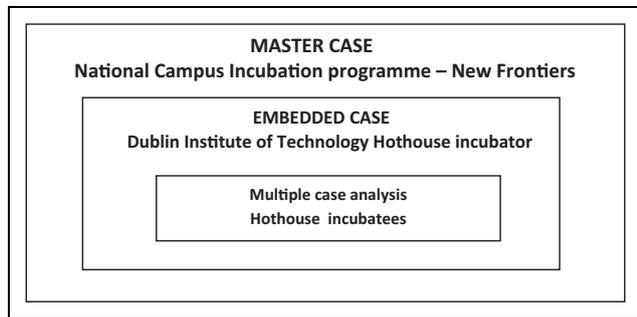


Figure 2. Case study research approach.
Source: Adapted from Yin (2018).

A case study is an empirical enquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis. (Yin, 2009: 18)

Case studies can be used to provide description, to test theory or to generate theory (Eisenhardt, 1989: 534). According to Martinson and O'Brien (2010: 164), they can be descriptive, explanatory or exploratory. The present research focus is *exploratory*, meaning that it is aimed at 'defining the questions and hypotheses of a subsequent and larger study' (Martinson and O'Brien, 2010: 164).

The overall research approach is an embedded, single-case design (Yin, 2018: 48–53). It is a case study of Ireland's campus-based, publicly funded technology incubator programme, 'New Frontiers', managed by the economic development agency Enterprise Ireland. Within this master case is embedded a subsidiary case study of 1 of the 21 higher education institutes (HEIs) implementing the national programme – the DIT with its technology incubator (DIT Hothouse). And within this embedded case is a multiple cross-case analysis (Yin, 2018: 58) of the experience of incubator participants in the New Frontiers programme in the DIT Hothouse incubator. This multilevel case-based approach is an appropriate research design when exploring the complexities of how the start-up incubation process contributes to the co-production of knowledge, innovation and growth. This approach is illustrated in Figure 2.

Illustrative case – New Frontiers

The Irish Government has identified six key areas; it is seeking to develop via a combination of macroeconomic and microeconomic policies in its attempts to create a vibrant entrepreneurial ecosystem in Ireland. These are

culture, human capital and education; business environment and support; innovation; access to finance; entrepreneurial networks and mentoring; and access to markets (National Policy Statement on Entrepreneurship in Ireland, 2014: 8).

In relation to micropolicies, there are a large number of specific supports directly available to entrepreneurs in Ireland. The Department of Business, Enterprise and Innovation (DBEI) provides 170 specific individual enterprise policy instruments, reflecting perhaps the absence of coherence and clarity (and rigorous evaluation) in the overall enterprise strategy to date (see DBEI, 2017). Enterprise Ireland, the government's implementation agency responsible for the development and growth of Irish enterprises in world markets, delivers a range of these supports, including the New Frontiers start-up incubation programme. The list of Enterprise Ireland supports, a description of each and the available exchequer funding for each is provided in Table 2.

From the list of entrepreneur support mechanisms identified in Table 2, 'Incubation Centres' and 'New Frontiers' constitute the extent of publicly sponsored support for start-up incubation in Ireland. Between 2013 and 2014, a total of €8.1 million of exchequer funding was appropriated to funding these incubation programmes. Based on Enterprise Ireland's budget of €219 million for enterprise development in 2014, incubation represents approximately 3.7% of expenditure (Enterprise Ireland, 2014: 11).

Technology business incubation in Ireland

In Ireland, the national publicly sponsored incubation programme, New Frontiers, has been delivered through the government's economic development agency, Enterprise Ireland, since 2012. The programme, like its predecessors, offers structured training, mentoring, networking opportunities, financial assistance and shared incubation space (De Faoite et al., 2004: 442) and 'provide[s] entrepreneurs with a supportive environment that assists them in bringing their idea to market, aimed at helping to reduce the risk aversion to failure' (Forfas, 2014: 119).

Campus incubator performance: Empirical Irish evidence

Empirical studies conducted by Forfas (2014) and Stephens and Onofrei (2012) have attempted to estimate the impact of the campus incubation programmes. The findings of these studies are included in Table 3. Neither study employs rigorous evaluation methodologies and both depend heavily on participant feedback when drawing their conclusions. Academics and professionals researching and practising in the evaluation domain would recognize this approach as a form of 'monitoring' and not as evaluation per se.

Table 2. Enterprise Ireland entrepreneurship supports.

Support	Description	Funding
EnterpriseSTART Workshops	Provide entrepreneurs with comprehensive information to understand the business development process including the key success factors and potential pitfalls as well as an outline of financial supports available from Enterprise Ireland and Local Enterprise Office.	€90,000 (2013)
Mentor Programme	Mentors provide advice, guidance and support, to help clients grow and build capability.	€571,000 (2013)
Competitive Feasibility Funds	Aimed at assisting entrepreneurs to investigate the viability of a new growth-oriented business that can succeed in global markets.	€1.0 m (2013)
HPSU Feasibility Study	Funding to investigate the viability and potential of an innovative/high-potential start-up and the development of an investor ready business plan.	€2.6 m (2013)
Competitive Start Fund	Aims to assist start-ups to bridge the equity gap and quickly validate their market.	€4.3 m (2013)
Innovative HPSU Programme	Equity investment for HPSU clients, on a co-funded basis to support the implementation of company business plans.	€21.7 m (2013)
Commercialization Fund	Drives the commercialization of research from HE research institutions by supporting the development of innovations at all stages of the commercial pipeline to the point where they can be commercialized as new products, services and companies.	€15.7 m (2013)
Technology Incubation Centres	Providing an essential transitional space between the research and business worlds.	€2.0 m (2013)
Community Enterprise Centres	Provide entrepreneurs with business space in a supportive environment with the aim developing entrepreneurship in both urban and rural locations.	€64 m (since 1989)
Seed and Venture Capital Scheme:	Aims to increase the availability of risk capital for SMEs to support economic growth through the continued development of the Seed and Venture Capital Sector in Ireland to achieve a more robust, commercially viable and sustainable sector.	€59 m invested in Irish companies
New Frontiers Programme	National incubation programme launched in 2012 that offers participants a package of supports to help accelerate their business development and to equip them with the skills to successfully start and grow a company.	€6.1 m paid (June 2014)

Source: National Policy Statement on Entrepreneurship in Ireland (2014: 62–64).

Note: HE: higher education.

A study by Ryan and Wright investigating the *experiences* of incubated companies in Cork and Waterford Institutes of Technology (IoTs) found a number of prevalent themes that highlighted the experience of participants (Ryan and Wright, 2009: 76). These key themes are outlined in Table 4.

Thus, in line with international evidence and experience, Ireland, like other smaller states, has not yet developed a strong culture of rigorous evaluation (as part of the policy learning process) nor has the academic research community yet found this a fruitful area to research. Consequently, the empirical evidence base is weak with only a small number of monitoring studies having been conducted so far.

New Frontiers (2012–)

New Frontiers was launched in February 2012 with the aim of supporting the establishment and growth of technology-intensive or knowledge-intensive ventures with the potential to trade internationally and create employment in Ireland (DIT Hothouse, 2015). As already noted, the programme is funded and coordinated by Enterprise Ireland and is delivered at the local level by the 15 IoTs. It provides aspiring entrepreneurs with a package of support that includes funding of €15,000, office space, mentoring and

workshops to help accelerate their business development (Enterprise Ireland, 2014: 31). New Frontiers standardized the provision of campus incubation services across the HEI sector. Figure 3 graphically represents the geographical location of each of the New Frontiers Campus Incubation Centres. New Frontiers is delivered by the HEIs in three phases, as detailed below.

Phases in the New Frontiers programme

The New Frontiers incubation programme consists of three phases:

- *Phase 1:* Delivered part-time (2 days per week) over a 10-week period to help validate the potential of the business idea.
- *Phase 2:* Participation is determined via a competitive selection process and requires successful applicants to be based in the campus incubation centre full-time for 6 months. The aim is to assist in the development of an investor-ready business-plan.
- *Phase 3:* This provides Phase 2 graduates with the option to avail themselves of incubation facilities for up to a further 3 months. The aim is to assist entrepreneurs in developing their business and client bases.

Table 3. Empirical findings on Irish campus incubation outcomes.

Study/ researchers	Review period	Sample size	Greatest benefit (% as expressed by sample)
Campus Incubation Programme Review, Forfas (2014)	1999–2007	149	Short term: Increase in company value (30%) New domestic sales (27%) and New export sales (17%) Increased export volumes (13%) (p. 127) Long term: Improved business capabilities (73%) Ability to attract highly skilled staff (40%) Better technological skills (38%) Greater higher level skills (23%) (p. 128)
BIC Study, Stephens and Onofrei (2012)	2012	43	Hard benefits: Enterprise growth (79%) Reduced reliance on incubation support (51%) Improved sales or profitability (35%) (p. 281) Soft benefits: Confidence, networking and business knowledge (79%) Cost savings due to incubation resources (70%) Increased positive publicity (42%) (p. 282)

Source: Forfas, 2014; Stephens and Onofrei, 2012.

Note: BIC: Business Incubation Centre.

Phase 2 represents the most intensive incubation phase of the programme and is therefore the focus of this research, with all entrepreneurs and firms involved in the research sample having participated in and graduated from this phase. The mentoring and support delivered throughout Phase 2 are oriented to helping new firms, on graduation from the programme, to achieve public equity investment from the following sources:

- *Competitive start fund*: A €50,000 equity investment designed to accelerate the development of high-potential start-up companies by helping them to achieve commercial and technical milestones, such as evaluating international market opportunities or building a prototype (Enterprise Ireland, 2015).
- *Innovative high potential start-up (HPSU) fund*: Equity investment, on a co-funded basis to support

Table 4. Experience of participants in campus incubation programmes.

Theme	Explanation
Networking opportunities	Informal, internal networking among participants through common facilities such as 'the canteen' was emphasized as a clear value-creating activity, 'particularly where there are opportunities to work together' (p. 77)
Co-location and mutual trust	There is a 'huge advantage being able to work with other companies of the same stage of development' and 'helping each other' which 'provides the potential to generate new ideas' (p. 77)
Relationship with incubation manager	The companies' relationship with the incubation centre manager is cited as being of 'strategic importance', particularly in linking client companies with the institutes (p. 77)
Physical proximity to the institute	Providing incubated companies with easy access to the 'knowledge, facilities and [potential] labour force' in the IoTs and the relationships between the incubator and academic staff 'played a key role in attracting several client companies to both incubators' (p.78)
Active collaboration not supported by all academic staff	A 'cultural disconnect' was highlighted between the incubated companies and academic staff, particularly 'a different mindset towards meeting deliverables and deadlines' (p. 79). This may be explained by the assertion that 'academic staff are not appropriately rewarded for actively engaging with industry, and therefore not motivated' (p.80)
Financial assistance, physical space and infrastructure	'Funding' and 'increased sales revenues' were highlighted as the biggest challenges the incubated companies faced, and the financial and infrastructural assistance of incubation enabled them to manage their cash flows and finances (p. 80)
Managerial functions	The younger incubated companies (less than 1 year) typically rely on incubator staff to fulfil their managerial functions, such as identifying funding, arranging business meetings and recruitment of staff/students for their business (p. 78)

Source: Ryan and Wright, 2009.

the implementation of a company's business plan. Investment is generally provided by Enterprise Ireland on a 'match-funding' basis; that is, at the same level as funding contributed by the business owners (Enterprise Ireland, 2015).

Table 5 provides a full list of supports provided to participants in New Frontiers Phase 2 throughout the 6-month duration.

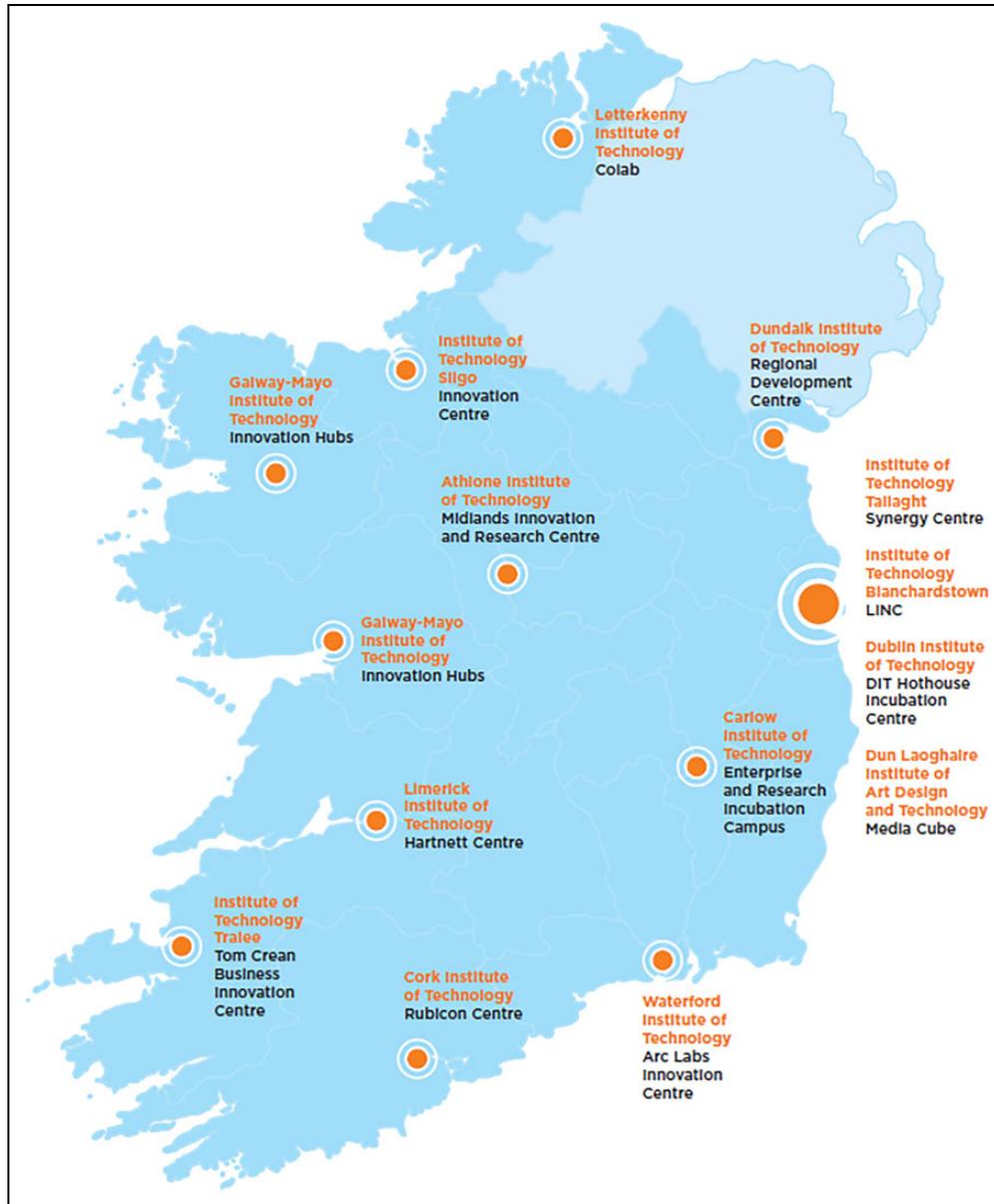


Figure 3. Location of new frontiers campus incubation centres.
Source: Enterprise Ireland (2015).

‘Based on the [perceived] success of [its] first year [...] a further €12.65 m [was] invested [by Enterprise Ireland] for the next three years of New Frontiers’ (Enterprise Ireland, 2013: 31). Given the relatively short time for which the New Frontiers programme has been in operation (less than 5 years at the time of writing), it is not yet possible to evaluate its long-term impact. According to the Forfas’ (2014) report commissioned by Enterprise Ireland, the programme is succeeding in terms of employment creation, good incubation practice is in evidence and the overall programme is delivering results, albeit ‘at a relatively early stage of a long term, strategic programme’ (Forfas, 2014: 134). However, it is evident from the empirical studies and state reports

outlined so far that there is a dearth of rigorous programme evaluation – rather the outcomes of these incubation programmes have simply been monitored and not evaluated, with no attempt to identify the ‘additionality’ delivered by the incubation process.

DIT hothouse incubation performance, 2001–2011

Between 2001 and 2011, before the launch of New Frontiers, DIT Hothouse, the incubation centre at DIT, operated 21 12-month venture programmes that provided entrepreneurs with professional expertise, incubation facilities and mentoring. The aim was to develop successful companies

Table 5. Incubation support provided through New Frontiers, phase 2.

1. Training in all areas of business including financial management, market research and validation, business models, patenting, product development, business development and sales.
2. Personalized hands-on support, advice and mentoring from experienced business advisers and practitioners.
3. Peer group learning from participants in the region and across the country.
4. Office space and other business incubation facilities
5. Funding stipend of up to €15,000.
6. Networking opportunities with other entrepreneurs and business development agencies.
7. Introductions to seed and early stage capital investment networks.
8. Access to entrepreneurship best practice – both national and international.
9. Expertise from HE institutes and the supportive environment of their BICs.
10. Access to the expertise in Enterprise Ireland through its Market Research Centre.

Source: Enterprise Ireland, 2015.

Note: BIC: Business Incubation Centre; HE: higher education.

Table 6. DIT hothouse venture programme outcomes (2001–2011).

Outcome	Trading	Acquired	Investment raised	Sustainable businesses	Jobs created
Total	171	8	€87 million	179	1055
Percentage/ per participant (pp)	62.9%	2.9%	€322,235 pp	65.8%	3.88 pp

Source: DIT Hothouse (2011).

for the global market. The key outcomes of the Hothouse venture programmes included 91 of the 272 programme participants (33.45%) subsequently became Enterprise Ireland HPSU clients and 37 of the 272 participants (13.6%) became County Enterprise Board (CEB) clients (DIT Hothouse, 2015: 19). The following achievements are noteworthy (see also Table 6):

- *Firm survival rate:* The Hothouse Incubation Programme had a firm survival rate of 62.9%, with 272 incubated firms still trading as at October 2012. Calvino et al. determined that the average survival rate for firms was ‘just above 60 per cent after 3 years, 50 per cent after 5 years, and just over 40 per cent after 7 years’ (Calvino et al., 2015: 6). Considering that a further eight of the incubated firms were subsequently acquired, this brings the total of sustainable businesses to 179, representing 65.8% survival.
- *Firm job creation:* With 272 programme graduates creating a total of 1055 jobs, just under four jobs

were created per incubated firm. This amounts to a cost of roughly €3800 per job based on a total expenditure of approximately €5 million over the period – a figure that appears to compare favourably to the average Enterprise Ireland cost per job of €6721, measured over the 7-year period from 2001 to 2007 (Enterprise Ireland, 2014: 59).

- *Private investment raised:* Raising investment poses a significant challenge for start-up companies, with the typical SME facing an ‘equity gap’ or ‘shortage of risk capital investment’ (Gualandri and Schwizer, 2008: 29) in the range of £250,000–£1 million, according to Deakins and Freel (2012: 166–167). The average outside equity raised by Hothouse participants was €322,235.

DIT Hothouse therefore had a significant track record of achievement in the incubator domain before New Frontiers was launched as the national programme in 2012. It is important to bear this in mind when considering the Hothouse performance. Against this backdrop, it is appropriate now to look at the experience of incubatees in the New Frontiers programme.

Multiple case analysis of New Frontiers incubatees in DIT hothouse

To determine the most appropriate theoretical sample for the multiple case analysis, secondary information on all 32 Hothouse New Frontiers 2012 programme graduates was reviewed. The 32 cases were analysed collectively in an attempt to identify an appropriate ‘theoretical sample’ (Eisenhardt, 1989), which would help to highlight ‘transparently observable’ contrasts between participants (Pettigrew, 1990).

The final case study sample consisted of three graduates from each of the two 2012 cohorts (six in total), three of whom were currently still trading and classified as ‘Surviving Firms and Entrepreneurs’ for the purposes of this study. The remaining three firms were not currently trading and were therefore classified as ‘Ceased Firms and Entrepreneurs’. The sample was deemed to be representative of the two cohorts (Martinson and O’Brien, 2010) in that it enabled direct comparison between surviving and ceased firms.

Interviews undertaken with all six programme participants followed a similar semi-structured format and the topic list was based on the key theoretical determinants of and influences on firm growth as suggested by Storey (1994) and Smallbone and Wyr (2012). Additional studies on the same topic, such as those by Dobbs and Hamilton (2007), Hansen and Hamilton (2011) and Barrow et al. (2011) also influenced the questions and framing of the topic list guide. Finally, the findings of incubator performance studies, such as those by Voisey et al. (2006) and

Table 7. Profiles of New Frontiers entrepreneurs and firms participating in study.

Case	Surviving firms			Ceased firms		
	A9	B3	B4	A3	B2	B6
Age range	35–40	35–40	29–34	20–25	45–50	29–34
Current role	CEO and Head of Sales	CEO	Managing Director	Chief Technology Officer	IT Program Manager	Global Sales Director
Gender	Male	Male	Male	Male	Male	Male
Nationality	Irish	Irish	Irish	Irish	Irish	Australian
Education	Master's degree	Bachelor's degree	Junior certificate – Second level education	Bachelor's degree	Bachelor's degree	Master's degree
Key motivators	Creativity, control, self-achievement	Wealth and financial freedom	Personal freedom and control	Solving a problem/lifestyle	Ambition to run a self-employed business	Opportunity/personal freedom
Pre-start-up	Employee	Employee	Self-employed	Student	Entrepreneur	Employee
Number of founders	One	Two	One	Three	Two	Three
Management experience	2 years	No	7 years	No	11 years	8 years
Sector experience	10 years	5 years	13 years	3 years	14 years	9 years
Prior business	Yes	No	Yes	No	Yes	No
Family history	Yes	No	No	Yes	No	No
Business networks	No	No	No	No	Yes, but limited activity	Yes
Involvement with other companies	Advisory roles	No	Non-active directorships	Advisor to some start-ups	Two external directorships at the time (portfolio)	Actively involved with multiple start-ups (portfolio)
External advisors	Yes	Yes	Yes	No	Yes	No
Leadership style	Laissez-faire	Situational, a blend of autocratic and participative	Dictatorial at times but becoming more participative	Adaptive, but generally hands-off with experienced staff	Target oriented	Hands-on, participative
Culture	Open, collaborative	Collaborative, innovative, open	Positive, fun workplace – Family, ethics, respect, positivity (company values)	Easy going, casual but focused	Tense, non-cooperative	Very free and open, passive
Legal form at entry	Unlimited	Limited	Limited	Unlimited	Limited	Limited
Current status	Limited	Limited	Limited	Limited (dormant)	Limited (dormant)	Dissolved
Incorporated	May 2013	February 2011	November 2011	November 2013	September 2008	February 2012
Location	Dublin	Dublin	Dublin	Dublin	Dublin	Dublin
Sector	Software	Software	Construction	Software	Software	Software

Source: Interviews with participants on DIT Hothouse New Frontiers programme.

Onofrei and Stephens (2011), discussions with key informants such as the Hothouse incubation centre manager and a review of previous incubator research also informed the programme-related questions. A summary of the participant profiles, derived from the topic list and secondary data, is provided in Table 7.

Following a detailed review of the six individual case reports, a 'data reduction' (Caudle, 2004: 421) process was undertaken. This involved categorizing, tabulating, summarizing, comparing and contrasting all information into 'data displays' to enable the identification of patterns and key themes (Caudle, 2004: 421). Table 8 presents an

Table 8. Did incubation contribute to the growth and development of your firm.

Incubator contribution to business	
Surviving firms	Ceased firms
A9: The practical and hands-on elements of the programme helped the company's growth. "How can we help to get you further along the road faster with that?" When that was demonstrated in the workshops or by the mentors that really did help'.	A3: The participant did not think the business 'would have followed on at all' if it had not been for acceptance for New Frontiers. However, he feels 'the Company hasn't benefited from it so much' given performance.
B3: Hothouse provided academic knowledge to perform the various tasks required to run a business. 'It gave me the training and the practical skills and encouragement to execute [those tasks]'. He doubts whether he would have had the confidence to start the business, stating 'Without that external credibility and validation I would have doubted myself [...] I would have gone back to my paid job'.	B2: 'I knew what the [business] problem was going to be but I didn't really know how to structure the growth strategy or an investment strategy'. This is where Hothouse added value.
B4: Networking was key benefit. 'New Frontiers contributed significantly [...] meeting DD was huge part of success [...] wouldn't be where it is now if it wasn't for DD [...] reason we've got out of small start-up phase is network of people we've built'.	B6: The participant advised that they had 'already set up the company' and begun trading, so support was limited from an acceleration point of view. However, he feels the company benefitted from an improved networking ability and were motivated through the 'positive energy' of start-ups, as well as inspirational talks from guest speakers.

Source: Interviews with participants in DIT Hothouse New Frontiers programme.

example of one of the displays of the primary data developed during the study.

The final stage in the research process was to compare the 'actual findings' (explained in this section) in the master case, embedded case and multiple case analysis of incubatee experiences to the logic model and ToC (see Figure 1). This comparison draws attention to the role (in practice and theory) of the incubation process in helping to explain actual incubation outcomes (Hackett and Dilts, 2004a, 2004b).

Discussion of exploratory findings

The secondary data gathered for this research show that technology incubation is a growing global phenomenon. It has accelerated sharply since the 'dot-com' era in 2000. While new campus incubators continue to be a favoured micropolicy intervention for governments attempting to increase levels of technology-driven entrepreneurship, it is not immediately obvious from the literature what services or supports should be provided. Indeed, the empirical evidence to date justifying the proliferation of incubators is weak. This is not to say that campus incubators do not or cannot add value to the growth and development of fledgling firms or entrepreneurial learning – but, to date, we do not have strong empirical evidence to suggest that they do. This is due in part to the methodological and data-related challenges encountered in researching this area. This unsatisfactory situation is exacerbated by the lack of independent reporting of incubator performance and, indeed, by the lack of consensus on what 'hard' and 'soft' metrics to report on. It is hard to see how governments can justify investment in this domain and claim to be making 'evidence-based' policy given the current

dearth of reliable and comparative data or rigorous independent evaluation. It would seem that a 'herd mentality' has taken hold in enterprise policymaking circles globally since 2000 – particularly in relation to technology incubation.

Although the growth trajectories of each of the six cases analysed in the multiple case analysis were idiosyncratic (as expected), a number of common themes emerged during the analysis of the interviews and supporting secondary data. When the development of the three successful and three unsuccessful firms was considered in light of the ToC, a number of significant differences emerged. In particular, the three trading firms appeared to have had a more developed technological offering (value proposition) than the three companies that had recently ceased trading. The surviving firms seemed to have benefitted from the establishment of a 'balanced' management team from the outset of the venture. This increased the absorptive capacity (Cohen and Levinthal, 1990) of the leadership team, thereby increasing the resilience (and longevity) of the venture. These firms appear to have derived more benefit from the incubation programme than those participants who subsequently returned to paid employment. Through a combination of buffering and bridging processes – mentoring, training and networking activities – incubation was perceived to have positively influenced the growth and development of the surviving firms. This was achieved, according to the interviewees, by improving the skills and ability of the owner-managers to develop and implement niche market strategies, to delegate authority and responsibility, to internationalize, to create innovative technologies and to develop formal planning processes. While the quality of the incubation processes appears to be a factor in

improving incubation outcomes, the quality of the selected entrepreneurs remains the most important input into the incubation process. Further research is required to develop robust selection processes, which will improve the chances of selecting candidates with an appropriate profile and so achieve better incubation outputs, outcomes and impacts. As data availability builds over time on technology incubation, more sophisticated descriptive and explanatory research can be conducted, which will allow for the difficult issue of 'selection bias' to be addressed.

The programme-related factors that were perceived to be most beneficial for participants were one-to-one mentoring, strategy workshops and financial management training. However, on the *least* beneficial aspects of the incubation process, opinions diverged between the surviving and ceased firms. The latter considered the networking activities, such as events and introductions, to be least important in terms of the role they played in influencing their entrepreneurial and professional development, whereas the surviving firms placed a high value on these activities.

Conclusion

This exploratory study suggests that publicly funded incubation programmes may make a contribution to firm growth and performance, as well as the entrepreneurial and professional development of individual participants – if, and only if, the entrepreneur or entrepreneurial team has the appropriate level of absorptive capacity and is at the appropriate state of readiness to leverage the benefits of the incubator services. However, further research is required to identify more scientific selection criteria and to clarify those aspects of the incubation process that are most beneficial to both the incubated firm and the individual programme participant. This study also highlighted the idiosyncratic nature of firm (and entrepreneur) development and the important role that fortune (and misfortune) can have in shaping the growth trajectories of young firms. Although there is no 'one-size-fits-all' approach to technology incubation programmes, both buffering and bridging mechanisms would appear to play *some* part in influencing firm performance and individual entrepreneurial success (once the correctly profiled incubatee has been selected). An important finding is that the leaders of surviving firms placed a higher value on the networking, events and introductions aspect of the bridging process than the leaders of firms that subsequently ceased – possibly indicating a more advanced state of readiness for incubator life and after life.

Directions for future research

There is a dearth of empirical research on the effectiveness of start-up incubation in influencing long-term firm survival and growth. Indeed, there is a significant level of

uncertainty regarding the effectiveness of and justification for enterprise micropolicy interventions in general. While the methodological and data-related challenges in this area are significant, it would seem nevertheless that longitudinal mixed and/or multi-research methods nested in TBE approaches can make a significant contribution to the quality and rigour of future studies in the domain. This in turn could lead to improved enterprise policy learning and, consequently, the implementation of appropriate evidence-based enterprise policies.

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