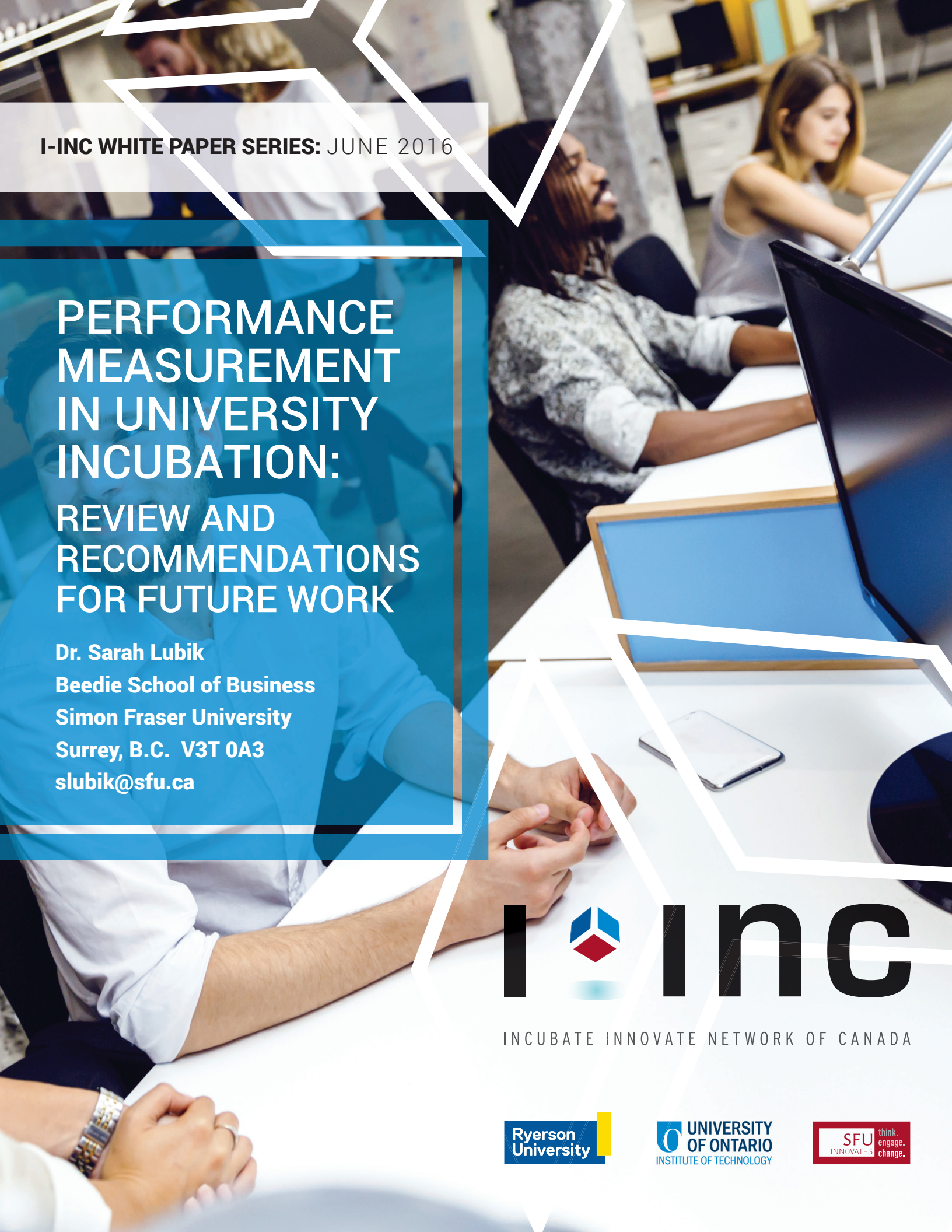

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PERFORMANCE MEASUREMENT IN UNIVERSITY INCUBATION:

REVIEW AND RECOMMENDATIONS FOR FUTURE WORK

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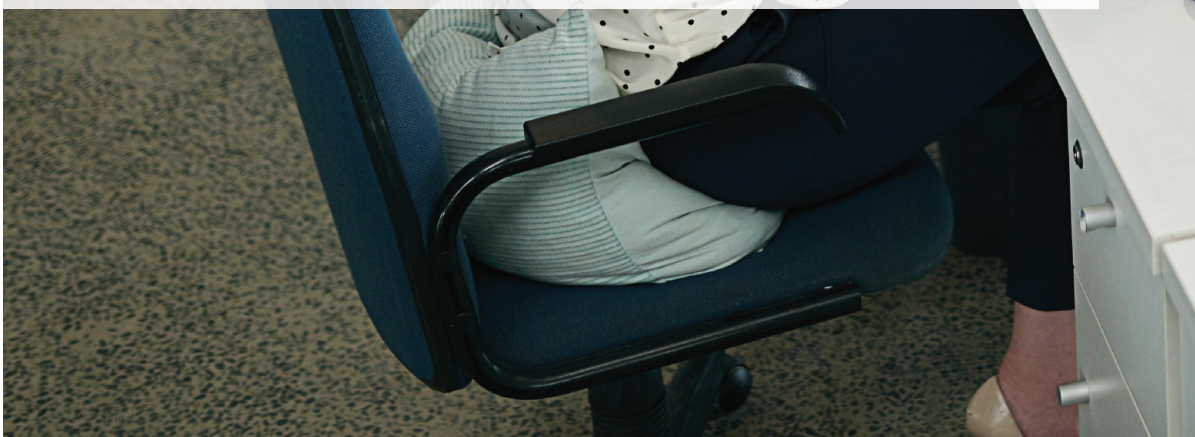
SFU INNOVATES think. engage. change.

1.0 INTRODUCTION

There has been a great deal of recent interest and investment in incubation from governments and universities (Bergek & Norrman, 2008; Grimaldi & Grandi, 2005; Scillitoe & Chakrabarti, 2010) to drive economic growth and leadership. It has been stated that university incubation has the potential to be particularly powerful because it represents a strong opportunity to translate between knowledge creation and industry applications and to create powerful hybrid actors such as academic-entrepreneurs (Etzkowitz, 2002). However, there is concern over how appropriate, robust and reflective are the commonly used performance metrics for university incubation projects (Allen & McCluskey, 1990; Dee, Livesey, Gill, & Minshall, 2011; Hackett & Dilts, 2008). The development and use of more insightful and robust, as well as user-friendly, frameworks may lead to improved and more accurate project evaluation and more strategic investment in future projects.

This white paper reviews the literature on metrics used for the performance evaluation of incubation and university incubation. We then address challenges that may arise from their use. This paper is intended provide an overview and recommendations that will set the foundations for further research. That research will in turn provide suggestions for more appropriate metrics and/or frameworks for evaluation of future incubation projects and lend greater insight into the true impact of this significant investment.



2.0 BACKGROUND

Governments and higher education institutions are increasingly investing substantial funding into incubation (European Court of Auditors, 2014; Government of Canada, 2016a, 2016b). While there are no completely agreed-upon definitions of incubation and acceleration, for the purposes of this paper, incubators are "programs that provide their client companies with business support services and resources tailored to young firms" and accelerators are similar but often employ a cohort model (InBIA, 2016). The expectation of investment in incubators and/or accelerators is that it will result in the commercialization of research, firm creation, job creation, and attraction of investment to the region. Incubation is broadly seen as a way to encourage the creation of value (usually wealth and/or jobs) from ideas and research through some combination of shared facilities and services (Bruneel, Ratinho, Clarysse, & Groen, 2012; Hackett & Dilts, 2004). This has been particularly true in the last generation of incubators, where services and networks have been emphasized as important to assisting in the growth of companies, as is true in Canada. Earlier generations of incubators were largely about shared space and physical resources (Etzkowitz, 2002; Scillitoe & Chakrabarti, 2010). There have been many studies into incubator performance, but few show evidence of much adoption for evaluation beyond academic literature.

With the surge of investment and activity in incubation, recent work suggests there could usefully be more consideration and rigour around incubation performance evaluation (Allen & McCluskey, 1990; Dee et al., 2011; Hackett & Dilts, 2008). Thus, it is important to consider whether currently-used performance indicators are accurately reflecting what is happening in the area and whether all objectives are being met. Common metrics used for reporting on such projects may not be ideal. They are generally the basis for future investment and funding. The funders of these projects are often the public sector, and according to Dee et al. (2011), "funding sources generally rely on intermediate outcomes (jobs, survival) at least as much as they use the hard measures of real growth and profitability" (2011, p. 6). This suggests the need for a more comprehensive and reflective framework for evaluation, as well as mechanisms for adoption.

We examined performance measures in literature and common project performance measurements in the light of additional literature to provide insight into potential challenges and shortcomings, and to provide suggestions for more appropriate metrics and future work in the area.

For example, the Government of Canada allocated $100 million to incubation in a single program from 2013-2014 and recently announced $800 million intended for innovation networks and clusters, part of which will likely go to

3.0 LITERATURE REVIEW

There is significant literature on incubation and incubation measurement. The following sections outline indicators that have been used previously in literature and commonly in reporting. We have reflected on these proposed metrics in light of additional literature and experience to provide recommendations for further work.

3.1 PERFORMANCE INDICATORS FOR BUSINESS INCUBATION

Dee et al. (2011) summarize incubator performance metrics used previously at both the incubatee level (Table 1 and Table 2) and incubator level (Table 3), also noting the stakeholders to whom these indicators matter.

The above metrics focus on firm-level activity measures. Dee et al (2011) point out that incubators may also be measured in terms of tenant innovation capabilities, which include input and output measures (Table 2).

Table 1: Incubatee Level Measures

Indicator	Stakeholder				
	Entrepreneur	Investor	Employee	University	Government
Survivability	X	X	X	X	X
Sales Growth (%)	X	X	X	X	X
Employment Growth (%)	X	X	X	X	X
Profit Growth (%)	X	X	X		X
Profitability Growth (%)	X	X	X		X
Finance Raised ($)	X	X			
Tax Growth (%)					X
Export Growth (%)					X

Modified from Dee et al. (2011) p. 41

Beyond aggregated incubatee performance, several measures have also been proposed for direct evaluation of the incubator (Table 3) including metrics around space, tenants and funding.

Table 2: Incubatee Company Inputs, Outputs and Outcomes

Indicator	Stakeholder				
	Entrepreneur	Investor	Employee	University	Government
Input: # of science/tech employees	X	X		X	X
Input: R&D expenditure	X	X		X	X
Output: # of patents	X	X		X	X
Output: # of copyrights	X	X			X
Output: # of products	X	X			X
Outcome State (survival, growth, business progress, decline, close or exit)	X	X	X	X	X

Modified from Dee et al. (2011) pp. 41-42

Table 3: Incubator Performance Measures

Indicator	Stakeholder				
	Entrepreneur	Investor	Employee	University	Government
Incubator Space	X				X
Occupancy Rate	X			X	X
Avg. Length of Tenancy	X			X	X
Avg. Capital Investment Cost	X				X
Proportion Revenue from Subsidies					X
Number of Tenants					
Presence of Research Park	X				X
Share of Operational Budget Supported through Internal Sources					X
Level of Funding Received from Key Donors (industry, university, etc.)	X	X	X	X	X
Development of Incubator in Life Cycle	X	X	X	X	X
Graduation Rate					X
New Firms Created	X	X	X	X	X
Ratio Staff: Tenants	X	X			
Proportion of Management Time Advising	X	X			
Cost per Job					X

Modified from Dee et al. (2011) p. 42

3.2 CHALLENGES IN INCUBATOR PERFORMANCE MEASUREMENT

Examining the proposed methods of incubator performance evaluation, several challenges are apparent and discussed in the following sections.

3.2.1 Not all stakeholders are served by each performance indicator

There are many possible incubation performance measures, each accruing value to one or several different stakeholders (Dee et al., 2011; Lubik, Maine, & Garnsey, 2012). However, many players are still indirectly linked to the success of the metrics of others. Without harmonizing these objectives and ensuring that all players are being rewarded, there may not be sufficient incentives to continue participating in the long term.

An evaluation framework can add value not only for evaluation but also as a communications tool. Because these stakeholders have different objectives by which to measure performance, there is a possibility of different patterns of behaviour that may or may not be beneficial to the system as a whole. Formulating a framework and agreeing on it with core players prior to the start of an incubation project may provide a shared vision about the objective of the initiative and their role in it, potentially leading to greater cooperation with evaluations. Moreover, evaluation frameworks can guide the practice of evaluation itself by making the relationships between different drivers clearer and exposing gaps.

3.2.2 Direct impact for the university appears to be under-represented in measurement

The previous section can be seen to emphasize the importance of the university as a partner in incubation. A partnership with a university strong on entrepreneurial education can assist with the high-quality inputs that lead to stronger outcomes, regardless of whether the incubator is focused on picking winners or adding value. However, Tables 1 to 3 show few common outcomes for which value can be attributed directly to the university.

In addition to the above, several additional indicators have been suggested for university incubators (Mian, 1997), namely students hired by tenants, entrepreneurs originating from the university, and entrepreneurs serving as faculty, but these do not appear to be the norm. Dee et al. (2011) suggest that incubators could also be measured by how well they support the university's mission, including:

- hiring students
- helping develop technologies
- impacting training and teaching
- teaching entrepreneurial skills to students
- consulting between the university faculty and tenants
- impact on a university's image
- impact on donation

However, no incubation literature was found examining or using these measures. Looking at literature on university entrepreneurship, the number of students involved in or starting ventures may also be a useful indicator (Astebro, Bazzazian, & Braguinsky, 2012; Boh, De-Haan, & Strom, 2012). At this point, it is worth noting that incubation does not only happen at a single stage of firm development. Several of the above recommendations would be most suitable for measuring the performance of an earlier stage incubator.

This suggests that the benefit for the university may not always be entirely clear, despite its powerful position in these ecosystems. It also suggests that interactions (and the benefits thereof) with the university have rarely been the focus of indicators, which may be an opportunity for further study, especially as universities are encouraged or enticed to create incubators.

3.2.3 Incubator performance is often an aggregate of client performance

As shown in the tables and literature above, incubator performance is often shown in terms of aggregated incubatee performance. This assumes that the performance of the incubatee is due to the activities of the incubator, but we find few studies that draw clear causation between incubation processes and incubatee results (Bergek & Norrman, 2008; Peters, Rice, & Sundararajan, 2004). Moreover, this past work does not distinguish between incubation models that are either "picking winners" (choosing from an already strong talent pool) or growing a local talent pool through strong intervention (Bergek & Norrman, 2008).

This suggests the need for more qualitative cases to be included in funding reports to show where intervention from the incubator added value if growing innovation capacity is indeed an objective, which would likely also provide insights into client satisfaction.

3.2.4 Business inputs are often used as performance measures

Job creation and funding raised are two popular performance indicators, but it is useful to note that these indications of resources going into a startup firm in order to create value (usually in the form of products exchanged for revenue) or a badge of approval from investors of possible future value (Maine, Lubik, & Garnsey, 2012).

Job creation is a highly prevalent metric used to measure performance, but a closer examination may suggest that this is a less useful measure of incubator value. According to the seminal work of Hackett and Dilts (2004), job creation should be secondary to creating a financially sound entity. Dee et al. (2011) point out that employee growth is often dependent on funding, and an emphasis on job creation "contradicts the advice of many investors who are acutely aware of the need to control spending by investee firms".

"Job creation is a highly prevalent metric used to measure performance, but a closer examination may suggest that this is a less useful measure of incubator value."

It is worth noting that this metric is often considered in lists like entrepreneur.com's top entrepreneurship universities.

This may be at odds with other venture investors encouraging rapid growth. Moreover, the early growth of a firm is often unavoidably turbulent, requiring pivots and fluctuations in employee numbers as the firm learns.

Funding is another one of the most common measures of firm (and thus incubator) success, as it represents new resources and also external validation of a business idea (Lockett & Wright, 2005), but funding is also an input variable to a firm being able to create undertake activities, hire and generate revenue. Lubik, Garnsey and Maine (2012) propose showing that these employees, funding and patents are necessary resources for a firm to create value (measured as revenue over time), but that revenue over time and profit over time are more suitable indicators of firm success over the life the firm, emphasizing the importance of recognizing the needs of firms at different stages in the firm life cycle and also when firms move between these stages.

> “...academic innovators may not have the skills required to become entrepreneurs and lead the formation and growth of the firm.”

These are necessary precursors to firm survival, but overemphasis on firm inputs may not put enough emphasis on what to do next (to generate revenue and capture profit). This would suggest that aggregate job creation and funds raised should be augmented with analysis of overall trends and firm outcomes to provide context.

3.2.5 Static performance measurement does not take inputs or long-term outcomes into consideration

Incubators do not exist as machines with uniform inputs. According to Hackett and Dilts (2004a), “lack of inputs such as capable entrepreneurs and/or critical or strategic technologies for commercialization might go a long way toward explaining why many incubators perform so poorly”. In the case of university inputs, Shane (2004) suggests that academic innovators may not have the skills required to become entrepreneurs and lead the formation and growth of the firm. This emphasizes the importance of skills and team development before and in concert with incubators to shorten learning curves, accelerate venture development and increase performance, but this is not often reflected directly in current performance measurement. This is further backed up by Wright et al. (2006) who, in the context of university spin-outs, helpfully place incubation as part of a much longer commercialization process and ecosystem of players.

The current methods also appear to take mostly the time the firm spends in the incubator into consideration, though this is a small amount of time compared to the life of a successful firm past graduation from the incubator, and it makes longitudinal studies challenging (Rothaermel & Thursby, 2005). Most current methods also do not take into consideration other outcomes such as social impact (Mian, 1997), second-generation spin-out companies or entrepreneurs who go on to become investors and mentors, or creating

cluster development (Lubik & Garnsey, 2014). Examples such as the Cambridge cluster show this to be a powerful map that can be developed to show impact (Evans & Garnsey, 2009).

This suggests that the incubator could be looked at in the context of an ecosystem and continuum, and sharing metrics between early and later partners would help form a more comprehensive view of performance. Moreover, it suggests that while the incubatee and the incubator appear to be the favoured units of analysis, the journey of the entrepreneur, perhaps through network analysis, may provide significant insights into the outcomes of incubation activities.

It is also worth noting that measures like employee growth and funding would bias investment toward the later stages where this would be higher, despite the importance of building innovation capabilities and ensuring quality and quantity of ideas and teams at earlier stages.

3.2.6 Firm sectors are given limited attention

Often, even mixed-use incubators report aggregate figures (Dee et al., 2011), and technology-based incubation studies mix types of technology together (Colombo & Delmastro, 2002), so these figures are rarely broken down into sectors, even though the sector of venture in question may have significant impact on those aggregate figures and what those figures mean. For example, firms in sectors such as software have low technical uncertainty and a relatively rapid time to market compared to science-based ventures (Table 4).

Table 4: Commercialization Time, Costs and Uncertainties for Software, Biotechnology and Advanced-Materials Ventures

	Development Time (years)	R&D Costs (USD millions)	Commercialization Costs (USD millions)	Technology Uncertainty	Market Uncertainty
Software	0-2	0-3	1-10	Low	Medium
Biotechnology	10-15	5-10	300-900	Very High	Medium
Advanced Materials	5-15	2-20	50-500	High	High

From Maine & Seegopaul (2016) p. 488

Investment in these sectors is important because science-based ventures are often those that can lead to long-term regional advantage (Maine & Seegopaul, 2016). Moreover, adequately supporting technology sectors with longer venture development cycles helps to unlock the value of cumulative

federal and provincial investment in research and educational infrastructure. However, the average incubation cycle is 2-3 years, and when relying on government funding, a typical election cycle is 4 years, which means that there may be pressure to focus on sectors where rapid results can be shown. This can also lead inexperienced managers to think that ventures are not making significant or sufficient progress.

3.2.7 Gathering a holistic view of incubation performance is resource intensive

In section 3.1, twenty-eight different indicators were proposed across Tables 1 to 3, and more possible indicators were suggested in the subsequent sections. Only a few, such as job creation, are collected most of the time, and it is reasonable to assume that this is not only because it helps justify public investment but also because it is a fairly easy metric to collect.

From a practical standpoint, it is worth noting that to track all of this information centrally would be time and resource intensive, suggesting that if a more comprehensive performance evaluation activity was planned, it would likely require buy-in from multiple players and require the active and ongoing participation of client firms and entrepreneurs. However, standardization and effective data sharing between agencies and governments could reduce reporting overhead, save time, and prevent reporting fatigue for companies, programs, and funders.

3.3 SUMMARY AND SUGGESTIONS FOR FURTHER RESEARCH

Our review suggests a significant number of challenges facing the measurement and evaluation of university incubator performance:

1. Not all indicators apply to or are valued by each stakeholder, suggesting that an effort should be made to ensure that future frameworks represent the needs of all key stakeholder groups.

2. Current measures do not appear to take benefits to the university into consideration, although some recent literature has several suggestions, including the use of metrics such as the number of faculty entrepreneurs and the number of students involved in ventures.

3. Current indicators show incubator performance as aggregate performance numbers of client firms but do not necessarily reflect value-added. Without qualitative data on processes and activities, this can make the actual performance and contribution of incubators challenging to accurately understand.

4. Measures used currently tend to emphasize the inputs into client firms (employees and funding) but not later firm performance, thus additional later-stage metrics such as revenue and profit are needed.

5. Current measures do not show the incubator as part of a longer continuum or ecosystem, downplaying the role of earlier players (such as universities and early-stage incubators) or the later outcomes (such as social impact or cluster development). There may be an opportunity for tracking flow and interaction between network players to gain a more comprehensive and multi-level perspective on incubation.

6. Current measures could bias investment toward particular sectors with shorter time horizons. This may be dangerous, as the sectors with longer firm development times are also the ones that can lead to long-term regional advantage.

7. Comprehensive impact measurement requires long-term planning and reporting horizons as well as commitment, resources, and buy-in from multiple stakeholders, plus an approach that is easy enough to engage with to ensure continued use.

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