

HOW TRAINING AFFECTS THE NEW VENTURE DEVELOPMENT OF TECHNOLOGY STARTUPS

by

Brian Jensen

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Carleton University

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Abstract

The objective of this research is to examine how the training services provided by incubators affect the approach to new venture creation utilized by founders of technology start-ups. The results of the research suggest that the Lead-To-Win business ecosystem training program can decrease reliance on causation approaches to new venture development and increase the affordable loss and flexibility sub-constructs of effectuation in the new venture development process. The results of this research may help operators of incubators design their training programs and simplify progress monitoring, as well as help start-ups better communicate value to their stakeholders.

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1 Introduction

Two distinct approaches to new venture development have been identified. These are the effectuation approach and the causation approach (Sarasvathy, 2001). The fundamental strategy that forms the basis of the effectuation approach to new venture development is emergence while the causation approach to new venture development is firmly based in the traditional strategies of planning and rational decision making (Chandler, DeTienne, McKelvie & Mumford, 2011). The effectuation approach to new venture creation proposed by Sarasvathy (2001) conceptualizes a new firm as leveraging existing and new networks to access resources it requires. Recently, a scale to measure effectuation and causation has been validated with elements of the effectuation process being positively related to measures of uncertainty (Chandler, DeTienne, McKelvie & Mumford, 2011). It has also been suggested that studying entrepreneurship students could yield additional insight into effectuation and aid in determining whether elements of effectuation could be taught (Perry, Chandler & Markova, 2011). The Lead-To-Win (LTW) incubator at Carleton University provides training services to founders of start-up technology firms using a business ecosystems approach (Bailetti, 2010). The LTW approach to technology services includes coaching, class room training and group networking with respect to business ecosystems and related material.

New technology firms face high uncertainty and failure rates. This drives their founders to seek the services of incubators to help ensure their survival and growth. Business support services provided by incubators have been identified as potentially the most important service (Bergek & Norrman, 2008) and they often include training (Ratinho, Harms & Groen, 2010). Lack of agreement on performance measures for early stage ventures complicates establishing incubator performance measures (Dee, Livesey, Gill & Minshall, 2011). Recent work to establish validated effectuation and causation measures and benchmarks has been completed (Chandler, DeTienne, McKelvie & Mumford, 2011) and this offers a potential solution for the performance indicator for incubators.

A review of the business ecosystem literature (Moore, 2006; Iansiti & Richards, 2006; Ding, Zhao, Wang, & Liu 2009; Li & Yan-Ru, 2009) suggests that a number of successful firms such as Microsoft, Apple, Cisco and Intel have leveraged a business ecosystem style strategy to gain a competitive advantage in

the market place. When start-up firms used knowledge of business ecosystems early in their life cycle they were able to access or create strong partner networks that enabled the creation of different complementary offerings and were able to leverage their environments to access or create the resources they lacked (Garnsey, Lorenzoni & Ferriani, 2008, Garnsey & Leong, 2008).

The concepts from the study of business ecosystems parallel similar concepts in the theory of effectuation and the founders of technology firms in the LTW incubator represent new entrepreneurs learning how to build new technology businesses. This provides us with an opportunity to measure the entrepreneurs in the LTW incubator using the newly validated effectuation and causation measurement techniques (Chandler, DeTienne, McKelvie & Mumford, 2011) to explore the training they received and the approach to new venture development being used by the LTW founders. We can explore these items by comparing the measures obtained from the LTW founders with known benchmarks (Chandler, DeTienne, McKelvie & Mumford, 2011) and with another incubator to act as a control group. For this study the Invest Ottawa incubator will act as the control group. By comparing the LTW measures with the Invest Ottawa measures we offer a methodology for comparing new venture performance measures between different incubators.

For the purpose of this research the following definitions are used:

1. Technology incubators or simply incubators are organizations that support technology based ventures (Ratinho, Harms & Groen, 2010).
2. Training services provided by incubators refers to coaching, class room training, group networking and assistance with business plan development (Ratinho, Harms & Groen, 2010).
3. Stakeholders are defined as a technology start-up's key customers, suppliers, channel and technology partners and investors (Bruneel, Yli-Renko & Clarysse 2006).
4. Founders following a effectuation approach to new venture development are experimenting with alternatives in which potential losses in the worst-case scenario are affordable, utilizing pre-commitments and strategic alliances in an attempt to control an unpredictable future, and remaining flexible so they can take advantage of changing environmental contingencies (Chandler, DeTienne, McKelvie & Mumford, 2011).
5. Founders following a causation approach to new venture development are envisioning the end from the beginning, maximizing expected returns, conducting business planning, using competitive analyses to predict an uncertain future, and exploiting pre-existing knowledge (Chandler, DeTienne, McKelvie & Mumford, 2011).

Objective

The objective of this research is to examine how the training services provided by the LTW incubator affects the approach to new venture creation utilized by founders of technology start-ups. The Invest Ottawa incubator will be used as a benchmark.

This research answers three questions:

1. Does an incubator's business ecosystem approach to training increase firm founders' knowledge of business ecosystems and affect the new venture creation process they use?
2. Does an incubator's business ecosystem approach to training increase the number and diversity of stakeholders for the new firm?
3. Does an incubator's business ecosystem approach to training services enable the founders of new firms to learn more about complementary products, services or technologies?

Deliverables

This research will deliver the results of testing the following Hypotheses:

Hypothesis 1: A business ecosystem approach to training increases the number of founders that use the effectuation approach to develop new ventures.

Hypothesis 2: A business ecosystem approach to training increases a founder's knowledge of potential complementary products, services or technologies.

Hypothesis 3: A business ecosystem approach to training increases the number and diversity of key partners for a start-up firm.

A recently developed scale to measure effectuation and causation has been validated and includes benchmarks for expert entrepreneurs (Chandler, DeTienne, McKelvie & Mumford, 2011). This scale is used in this research.

Relevance

This research may be relevant to at least five groups: operators of incubators, researchers, economic development organizations, risk capital providers, and founders of technology firms.

This research will provide the operators of incubators with an output performance measure that is related to training. Measuring the performance of incubators is difficult and a broad agreement on performance measures does not exist. This research focuses on the link between incubator training efforts and founders' two approaches to firm development: effectuation and causation.

This research will be of interest to economic development organizations and risk capital providers as effectuation development strategies are important when firm founders face environments of high uncertainty. This research can help guide government program development for technology incubation and gives capital providers measures to evaluate and mitigate investment risk which are related to training.

This research may be used by founders of technology firms to select training programs and identify incubators that can better help them.

Contribution

This research makes at least two contributions. First, this research links knowledge about business ecosystems to the emerging theory of effectuation development processes for new firms.

The second contribution this research makes is that it shows how to measure the new venture development performance of firms in two different incubators and compare these measures with known benchmarks. The lack of a common understanding of how to measure new venture performance has been identified as a key roadblock to understanding how incubators affect the performance of new firms.

Organization

This thesis is divided into seven chapters. Chapter 1 is the introduction. Chapter 2 reviews the literature. Chapter 3 provides the research model and Chapter 4 provides the research method. Chapter 5 provides the results of this research, Chapter 6 provides a discussion of results and Chapter 7 provides conclusions, limitations and suggestions for future research.

2 Literature Review

Chapter 2 is organized into four sections. The first two sections describe the three literature streams relevant to this research. These are business ecosystems, effectuation and incubation. Section 2.1 examines the business ecosystem literature and the factors that influence the success of start-up firms. Section 2.2 examines the effectuation literature stream and the incubation literature stream. Section 2.2 also provides a comparison of effectuation and causation and highlights the differences between the two approaches to new firm development. Section 2.3 presents the commonalities and differences between the three streams of research. Section 2.4 provides the lessons learned from the literature review.

2.1 Business Ecosystems

The business ecosystem literature stream focuses on the nature of business ecosystems and how they can be leveraged to grow start-up technology firms.

This section provides a review of English language journal articles that contain references to the work of James F. Moore and were published after December 31, 2004. This literature review does not examine books and book reviews. This approach will focus the review on more recent articles that advance the foundational thoughts of business ecosystems.

The business ecosystem literature stream is organized into four parts: Foundational, Analytical, Mechanical and Situational.

2.1.1 Foundational Stream

The foundational stream focuses on the theoretical aspects of business ecosystems. It includes contributions published in biology, business strategy, marketing, complexity, network theory and technology strategy.

A business ecosystem is a loosely connected network of organizations that focus on continuous innovation for renewed growth and survival. The literature identifies and discusses three primary constructs: kestones, niches and dominators (Moore, 2006; Lansiti & Richards, 2006; Ding, Zhao, Wang, & Liu 2009) each with a particular role to play in order for the ecosystem to survive and thrive. These

elements appear under different names with central contributors and core strategies being comparative to keystones while slit strategies (Ding N., Zhao L., Wang Z. & Liu W, 2009) and followers are comparable to niche players.

The literature presents keystones as richly connected hub firms that provide open technology platforms and complementary services that enable ecosystem members to build value. An ecosystem will typically have few keystones and many niche firms. Niche firms are firms that have selected a sustainable niche business strategy that leverages the platform technologies and tools offered by one or more keystones. Healthy ecosystems will have a large number of diverse niche firms that will be extending the keystone technology platforms into multiple markets or across industries. Dominators are at the opposite end of keystones in an ecosystem and operate at the expense of the other members. Dominators appear to employ closed technology stacks and seek to overtake or eliminate niche firms.

The three constructs are conceptualized as key operating routines in a business ecosystem. Successful ecosystems will have keystones that continuously innovate and integrate new technologies into their platforms to encourage the development of more niches. Strong ecosystem keystones will be active in reducing the complexities of interconnecting niches in order to facilitate business growth. A successful niche will maintain rich connections beyond the technology platform with their keystones and key complementary niches firms, in addition to utilizing keystone platforms. Successful niches will also develop strong technology integration skills and can even grow to become keystones in their own right that dramatically extend and strengthen the ecosystem.

The papers in this stream also illuminate robustness, productivity and niche creation as central aspects of ecosystem health and come into play in arguments on anti-trust and expansion. All of these attributes provide niche firms and keystones with a defence against dominators that is both highly complex and deep. Dominators will invest heavily in innovation via internal R&D and create offerings that replace those of niche firms. They will employ vertical integration strategies to limit supply to other members and use concentric expansion as a method to overtake adjacent niche firms. The actions of dominators will restrain opportunities for new growth within ecosystems.

The foundational literature consistently uses Microsoft and Intel as examples of keystones and curiously appears to show Apple has having evolved from a dominator during its early years in the PC market to a strong keystone in the music industry today. The foundational literature also includes fundamental thoughts on the study of marketing itself (Layton, 2008). These thoughts propose a basic shift in study away from the current transactional nature of marketing study towards a more systematic thinking that offers the potential to stimulate renewed interest and improved insights in different and evolving systems of marketing such as business ecosystem.

The foundational literature stream points to the keystone and niche constructs as key strategies for firms seeking growth within a business ecosystem. Firms selecting one of these strategies can then access multiple methods to remove barriers to growth. Table 1 identifies the barriers to growth faced by new technology firms and ways that an ecosystem approach can be used to remove these barriers.

In Table 1 the column titled Barrier is taken from Bailetti 2010 while the column titled Ecosystem Approach to Barrier Removal is developed from the papers reviewed in section 2.1.1.

Table 1 - Removal of Growth Barriers

Barrier	Ecosystem Approach to Barrier Removal
Skills	<ul style="list-style-type: none"> • Use platforms that make-up for lack of skills • Obtain expertise from the networks around keystones • Gain knowledge from complements provided directly by keystones • Be a member of more than one ecosystem • Connect with non-competitive niches to learn new skills
Access	<ul style="list-style-type: none"> • Continuous innovation can drive expanding market access • Integration may solve problems not accessible to you otherwise • Find ecosystem members that can utilize you and your technology to gain market access • If you are a niche, learn whether becoming a keystone is possible and follow that path • Create open architectures and systems that enable further participation
Time	<ul style="list-style-type: none"> • Find technology integration approaches that are faster than traditional R&D • Use keystones to quickly connect with others to close knowledge or capability gaps • Look for ways that ecosystem members can utilize you and your technology to enable fast integration • Integrate technology from more than one ecosystem
Wealth	<ul style="list-style-type: none"> • Select platforms that make up for lack of wealth • Find technology integration methods that cost less than R&D • Active keystone affiliation can defend against larger competitors • Influence platform development by keystones • For keystone – Strengthen relationships innovative niches • Influence development in critical complementary niches

(Source Author)

2.1.2 Analytical Stream

The analytical literature stream provides frameworks for the study and analysis of business ecosystems.

The papers in the analytical stream consider the interactions of entities within the business ecosystem and discuss the effect of decisions made by them.

The analytical literature stream focuses on the interactions among firms in an ecosystem as a key line of thought. This suggests that firms that seek to grow must be very knowledgeable about the ecosystem within which they operate as well as the key interactions and feedback mechanisms available to them.

There are two dominant frameworks in the analytical stream. The first builds on theories of complexity and evolutionary economics (Peltoniemi, 2006) and the second uses simulation and modelling techniques to map business ecosystems (Tian, Ray, Lee, Cao & Ding, 2008).

2.1.3 Mechanical Stream

The mechanical literature stream focuses on the dynamic mechanisms at work within a business ecosystem. The core theme of these papers is the ecosystem dynamic mechanism with each one exploring a unique aspect of ecosystem operations. These operational dynamics include how new business ecosystems are started, how decisions by core firms affect niche players, how relationships between firms affect performance, how new firms move new technology into new markets, governance dynamics and how information technology can strengthen an ecosystem. These papers provide insights that may be of particular interest to small, or start-up firms as a number of them specifically explore the dynamics of early ecosystem development and the shaping of a favourable environment for a new firm.

From a start-up oriented perspective the evolution of ARM, a technology spin-off from Acorn Computers that grew to be a world leader in micro-processor technology by creating a new ecosystem based around an innovative technology platform (Garnsey, Lorenzoni & Ferriani, 2008) is compelling. Also, the start-up dynamics of early stage pharmaceutical companies (Garnsey & Leong, 2008) would also be of interest to start-ups as it explores the genesis of a new ecosystem. Central to these discussions is the idea that new firms can leverage their environments to access or create the resources they lack.

The ARM study examines the technology spin-off process that is based on the concept of speciation from the study of ecology. A combination of resource based and evolutionary theories is used to explain the development of a new pharmaceutical ecosystem. A common theme centers around the firms' efforts to shape their external environment and the role of the initial strategy of each firm involved is discussed. For ARM this strategy was the maximization of resources to deliver technology and win business, while the pharmaceutical firms took direct aim at deliberately transforming their environments to their advantage. These early stage firms started creating network advantages early in their development and used partnering to increase market access, build capabilities and create value for partners. They all used knowledge sharing to build partner value by enhancing the capabilities of their networks but ARM took this even further to include not only its partners but its partners customers.

These strategies created many environmental connections that enabled the creation of different complementary offerings and capabilities. These interactions with the environment are further amplified by an exploration of how the challenges experienced by technology development firms affect their success (Adner & Kapoor, 2008). This study links the potential for learning with greater competitive advantage and shows that when the technology development requires the developing firm's component supplier to be innovative then a greater advantage will accrue to the developing firm. Additionally, Adner and Kapoor (2008) show that when suitable complementary technologies are unavailable then the competitive advantage of the developing firm is reduced. We can see a number of interacting dynamics here that are worthy of consideration by start-up technology firms planning on building new technology and in all these papers there is a common theme of broad ecosystem interaction with learning from partner networks that leads to advantage. The notion of learning is an important aspect of establishing effective governance structures that is highlighted by a study of the efforts to create a sustainable Internet-based business service creation environment using open source software (Mansell, 2006). The study indicates that the lack of a set of working rules was a significant barrier to commercial sustainment of the project.

The evolution and demise of ARM's parent company, Acorn Computers is also discussed. It points to the rapid development of a new technology as the initiation point, slowing performance as a catalyst for the

spin-off and a closed technology stack with low understanding of the business environment as key contributors to its eventual disbanding. We see here a low cost R&D strategy was used as a successful initiation strategy. This approach is shared with ARM and with at least one of the pharmaceutical firms that was studied. Conversely we observe that growth is hindered when the technology is not open and the focus is not placed on the external environment at Acorn. This highlights a key difference between the unsuccessful growth strategy of Acorn Computers and the successful strategies employed by all the others. An aspect shared by all of the organizations discussed here, including Acorn Computers is that they all had exceptionally knowledgeable and talented staff.

The final contributors to the mechanical stream bring forward thoughts and analysis on the roles and actions of larger firms in an ecosystem. The mechanical stream of literature considers the health of ecosystems from the perspective of information technology strategy (Kim, Lee & Han 2010) and the overall business strategic choices made by larger firms (Lamar, 2008). These papers consider the turbulence or degree of change in the environment in which the firm is operating as key influencers of ecosystem health. In one instance we are presented with IT strategies that can be employed by core firms to assist in maintaining ecosystem health while in another we find a study of how decisions around pricing, provision of complements, product durability, redesign frequency and degree of design change by core firms can negatively affect the health of ecosystem niche players. In the turbulent environment it was observed that when niche firms relied on forward price predictions as a salient element of their overall strategy that they were more exposed to danger from the environment (Lamar, 2008).

In the guide provided to becoming a health flagship company (Kim, Lee & Han 2010) the first step is "Know Your Ecosystem". From the start-up perspective it is thought this same step would apply to creating an ecosystem strategy by examining the IT strategy of the core firms you intend to work with and understanding their platforms. A solid understanding of the platform roadmaps involved in the solution is thought to be significant since changes in pricing, provision of complements, product durability, redesign frequency and degree of design changes by core firms can strongly influence the success of a niche venture.

2.1.4 Situational Stream

The situational literature stream provides detailed, real world examples of business ecosystem creation and evolution. The stream covers both hardware and software technologies from Cisco and Amazon respectively with the Internet as the thread that connects them together. From the hardware perspective we have the formation of complementary niche firms around Cisco's proprietary Internet Operating System (IOS). From the software perspective we have Amazon attracting niche players to its Amazon Web Service (AWS). Amazon has opened its database to external developers. While the AWS is not proprietary, Amazon directly controls its access giving it regulatory control. Both Cisco and Amazon actively use the ecosystem to drive their businesses with Amazon using AWS to create greater web awareness for their product business and Cisco using the external environment as its R&D facility. Cisco can do this because of its mergers and acquisitions strategy.

In both of these cases, we observe a symbiotic growth relationship between the central firm and the ecosystem. For Cisco, we can see that the more it helps the ecosystem grow and solve problems the more M&A targets will be available for Cisco allowing it to further enrich the cycle. For Amazon we see that the more it helps AWS connections to grow and interconnect the more business will flow towards Amazon allowing it to further enrich the cycle.

These papers highlight the nature of growth relationships in healthy, successful business ecosystems in the real world and provide concrete examples of how a central firm can regulate the environment. As a niche firm you would need to understand the growth engine and regulations related to your keystones while keystones need to understand what is needed in the environment for niches to flourish while providing adequate regulation. As discussed with the mechanisms it is thought that these elements could be adapted to remove any one or a set of growth barriers.

2.1.5 Comparison of Traditional and Ecosystem Approaches

The Open Source Resource Bulletin issued in June 2010 (Bailetti, 2010) provides an illustration of traditional approaches to technology business growth with respect to pertinent elements of the overall business strategy. Table 2 compares the traditional and ecosystem approaches to firm growth.

In Table 2 the columns titled Element and Traditional Approach are taken from Bailetti 2010 while the column titled Ecosystem Approach is developed from the papers reviewed in section 2.1.

Table 2 - Comparison of Traditional and Ecosystem Approaches to Growth

Element	Traditional Approach	Ecosystem Approach
Go-To-Market	Direct sales	<ul style="list-style-type: none"> • Select niche or keystone strategy • Create network to build and share value
Deliver Value to	Customers	<ul style="list-style-type: none"> • Deliver value to multiple players including: • Customers • Partners • Partners-customers • Customers-customers
Entry Strategy	Raise money to develop hard product, then sell to target market and then expand	<ul style="list-style-type: none"> • Shape environment to accelerate success • Rapid, low cost R&D leveraging platforms • Look for innovative suppliers • Ensure customers have easy access to compliments
Top Management Focus	Internal hierarchy and control over transactions to develop and sell	<ul style="list-style-type: none"> • External ecosystem learning • Building relationships at many levels with multiple players • Concerned with keystone regulation
Target	Players who agree with what we do	<ul style="list-style-type: none"> • Players who share vision
Outcomes linked to:	Internal workings and go-to-market tactics.	<ul style="list-style-type: none"> • Co-evolution and symbiotic growth
Plans to:	Make profit from revenue	<ul style="list-style-type: none"> • Ensure ecosystem partners are successful • Make profit from revenue

(Source Author)

2.1.6 Business Ecosystem Summary

The literature examines novel structures and mechanisms to enable growth for technology ventures. The literature provides concrete real-world examples of successful firms operating in business ecosystems and provides interesting insights into the value creation mechanisms and growth strategies of interconnected, innovative firms that share a common vision.

2.2 Effectuation and Incubation

This section examines the effectuation and the incubation literature streams. Two recent literature reviews were found that provided a very detailed, broad and well organized examination of both the effectuation and incubation literature. The two literature reviews were compared to highlight similarities and contrast differences between the two concepts and their states of development. This examination of the two literature reviews forms the foundation of this section and improves our knowledge of effectuation, causation and technology incubation research by focusing on two key areas within the literature streams. These two key areas are the current state of research development with open research questions and key results from previous studies relating to new venture growth. This approach will provide us with an understanding of the state of development of each stream and how it supports the development of new ventures.

The article Entrepreneurial Effectuation: A Review and Suggestions for Future Research (Perry, Chandler & Markova, 2011) forms the basis of the effectuation review while the article Incubation for Growth, A review of the impact of business incubation on new ventures with high growth potential (Dee, Livesey, Gill & Minshall, 2011) forms the basis of the incubation stream. Both of these articles are extensive literature reviews covering the effectuation and business incubation streams respectively. The stated purpose of the effectuation literature review article is to encourage further research (Perry, Chandler & Markova, 2011) while the stated purpose of the incubation article is to identify incubation models that have the greatest impact on the mission of building high-growth, innovative firms (Dee, Livesey, Gill & Minshall, 2011).

2.2.1 Current State of Development

The literature reviews of effectuation and business incubation are comprehensive and begin with the initial thoughts and efforts in each area; however the business incubation literature review focuses on papers published within the last 10 years (Dee, Livesey, Gill & Minshall, 2011). The effectuation review highlights the start of the theory with its first mention in 1998 (Sarasvathy, Simon & Lave, 1998) and the definition of causation as a goal driven model based on the rational decision making processes found in neoclassical economics. Effectuation is conceptualized with a definition and comparison to causation (Sarasvathy, 2001). Table 3 compares effectuation and causation and both columns are developed from Sarasvathy 2001.

Table 3 – Comparison of Causation and Effectuation

Causation	Effectuation
Begin with a given goal	Begin with a set of given means
Focus on expected returns	Focus on affordable loss
Emphasize competitive analysis	Emphasize strategic alliances & partners
Exploit pre-existing knowledge	Leverage environmental contingencies
Try to predict a risky future	Try to control an unpredictable future

(Source Author)

Business incubation is traced to its start in Batavia, New York where the first incubator was established in 1959. The literature stream for incubation starts in 1984 with definitions and taxonomies. Research in these areas has been evolving continuously since inception (Dee, Livesey, Gill & Minshall, 2011); however a key difference between the effectuation literature and the incubation literature is the existence of identifiable, intermediate theoretical development artefacts in the effectuation literature (Perry, Chandler & Markova, 2011). This is contrasted with the incubation literature review that indicates further research is warranted for the fundamentals of incubation models and that this topic is largely unaddressed by the business incubation literature. Effectuation is a relatively new concept that has been categorized as being in the nascent stage of development (Perry, Chandler & Markova, 2011) while the number of incubators has been growing continuously with a world-wide population of less than 1000 in 1990 to over 3500 in 2005 (Barrow, 2001, Dee, Livesey, Gill & Minshall, 2011).

Effectuation was introduced to explain the creation of new firms in contrast to the causation models that form the main body of entrepreneurship research while the *raison d'être* behind business incubation has emerged as being two fold. The incubation literature posits that incubators assist new technology firms overcome the uncertainty associated with early development and can act as a systematic accelerator of the entrepreneurial process (Hansen, Chesbrough, Nohria & Sull, 2000).

The two literature reviews discuss the foundations of each concept, review research questions and provide insight into the state of development of both streams. The literature that covers business incubation includes a number of studies that cover a variety of organizations, offering a multitude of incubation services and delivery models (Dee, Livesey, Gill & Minshall, 2011). This has created diverse terminology for business incubation (Hackett, Dilts, 2004) and hinders the broad agreement of foundational concepts or the refinement of clear typologies for the study of business incubation. In contrast to the business incubation literature, the early effectuation literature lays a clear foundation for the study of effectuation and explores core, definitional research on the subject (Sarasvathy, 2001). These initial effectuation articles compare effectuation with causation and develop testable propositions between effectuation and other concepts such as trust, entrepreneurial expertise, and new venture creation.

Both the effectuation and business incubation literature reviews offer insights into performance measurement for each of the concepts. The business incubation literature review highlights a lack of consensus related to the measurement of new venture performance which increases the complexity of measuring the performance of incubators and hinders further theoretical refinement (Phan, Siegel & Wright, 2005). The effectuation review includes a discussion of validated measures for both effectuation and causation (Chandler, DeTienne, McKelvie & Mumford, 2011). The review of effectuation goes further to suggest that additional insights into effectuation may be gained by gathering data from entrepreneurship students to determine if the dimensions of effectuation can be taught while the business incubation review suggests that absolute measure of incubator performance are impractical but that firms under incubation experience stronger learning when they interact with incubator management and networks (Dee, Livesey, Gill & Minshall, 2011).

Each literature review includes discussions that relate the concepts of effectuation or business incubation to other, more well-defined constructs. Business incubation organizations are compared with venture capital firms and professional service firms (HSU, 2007, Aaboen, 2009) while novice entrepreneurs are compared with experts to assess if the frame decisions is causal or effectual (Dew, Read, Sarasvathy & Wiltbank, 2008). The business incubation comparison highlights the elements unique to the concept of business incubation while comparison of expert entrepreneurs to novices highlights the propensity of experts to use effectual logic when making decisions related to new ventures.

The literature provides insight into how the concepts of technology incubation and entrepreneurial effectuation impact new ventures. Incubators affect firms under technology incubation by providing the founders with physical facilities, support services and access to partner networks (Ratinho, Harms & Groen, 2010) while effectuation is an approach to new venture development used by founders and driven by available means, affordable loss, strategic alliances, leveraging environmental contingencies and seeking to control an unpredictable future (Sarasvathy, 2001).

2.2.2 Key Contributions

An important commonality between the two streams of literature is the shared focus on new venture development.

The technology incubation literature suggests that incubators can have a positive and critical impact on new ventures (Perry, Chandler & Markova, 2011) while the effectuation literature argues that effectual logic is emphasized earlier in new venture creation (Sarasvathy, 2001). Going further the business incubation literature review suggests that incubators need to provide support to new ventures that are in a state of uncertainty (Phan, Siegel & Wright, 2005) while the theory of effectual logics is founded in decision making under uncertainty with empirical research supporting a positive relationship between an effectual approach to strategy and new venture performance under uncertainty (Chandler, DeTienne, McKelvie & Mumford, 2011). A common approach to understanding new venture performance was indicated as an impediment to developing a better understanding of business incubation (Phan, Siegel & Wright, 2005) and was addressed in the effectuation literature using a meta-analysis of previous studies

related to new venture development (Read, Song & Smit, 2009). The meta-analysis related to effectuation cited partnerships as significantly and positively related to new venture performance.

Lack of consensus on how to measure performance of early stage ventures complicates finding incubator performance measures (Dee, Livesey, Gill & Minshall, 2011), however validated effectuation and causation measures offer a potential performance indicator for incubators (Chandler, DeTienne, McKelvie & Mumford, 2011). Performance indicators are discussed in the incubation literature as being useful measures.

2.1.3 Effectuation and Incubation Summary

Incubators are growing in popularity and can accelerate the entrepreneurial process required for new venture development (Hansen, Chesbrough, Nohria & Sull, 2000). Effectuation theory provides insights into the firm development approach used by expert entrepreneurs to overcome the risks and uncertainty associated with new technology ventures (Dew, Read, Sarasvathy & Wiltbank, 2008, Sarasvathy 2001). The literature reviews provide a comprehensive guide to both concepts and provide a connection to new venture development.

2.3 Comparing Streams: Ecosystems, Effectuation and Incubation

Table 4 compares the ecosystem, effectuation and incubation literature streams and is developed from all the papers reviewed in section 2.

Table 4 - Comparison of the Ecosystems, Effectuation and Incubation Literature Streams

	Ecosystem Stream	Effectuation & Incubation Stream	Common Concepts
Unit of Analysis	<ul style="list-style-type: none"> Interaction between firms 	<ul style="list-style-type: none"> Incubation model New Venture Development Approach 	
Input Characteristics	<ul style="list-style-type: none"> Strategic Role/position Network access Current environment 	<ul style="list-style-type: none"> Available Means New Ventures Operating Environment 	<ul style="list-style-type: none"> Partner Networks Environment
Process/Operations	<ul style="list-style-type: none"> Environment Shaping Network creation Knowledge sharing 	<ul style="list-style-type: none"> Service Delivery Causation processes Effectuation processes Partners & Alliances 	<ul style="list-style-type: none"> Environmental Shaping Environmental Control Partner Development Knowledge Sharing
Output/Outcome	<ul style="list-style-type: none"> Niche proliferation Ecosystem Health Complementary Products & Services 	<ul style="list-style-type: none"> Limited loss Firm Growth/Survival 	<ul style="list-style-type: none"> New Venture growth Partner growth

(Source Author)

The three literature streams reviewed consider partner networks, alliances and interaction with the environment to enable growth. Partner networks and the current environment are considered by all streams. However the ecosystem literature pays considerable attention to the specific role that firms play within the ecosystem while available means is a key consideration for effectuation.

Shaping and controlling the environment and partner growth are key considerations for ecosystem development and effectuation.

2.4 Lessons Learned

Three major streams of literature were reviewed: business ecosystems, effectuation and incubation.

There are four key lessons learned from the review.

- 1) The three literature streams discuss new venture growth, partner networks and leveraging the environment
- 2) The business ecosystem literature stream has developed independently from the effectuation and incubation literature
- 3) There is no connection between business ecosystem training and new venture development process
- 4) Common performance measures for incubators have been difficult to establish

The primary focus of the effectuation and incubation literature streams is the development of new ventures or start-ups. The business ecosystem stream discusses the foundations of business ecosystems and their operation. While the business ecosystem stream of literature does highlight the structures and mechanisms that can enable growth for both start-up and established firms it does not directly address the development of new technology ventures.

While the three literature streams discuss similar ideas and concepts that support the development of new ventures, no areas of overlapping research were identified among the streams. Table 3 identifies the similar ideas and concepts that are discussed between the streams. The research areas of business ecosystem and effectuation represent relatively new lines of research that have been developing independently. The business ecosystem literature stream discusses the applications of business ecosystem knowledge to start-up firms but does not provide any references to literature in either the effectuation or incubation stream. Similarly the effectuation stream discusses partner networks and alliances but does not link to any literature in the business ecosystem stream or the incubation stream.

The business incubation literature cites the lack of a common understanding of new venture performance as a key roadblock in further understanding the impact of incubators on firm performance. The effectuation literature provides both a method to measure new venture development and benchmarks to compare against but is not linked to either the business incubation literature or business ecosystems literature stream.

The effectuation literature is largely founded on how expert entrepreneurs approach the development of new ventures yet none of the literature provided an approach that novice entrepreneurs could utilize to develop a new venture like an expert. The effectuation literature does not directly address incubators or provide any guidance on how they could encourage members of the incubator to follow an effectuation approach to new venture development.

3 Research Model

The following section describes the model for this research. This model focuses on business ecosystem training, effectuation, causation, complementary offerings and key partners. It is expected that founders who receive business ecosystem training will be more likely to:

- 1) Follow an effectuation approach to new venture development rather than a causation approach
- 2) Consider complementary offerings early in the development of their venture
- 3) Include the sale of a complementary offering as part of their venture
- 4) Have a greater diversity of stakeholders involved in their venture

Figure 1 depicts the independent variable (Business Ecosystem Training) with the 5 dependant variables and how the dependent variables relate to the hypotheses.

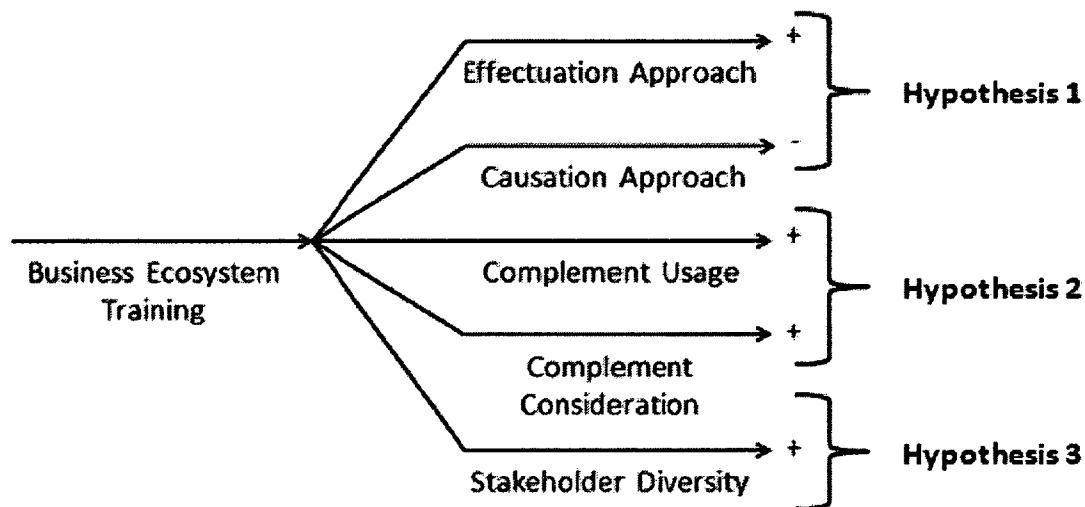


Figure 1 – Independent and Dependent Variables

3.1 Effectuation & Causation

The business ecosystems literature and effectuation literature both focus on the effect that networks have on venture development. We expect that training related to business ecosystems will influence founders to develop their new ventures using an effectuation approach rather than a causation approach. This leads to the first hypothesis.

Hypothesis 1: A business ecosystem approach to training increases the number of founders that use the effectuation approach to develop new ventures.

3.2 Complementary Offerings

The review of business ecosystems identified the broad interaction among keystone and niche players with learning from partner networks as a key mechanism that leads to competitive advantage. From a learning perspective we know that firms engaged in relationships with other organizations acquire new skills and capabilities (Bruneel, Yli-Renko & Clarysse 2006). The business ecosystem literature also suggests that when a business ecosystem strategy is adopted by start-up firms they are able to access or create strong partner networks that enable the creation of different complementary offerings and capabilities (Garnsey, Lorenzoni & Ferriani, 2008; Garnsey & Leong, 2008). This leads to the enhancement of the firm's existing capabilities and skills and the possibility to create next-generation competencies (Hamel 1991).

Since the creation of complementary offers and capabilities is a key result of the early adoption of business ecosystem knowledge we would expect that founders that receive training in business ecosystems are more aware of the impact and importance of complementary products and thus work to learn more about complementary offerings than founders that do not receive business ecosystem training. This leads to the second hypothesis.

Hypothesis 2: A business ecosystem approach to training increases a founder's knowledge of potential complementary products, services or technologies.

3.3 Key Stakeholders

The review of business ecosystem literature revealed that when a business ecosystem strategy was adopted by start-up firms early in their development they were able access or create strong partner networks that enabled the creation of different complementary offerings and capabilities (Garnsey, Lorenzoni & Ferriani, 2008, Garnsey & Leong, 2008). The review also pointed out that knowledge can be gained from keystones, non-competitive niches and by becoming a member of multiple different ecosystems.

Partner networks and interacting with multiple partners plays a key role throughout the business ecosystem literature and this lead us to believe that founders who receive business ecosystems training may tend to partner with more stakeholders when developing their ventures than founders who do not get business ecosystem training. This leads to our third hypothesis.

Hypothesis 3: A business ecosystem approach to training increases the number and diversity of key partners for a start-up firm.

4 Research Method

This section is divided into eight sections. Section 4.1 provides an overview of the research method carried out during this research. Section 4.2 describes the sample used in the research. Section 4.3 identifies the time period for this research. Section 4.4 identifies the unit of analysis. Sections 4.5 to section 4.8 provide details of each step carried out to complete this research.

4.1 Research Method Overview

Table 5 provides an overview of the steps carried out to complete this research. For each step, the dominant activities undertaken to produce the deliverables are described.

Table 5 - Research Method Overview

Step	Dominant activity undertaken to produce deliverables.
1. Develop survey	<p>Enter causation and effectuation measurement survey (Chandler, DeTienne, McKelvie & Mumford, 2011) into web based survey tool.</p> <p>Write new questions to:</p> <ol style="list-style-type: none"> 1) Identify sample 2) Capture stakeholder diversity and number 3) Capture founders knowledge of complementary products, servicers & technology 4) Capture founders prior knowledge of business ecosystems 5) Capture impact of external training on ecosystem knowledge <p>Add new questions to survey tool.</p>
2. Collect email addresses of start-up founders	Establish list of email contacts for a population of firms from each incubator in the research study.
3. Collect data via survey	Send email from web based tool to each survey participant with link to survey. Send periodic follow-up emails.
4. Analyze responses to survey	<p>For effectuation & causation results</p> <ul style="list-style-type: none"> • Compare the returned survey results for each incubator with benchmarks • Compare the returned survey results for each incubator with each other <p>For complements and diversity results</p> <ul style="list-style-type: none"> • Compare the returned survey results for each incubator with each other

(Source Author)

4.2 Sample

The sample for this study was drawn from founders of the firms in the Lead-To-Win incubator and compared with a benchmark sample drawn from the Invest Ottawa incubator located in Ottawa, Ontario, Canada. The two incubators in this study are from the same geographic region and are influenced by the same culture, language, regulations and economy with some overlaps between them as well. This makes the Invest Ottawa incubator an excellent control group for our study as there is a high probability that the founders entering the Invest Ottawa incubator will be reasonably similar to those entering the LTW incubator. A sample web page from the Invest Ottawa incubator is included in Appendix B.

4.3 Time Period

The data was collected and analyzed during the period May to August, 2012.

4.4 Unit of Analysis

The unit of analysis was comprised of responses to a survey completed by founders of technology start-ups using services of two different incubators.

4.5 Develop Survey

The survey was developed in four major sections. These sections are the introduction, effectuation and causation, complements, and diversity.

4.5.1 Develop Survey – Introductory Section

The introductory section included the development of 11 questions and the approval of the questionnaire by the university. The first 11 questions in the survey addressed the following issues:

- 1) Agreement to participate in the study
- 2) Indication of incubator membership (LTW or Invest Ottawa)
- 3) Indication if membership in incubator has been longer than 3 months
- 4) Indication of founders knowledge of business ecosystems prior to any training
- 5) Indication if founders firm is more than 3 years old
- 6) Indication if the founder attended training delivered by the incubator
- 7) Indication by founder if incubator training increased knowledge of business ecosystems

- 8) Indication if founder created and successfully exited a venture before
- 9) Indication if the founder attended 3rd party training (i.e., training delivered by organizations not related to the incubator)
- 10) Indication if the founder's firm developed its own intellectual property.
- 11) Indication by founder if 3rd party training increased knowledge of business ecosystems

These questions were used to select the sample and question 7 was used to determine if incubator training increased the founder's knowledge of business ecosystems. Question 4 was used to determine the level of business ecosystem knowledge prior to training.

4.5.2 Develop Survey – Effectuation & Causation Section

This section analyzes the effectuation and causation measures for the founders in the LTW sample. Survey questions 12 thru 31 measure the causation and effectuation approaches. Causation is a single construct and is measured directly using survey questions 12 thru 18 while effectuation is multi-dimensional and composed of the sub-constructs of Affordable Loss, Experimentation, Flexibility and Pre-Commitments. The survey questions and 5 point Likert scale used for the effectuation and causation are taken directly from previous research (Chandler, DeTienne, McKelvie & Mumford, 2011). The 5 point Likert scale in these questions is anchored by Strongly Agree and Strongly Disagree.

The survey questions used to measure the sub-constructs of effectuation are provided in the table 6.

Table 6 – Effectuation Questions

Effectuation Sub-Construct	Survey Questions Used
Experimentation	19, 20, 21, 22
Affordable Loss	23, 24, 25
Flexibility	26, 27, 28, 29
Pre-Commitments	30 & 31

Table 7 shows the benchmark values obtained from Chandler, DeTienne, McKelvie & Mumford (2011).

Table 7 – Benchmark Values

Constructs	Benchmark Values
Causation	3.32
Experimentation	3.98
Affordable Loss	2.55
Flexibility	3.48
Pre-Commitments	3.04

4.5.3 Develop Survey – Complements Section

This section of the survey was used to evaluate the founder's consideration and use of complementary products, services and technologies. Question numbers 32 and 33 were used for this purpose and are shown in table 8 for reference.

Table 8 – Complement Questions

Complement Questions					
* 32. We considered including the sale of complementary products, services and technologies early in the development of our venture.					
Answer:	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	<input type="radio"/>				
* 33. The sale of complementary products, services and technologies is a key element of our business model.					
Answer:	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	<input type="radio"/>				

4.5.4 Develop Survey – Diversity Section

This Diversity section of the survey included Questions 34 and 35. They were used to measure the number and diversity of key stakeholders that the founder indicated were involved in the launch of their venture. These are shown in table 9.

Table 9 – Diversity Questions

*** 34. Key Stakeholders are defined as a start-up technology firm's key customer, supplier, partner for commercial development (distribution), investor and partners for technology development.**

How many Key Stakeholders are/were involved in the launch of your venture?

- Zero
- 1 to 3
- 4 to 6
- 7 to 9
- 10 to 12
- More than 12

*** 35. How many different types of key stakeholders are involved with your venture?
(Select all that apply to your venture)**

- Capital - Providers of capital
- Technology - Providers of technology
- Infrastructure - Providers of infrastructure
- Market Access - Providers of access to markets and customers
- Delivery Service - Delivery/installation of your market offers
- Market Expertise - Expertise related to markets and customers
- Technology Expertise - Expertise for technologies related to your offer
- Operational Expertise - Expertise related to operating your business
- Distribution Expertise - Expertise related to distributing your offer
- Infrastructure Expertise - Expertise related to infrastructure management
- Complementary Services - Services sold alongside or with your offer
- Complementary Products - Products sold alongside or with your offer
- Complementary Technology - Technology sold alongside or with your offer
- Other (please specify in box below)

(Source Author)

4.6 Obtain Email Addresses

Email addresses were obtained from the manager of each of the incubators.

4.7 Collect Data Using Survey

An email message with a link to the online survey tool was sent to each email address received from the manager of each incubator.

4.8 Analyze Survey Responses

This data analysis section is divided into seven sections. Section 4.6.1 examines the founders' initial knowledge of business ecosystems and the effect of training provided by the incubator on the founders' knowledge of business ecosystems. Section 4.6.2 covers the analysis of the LTW effectuation and causation benchmark comparison. Section 4.6.3 covers the analysis of the Invest Ottawa effectuation and causation benchmark comparison. Section 4.6.4 covers the analysis of the comparison of LTW and Invest Ottawa effectuation and causation survey results. Section 4.6.5 covers the analysis of LTW causation and effectuation survey results and dependencies on LTW training affects. Section 4.6.6 covers analysis of LTW and Invest Ottawa complements survey results. Section 4.6.7 covers analysis of LTW and Invest Ottawa diversity survey results

4.8.1 Analysis: Initial Knowledge and Training

This section analyzes the results returned for survey question 4 and survey question 7. This analysis is used to establish if there is a difference in initial knowledge about business ecosystems between the LTW founders and the Invest Ottawa founders. This will also help us establish if the training provided by the incubator increased the founder's knowledge of business ecosystems.

For the analysis of question 4 we compare the results for LTW (μ_1) with the results for Invest Ottawa (μ_2) to determine if there is a statistically significant difference in the results. This analysis uses a two-tailed t-test to determine if the founder's initial knowledge of business ecosystems is different between the two groups.

For the analysis of question 7 we compare the results for LTW (μ_1) with the results for Invest Ottawa (μ_2). This analysis uses a single-tailed t-test to determine if more founders in LTW incubator report increased knowledge of business ecosystems as a result of incubator training than in the Invest Ottawa incubator.

4.8.2 Analysis: LTW Causation & Effectuation Benchmark Comparison

This section analyzes the effectuation and causation measures for the founders in the LTW sample.

The computed LTW causation sample mean is compared with the benchmarks using a single-tailed t-test with a 0.05 confidence level. The LTW sample causation measure (μ) is compared with the benchmark causation measure to determine if the LTW measure shows less support for causation than the benchmark.

Next, the LTW sample measures (μ) for each of the effectuation sub-constructs are compared with the benchmark measures to determine if the LTW measures show greater support for the effectuation sub-constructs than the benchmarks. A single-tailed t-test with a 0.05 confidence level is used for this test.

4.8.3 Analysis: Invest Ottawa Causation & Effectuation Benchmark Comparison

This section analyzes the effectuation and causation measures for the founders in the Invest Ottawa sample. The Invest Ottawa measurements were obtained in the same manner as the LTW measures and are compared to the same benchmarks. This was previously discussed in section 4.6.2.

4.8.4 Analysis: LTW/Invest Ottawa Causation & Effectuation Comparison

This section compares the effectuation and causation measures for the founders in the LTW sample with the effectuation and causation measures for the founders in the Invest Ottawa sample. In this section the computed sample means for LTW are compared with the sample means for Invest Ottawa using a series of single-tailed t-tests using a 0.05 confidence level.

First, the LTW sample causation measure (μ_1) was compared with the Invest Ottawa causation measure (μ_2) to determine if the LTW measure shows less support for causation than the Invest Ottawa measure.

Next, the LTW sample measures (μ_1) for the effectuation sub-constructs was compared with the Invest Ottawa sample measures (μ_2) to determine if the LTW measures showed greater support for effectuation than Invest Ottawa.

4.8.5 Analysis: LTW Chi Squared Analysis

A Chi Squared analysis was used to determine if there was a dependency between the LTW founder's responses to the causation questions (questions 12 thru 18) and the business ecosystem training question (question 4) from the LTW sample. A Chi Squared analysis was used to determine if there was a dependency between the LTW founder's responses to the Affordable Loss effectuation sub-construct questions (questions 23 thru 25) and the business ecosystem training question (question 4) from the LTW sample.

First, the responses for the causation questions and the business ecosystem training question from the LTW sample were compared to determine if a relationship exists between these two results. The results were compared using a chi-squared test with a 0.05 level of significance.

Next, a Chi Squared analysis was used to determine if there was a dependency between the LTW founder's responses to the effectuation sub-construct questions related to Affordable Loss and the business ecosystem training questions.

4.8.6 Analysis: Complementary Products, Services & Technologies

The results for question 32 were analysed to determine if the LTW founders (i_1) were more likely to consider the use of complements early in the development of their venture than the Invest Ottawa founders (i_2). The results were compared using a single tailed t-test with a 0.05 level of significance. The results for question 33 were analysed to determine if the LTW founders (i_1) were more likely to consider the sale of complements as a key element to their business model than the Invest Ottawa founders (i_2). The results were compared using a single tailed t-test with a 0.05 level of significance.

4.8.7 Analysis: Stakeholder Number and Diversity

Question numbers 34 and 35 were used for the purpose of measuring stakeholder diversity. The sample results for question 34 were analysed to determine if there was a difference between the number of stakeholders identified by the LTW founders (i_1) and the number identified by the Invest Ottawa founders (i_2). The weighted average and standard deviation was computed for each sample and the results were compared using a two tailed t-test with a 0.05 level of significance.

The sample results for question 35 were analysed to determine if there was a difference between the diversity of stakeholders identified by the LTW founders and the diversity of stakeholders identified by the Invest Ottawa founders. A Herfindahl-Hirschman index (HHI) was created using the sample data from the founders in each incubator.

The HHI index for the founders in each incubator was computed using the following formula:

$$\text{Diversity} = 1 - \sum_{i=1}^V (n_i/N)^2$$

Where:

V is the total number of variables

n_i is the value of an individual variable

N is the sum of all variables

This produces a value between 0 and 1. The HHI index for each incubator was compared

5 Results

This chapter is organized into three sections. Section 5.1 describes the sample used in this study. Section 5.2 provides the results of the statistical analysis performed. Section 5.3 provides the results of testing the three hypotheses developed in chapter 3.

5.1 Sample Results

A total of 95 survey responses were received. Of the 95 survey responses 61 came from founders serviced by the LTW incubator and 34 from founders of the Invest Ottawa incubator.

Only completed surveys were used for this research. A total of 16 surveys were not completed. Of the 79 completed survey responses received, 52 came from the LTW incubator and 27 from the Invest Ottawa incubator.

5.1.1 LTW Sample

In the LTW survey group there were two respondents that indicated they were members of the Invest Ottawa incubator and were excluded from the results leaving 52 completed LTW survey results. A sample was selected from the 52 completed LTW survey results that included respondents with the following characteristics:

- 1) Members of the incubator for at least 3 months
- 2) Attended training offered by the incubator
- 3) Founder had not previously developed a venture

This resulted in a sample size of 32 completed survey responses for the LTW incubator. All analysis of LTW data for this research was conducted using this sample.

5.1.2 Invest Ottawa Sample

In the Invest Ottawa survey group there were 7 respondents that indicated they were members of the LTW incubator and were excluded from the results leaving 20 completed Invest Ottawa survey results. A sample was selected from the 20 completed Invest Ottawa survey results that included respondents with the following characteristics:

- 1) Founder had not previously developed a venture

This resulted in an Invest Ottawa sample size of 15 completed survey responses. If additional selection criteria were applied then the sample size for the Invest Ottawa group dropped below 10 items. All analysis of Invest Ottawa data for this research was conducted using this sample.

5.1.3 Sample Comparison

Both samples, the LTW and Invest Ottawa, are based on founders that indicated they had not previously developed or successfully exited a venture. This is thought to be a critical element of comparison as the initial work on effectuation utilizes expert entrepreneurs (Sarasvathy, 2001). As both samples contain those that indicate inexperience in new venture creation it does provide us with an opportunity to examine if the incubators are influencing these inexperienced founders. Only 1 Invest Ottawa founder indicated they did not create their own IP while 4 LTW founders indicated they did not create their own IP.

For the Invest Ottawa founders there were 10 founders that indicated they joined the incubator after January 1, 2012 and nine that indicated they had not attended any training offered by the Invest Ottawa incubator. For these Invest Ottawa founders we would expect the influence of the Invest Ottawa incubator would not be as detectable as those from the LTW sample as some of the Invest Ottawa founders have not been exposed to the effects of the Invest Ottawa incubator as long as the founders in the LTW sample.

5.2 Data Analysis

This data analysis section is divided into four sections. Section 5.2.1 examines the founders' initial knowledge of business ecosystems and the effect of training provided by the incubator on the founders' knowledge of business ecosystems. Section 5.2.2 covers the data analysis of LTW and Invest Ottawa survey sample data for effectuation and causation. Section 5.2.3 covers the data analysis of LTW and Invest Ottawa survey sample data for use and consideration of complements while section 5.3.4 provides an analysis of the stakeholder number and diversity data.

5.2.1 Results: Initial Knowledge and Training

This section analyzes the results returned for survey question 4 and survey question 7. This is shown in table 10.

Table 10 – Results - Prior Business Ecosystem Knowledge & Ecosystem Training

Prior Ecosystem Knowledge		Ecosystem Training	
Null Hypothesis:	$\mu_1 = \mu_2$	Null Hypothesis:	$\mu_1 = \mu_2$
Alternative Hypothesis	$\mu_1 \neq \mu_2$	Alternative Hypothesis	$\mu_1 > \mu_2$
LTW Mean μ_1	2.78	LTW Mean μ_1	4.24
LTW STD S1	0.83	LTW STD S1	1.00
LTW n1	32	LTW n1	32
Invest Ottawa Mean μ_2	3.53	Invest Ottawa Mean μ_2	3.22
Invest Ottawa STD S2	0.74	Invest Ottawa STD S2	1.00
Invest Ottawa n2	15	Invest Ottawa n2	15
S^2	0.65	S^2	1.00
S	0.81	S	1.00
t	-2.983575232	t	3.254874235
P-Value	0.004590456	P-Value	0.001078739
	REJECT		REJECT

For initial ecosystem knowledge the t test results reject the Null Hypothesis. The results show that at the 0.05 level the initial ecosystem knowledge in each group is different.

For business ecosystem training the t-test rejects the Null Hypothesis as the data provides statistically significant results at the 0.05 confidence level that the LTW incubator training could be increasing the LTW founder's knowledge of business ecosystems to a greater degree than the Invest Ottawa training. These results suggest that on average:

- 1) The founder's initial knowledge of business ecosystems is different between the Invest Ottawa incubator and the LTW incubator.
- 2) The LTW incubator training increasing a founder's knowledge of business ecosystems to a greater degree than the Invest Ottawa training.

5.2.2 Results: LTW Causation & Effectuation Benchmark Comparison

This section analyzes the effectuation and causation measures for the founders in the LTW sample.

Using the data from the LTW sample the computed sample mean values are shown in table 11.

Table 11 – LTW Sample Mean Values

Constructs	LTW Mean Values
Causation	3.78
Experimentation	3.25
Affordable Loss	4.04
Flexibility	4.19
Pre-Commitments	3.05

Table 12 shows the results of the benchmark comparison for the LTW incubator.

Table 12 - Results - LTW Causation Measure

Causation	
Null Hypothesis:	$\mu = 3.32$
Alternative Hypothesis	$\mu < 3.32$
Benchmark Mean	3.32
LTW - Sample Mean	3.78
LTW - Sample STD Dev	0.38369755
n	32
DF	31
t	6.739658664
P-Value	0.999999924
	DO NOT REJECT

This analysis shows that we do not reject the Null Hypothesis and thus the results do not suggest less support for causation than the benchmark.

Table 13 contains the results of LTW sample measures (μ) for the effectuation sub-constructs compared with the benchmark measures.

Table 13 – Results - LTW Effectuation Measurements

Experimentation		Affordable Loss	
Null Hypothesis:	$\mu = 3.98$	Null Hypothesis:	$\mu = 2.55$
Alternative Hypothesis	$\mu > 3.98$	Alternative Hypothesis	$\mu > 2.55$
Benchmark Mean	3.98	Benchmark Mean	2.55
LTW - Sample Mean	3.25	LTW - Sample Mean	4.04
LTW - Sample STD Dev	0.202813543	LTW - Sample STD Dev	0.202813543
n	32	n	32
DF	31	DF	31
t	-20.36108406	t	41.55892499
P-Value	1	P-Value	4.71103E-29
	DO NOT REJECT		REJECT
Flexibility		Pre-Commitments	
Null Hypothesis:	$\mu = 3.48$	Null Hypothesis:	$\mu = 3.04$
Alternative Hypothesis	$\mu > 3.48$	Alternative Hypothesis	$\mu > 3.04$
Benchmark Mean	3.48	Benchmark Mean	3.04
LTW - Sample Mean	4.19	LTW - Sample Mean	3.05
LTW - Sample STD Dev	0.145688023	LTW - Sample STD Dev	0.113137085
n	32	n	32
DF	31	DF	31
t	27.47119704	t	0.5
P-Value	1	P-Value	0.689697024
	REJECT		DO NOT REJECT

This analysis shows that we do not reject the Null Hypothesis for the Experimentation and Pre-Commitments sub-constructs and thus the results do not suggest greater support than the benchmarks for these items. However, for the Flexibility and Affordable Loss sub-constructs we do reject the Null

Hypothesis at the 0.05 confidence level and thus suggest greater support for these particular effectuation sub-constructs than the benchmarks.

In summary, this analysis has provided statistically significant results at the 0.05 level that LTW founders place more emphasis on the effectuation sub-constructs of Affordable Loss and Flexibility during the development of their new ventures than benchmarks for expert founders.

5.2.3 Results: Invest Ottawa Causation & Effectuation Benchmark Comparison

This section provides the results of the effectuation and causation measure benchmark comparisons for the founders in the Invest Ottawa sample. Using the data from the Invest Ottawa sample the following mean values were computed for the effectuation sub-constructs. Table 14 shows the Invest Ottawa sample means that were computed.

Table 14 – Invest Ottawa Sample Mean Values

Constructs	Invest Ottawa Mean Values
Causation	4.18
Experimentation	3.17
Affordable Loss	3.64
Flexibility	4.33
Pre-Commitments	3.24

Table 15 below shows the results of the Invest Ottawa causation comparison with the benchmarks.

Table 15 – Results – Invest Ottawa Causation

Causation	
Null Hypothesis:	$\mu = 3.32$
Alternative Hypothesis	$\mu < 3.32$
Population Mean	3.32
Sample Mean	4.18
Sample STD Dev	0.351256249
n	15
DF	14
t	9.498189774
P-Value	0.999999912
	DO NOT REJECT

This analysis of Invest Ottawa causation measures shows that we do not reject the Null Hypothesis and thus the results do not suggest less support for causation than the benchmark.

Table 16 shows the results of the Invest Ottawa effectuation comparison with the benchmarks.

Table 16 – Results - Invest Ottawa Effectuation

Experimentation		Affordable Loss	
Null Hypothesis:	$\mu = 3.98$	Null Hypothesis:	$\mu = 2.55$
Alternative Hypothesis	$\mu > 3.98$	Alternative Hypothesis	$\mu > 2.55$
Population Mean	3.98	Population Mean	2.55
Sample Mean	3.17	Sample Mean	3.64
Sample STD Dev	0.589484238	Sample STD Dev	0.589484238
n	15	n	15
DF	14	DF	14
t	-5.338224106	t	7.183333362
P-Value	0.99994767	P-Value	0.999997658
	DO NOT REJECT		REJECT
Flexibility		Pre-Commitments	
Null Hypothesis:	$\mu = 3.48$	Null Hypothesis:	$\mu = 3.04$
Alternative Hypothesis	$\mu > 3.48$	Alternative Hypothesis	$\mu > 3.04$
Population Mean	3.48	Population Mean	3.04
Sample Mean	4.33	Sample Mean	3.24
Sample STD Dev	0.470177272	Sample STD Dev	0.049497475
n	15	n	15
DF	14	DF	14
t	7.001690732	t	15.25798553
P-Value	0.999996884	P-Value	1
	REJECT		REJECT

The results show that we do not reject the Null Hypothesis for the Experimentation sub-construct and thus the results do not suggest greater support than the benchmark for this item. However, for the Flexibility, Affordable Loss and Pre-Commitments sub-constructs the results do reject the Null Hypothesis at the 0.05 confidence level and thus suggest greater support for these particular effectuation sub-constructs than the benchmarks.

In summary, this analysis has provided statistically significant results at the 0.05 level that Invest Ottawa founders place more emphasis on the effectuation sub-constructs of Flexibility, Affordable Loss and Pre-Commitments during the development of their ventures than expert founders.

5.2.4 Results: LTW/Invest Ottawa Causation and Effectuation Comparison

This section compares the effectuation and causation measures for the founders in the LTW sample with the effectuation and causation measures for the founders in the Invest Ottawa sample. Table 17 shows the causation comparison results.

Table 17 – Results - LTW/Invest Ottawa Causation Comparison

Causation	
Null Hypothesis:	$\mu_1 = \mu_2$
Alternative Hypothesis	$\mu_1 < \mu_2$
LTW Mean μ_1	3.78
LTW STD S1	0.38
LTW n1	32
Invest Ottawa Mean μ_2	4.18
Invest Ottawa STD S2	0.35
Invest Ottawa n2	15
S^2	0.14
S	0.37
t	-3.455390467
P-Value	0.000604944
	REJECT

The comparison of LTW and incubator causation measures shows that we reject the Null Hypothesis at the 0.05 confidence level for the causation construct. This suggests support for the hypothesis that LTW founders are less likely to follow causation approaches when developing their new ventures than their Invest Ottawa counterparts.

Table 18 shows the results of the effectuation comparison for LTW and Invest Ottawa.

Table 18 – Results - LTW/Invest Ottawa Effectuation Comparison

Experimentation		Affordable Loss	
Null Hypothesis:	$\mu_1 = \mu_2$	Null Hypothesis:	$\mu_1 = \mu_2$
Alternative Hypothesis	$\mu_1 > \mu_2$	Alternative Hypothesis	$\mu_1 > \mu_2$
LTW Mean μ_1	3.25	LTW Mean μ_1	4.04
LTW STD S1	0.20	LTW STD S1	0.05
LTW n1	32	LTW n1	32
Invest Ottawa Mean μ_2	3.17	Invest Ottawa Mean μ_2	3.64
Invest Ottawa STD S2	0.59	Invest Ottawa STD S2	0.10
Invest Ottawa n2	15	Invest Ottawa n2	15
S^2	0.14	S^2	0.00
S	0.37	S	0.07
t	0.713751642	t	18.44404071
P-Value	0.239533262	P-Value	6.56803E-23
	DO NOT REJECT		REJECT
Flexibility		Pre-Commitments	
Null Hypothesis:	$\mu_1 = \mu_2$	Null Hypothesis:	$\mu_1 = \mu_2$
Alternative Hypothesis	$\mu_1 > \mu_2$	Alternative Hypothesis	$\mu_1 > \mu_2$
LTW Mean μ_1	4.19	LTW Mean μ_1	3.05
LTW STD S1	0.15	LTW STD S1	0.11
LTW n1	32	LTW n1	32
Invest Ottawa Mean μ_2	4.33	Invest Ottawa Mean μ_2	3.24
Invest Ottawa STD S2	0.47	Invest Ottawa STD S2	0.05
Invest Ottawa n2	15	Invest Ottawa n2	15
S^2	0.08	S^2	0.01
S	0.29	S	0.10
t	-1.576916991	t	-6.040329967
P-Value	0.06090975	P-Value	0.999999864
	DO NOT REJECT		DO NOT REJECT

The comparison of the LTW and Invest Ottawa effectuation sub-construct measures shows that we do not reject the Null Hypothesis for the Experimentation, Flexibility or Pre-Commitments sub-constructs. This result does not suggest greater support for these items in the LTW founder's results than in the Invest Ottawa founder's results. However, for the Affordable Loss sub-construct we do reject the Null Hypothesis at the 0.05 confidence level and thus suggest greater support for the Affordable Loss sub-constructs of effectuation by the LTW founders versus the Invest Ottawa founders.

In summary, this analysis has provided statistically significant results at the 0.05 level that LTW founders may place more emphasis on the effectuation sub-construct of Affordable Loss and may be less likely to follow causation approaches during the development of their ventures than founders from the Invest Ottawa incubator.

5.2.5 Results: LTW Chi Squared Analysis

This section presents the results of a Chi Squared analysis used to determine if there is a dependency between the LTW founder's responses to the causation questions (questions 12 thru 18) and the business ecosystem training question (question 4) from the LTW sample. This section also presents the results of a Chi Squared analysis used to determine if there is a dependency between the LTW founder's responses to the Affordable Loss effectuation sub-construct questions (questions 23 thru 25) and the business ecosystem training question (question 4) from the LTW sample.

Table 19 presents the results of the Chi Squared analysis of business ecosystem training responses and responses to the causation questions for the LTW sample.

Table 19 – Results - Invest Ottawa/LTW Causation Chi Squared Analysis

Null Hypothesis:	Ecosystem training and response to causation questions are independent.
Alternative Hypothesis:	Ecosystem training and response to causation questions are not independent.
Causation	
Question	LTW
12	0.00016
13	0.07381
14	0.03733
15	0.00004
16	0.07095
17	0.11018
18	0.00721

This Chi Squared analysis provides statistically significant results at the 0.05 level that the LTW founder's reduced response to causation questions 12, 14, 15 and 18 may not be independent from the level of business ecosystem training they reported having received from the LTW incubator.

This analysis of LTW sample data did not report statistically significant results for questions 13, 16 or 17.

Table 20 presents the results of the Chi Squared analysis of business ecosystem training responses and responses to the Affordable Loss questions for the LTW sample data.

Table 20 – Results - LTW Affordable Loss Chi Squared Analysis

Null:	Ecosystem training and response to affordable loss questions are independent.
Alternative:	Ecosystem training and response to affordable loss questions are not independent.
Affordable Loss	
Question	LTW
23	0.31081
24	0.41922
25	0.43434

The Chi Squared analysis of LTW affordable loss and ecosystem training data does not provide any statistically significant results at the 0.05 level of significance.

5.2.6 Results: Complementary Products, Services & Technologies

Questions 32 and 33 were used to evaluate complements. Results for question 32 are shown in table 21.

Table 21 – Results – Consideration t-test

Consideration	
Null Hypothesis:	$\mu_1 = \mu_2$
Alternative Hypothesis	$\mu_1 > \mu_2$
LTW Mean μ_1	3.72
LTW STD S1	1.11
LTW n1	32
Invest Ottawa Mean μ_2	3.73
Invest Ottawa STD S2	1.16
Invest Ottawa n2	15
S^2	1.28
S	1.13
T	-0.041263962
P-Value	0.516365997
	DO NOT REJECT

The results of the analysis for question 32 show we should not reject the Null Hypothesis. This indicates there is no significant statistical difference between the LTW group of founders and the Invest Ottawa group of founder's early consideration of the use of complementary products, services or technologies.

The results for question 33 are shown in table 22.

Table 22 – Results – Business Model t-test

Business Model	
Null Hypothesis:	$\mu_1 = \mu_2$
Alternative Hypothesis	$\mu_1 > \mu_2$
LTW Mean μ_1	3.34
LTW STD S1	1.21
LTW n1	32
Invest Ottawa Mean μ_2	3.80
Invest Ottawa STD S2	1.01
Invest Ottawa n2	15
S^2	1.32
S	1.15
t	-1.266745561
P-Value	0.105881849
	DO NOT REJECT

The results of the analysis for question 33 show we should not reject the Null Hypothesis. This indicates there is no significant statistical difference between the LTW group of founders and the Invest Ottawa group of founder's when it comes to the sale of complements as a key element of their business model.

In summary there were no statistically significant findings when comparing the LTW founder's consideration or use of complements with the Invest Ottawa founder's consideration or use of complements.

5.2.7 Results: Stakeholder Number and Diversity

Questions 34 and 35 were used to evaluate stakeholder number and diversity. The results for question 34 are shown in table 23.

Table 23 – Results – Stakeholder Number t-test

Stakeholder Number	
Null Hypothesis:	$\mu_1 = \mu_2$
Alternative Hypothesis	$\mu_1 \neq \mu_2$
LTW Mean μ_1	2.47
LTW STD S1	2.41
LTW n1	32
Invest Ottawa Mean μ_2	3.47
Invest Ottawa STD S2	3.63
Invest Ottawa n2	15
S^2	8.10
S	2.85
T	-1.120209823
P-Value	0.134283784
	DO NOT REJECT

The results of the analysis for question 34 show we should not reject the Null Hypothesis. This indicates there is no significant statistical difference between the LTW group of founders and the Invest Ottawa group of founder's when it comes to the number of key stakeholders that the founder indicated were involved in the launch of their venture.

Herfindahl-Hirschman index (HHI) was created using the sample data from the founders in each incubator. The HHI index for each incubator is shown in table 26.

Table 24 – Results – Incubator HHI Value

Incubator	HHI Values
Lead-To-Win	0.079
Invest Ottawa	0.078

The results of this analysis indicate the two samples have nearly identical diversity with only a difference of 0.01 between the two measures.

In summary there were no statistically significant findings when comparing the number of stakeholders in the two groups. A comparison of the diversity measures did not indicate any appreciable difference between the two groups.

5.3 Support for Hypotheses

Table 25 shows the results from testing the three hypotheses.

Table 25 – Supporting Data for Hypotheses

Hypothesis	Supporting Data
1) A business ecosystem approach to training services by a incubator increases the number of firm founders developing new technology ventures using an effectuation approach.	1) Initial knowledge of business ecosystems reported lower by LTW founders than incubator founders. 2) More LTW founders reported that incubator training increased their knowledge of business ecosystems than incubator founders. 3) LTW founder's measurements for effectuation sub-constructs of affordable loss and flexibility were greater than benchmarks. 4) LTW founder's measurements for the effectuation sub-construct of affordable loss were greater than incubator founders. 5) LTW founder's measurements for causation were less than incubator founders. 6) LTW founder's measurements for causation not independent of reported increase in business ecosystem knowledge.
2) A business ecosystem approach to training services by a incubator increases a founder's knowledge of potential complementary products, services or technologies.	No supporting data was identified for this hypothesis.
3) A business ecosystem approach to training services by a incubator increases the number and diversity of key partners for a start-up firm.	No supporting data was identified for this hypothesis.

The results suggest that LTW founders show higher measurement for the Affordable Loss and Flexibility effectuation sub-constructs. The causation responses from the LTW founders appeared to be dependent on their responses to the question related to business ecosystem training received from their incubator. No significant results were observed for propositions 2 or 3. It may be the ventures have not developed to the point where support for proposition 2 and 3 can be observed.

6 Discussion of Results

Chapter 6 is organized into two sections. The first section discusses the key findings of this research while the second section links the results of this research with the literature.

6.1 Key Findings

This section discusses the three most valuable lessons learned that were not known before this research was conducted.

For the effectuation sub-constructs of Affordable Loss and Flexibility the founders in the LTW incubator and the Invest Ottawa incubator had scores that were higher than the expert benchmarks and statistically significant.

These results suggest that involvement with these incubators is influencing the founders to act more like expert entrepreneurs. The measurement of incubator performance and the benefits that incubators provide to founders and other stakeholders is difficult to measure and communicate. These new measures can work to solve this well-known problem by enabling the comparison of new venture performance between different incubators. This data provides all the stakeholders involved with the development of a new technology venture with a measure of the benefits that the incubator provides to the founders. Founders in the Invest Ottawa incubator also had scores that were higher than the expert benchmarks and statistically significant for the effectuation sub-construct of Pre-commitments. This shows that founders in the Invest Ottawa incubator had statistically significant results for 3 out of 4 of the effectuation sub-constructs suggesting the Invest Ottawa incubator has some ability to influence key elements of an effectuation new venture development process with the founders.

Statistically significant results were observed to support the following ideas for founders in the LTW incubator versus founders in the Invest Ottawa group:

- 1) More LTW founders reported increased knowledge of business ecosystems
- 2) LTW founders reported lower measures for causation development approaches
- 3) LTW founders reported higher measures of the Affordable Loss effectuation sub-construct
- 4) LTW founders measurements of causation development appeared dependant on their increased knowledge of business ecosystems

These results suggest that involvement with the LTW incubator and its business ecosystem training approach has a greater degree of influence over the LTW founders than the training provided by the Invest Ottawa incubator along the two key dimensions of causation and the Affordable Loss sub-construct of effectuation. Further analysis of the LTW sample showed statistically significant results for the idea that founder's responses to 4 out of the 7 causation questions could be dependent on the level of ecosystem training. No statistically significant results were observed to support a similar dependency between the level of ecosystem training and the responses to questions about the Affordable Loss sub-construct of effectuation. These results could suggest that support for causation approaches to new venture development were dampened by the LTW business ecosystem training regime.

No statistically significant results were observed from the comparison of consideration and use of complementary offers measurements or the number and diversity of stakeholder's measurements.

The measures for the consideration of complements and stakeholder diversity were very similar between the two groups with consideration of complements differing only by 0.01 and stakeholder diversity differing by only .001. The mean number of stakeholders and the mean number of founders indicating use of complements was a key element of their business model was greater for the Invest Ottawa group of founders but not significantly different from the LTW founders when compared statistically. Even though the business ecosystem literature points to complementary products and services from multiple different stakeholders these elements did not seem to factor as strongly with founders in the LTW incubator as they did with founders in the Invest Ottawa group.

Since we are examining founders of early stage companies it is entirely likely their businesses and market offers have not evolved to the point that these elements are readily measurable. We do observe higher scores for the effectuation sub-constructs of Flexibility in these founders and it is completely likely that this early flexibility is impacting these measures. If a founder is being flexible they may have had a set of stakeholders and complements but then altered course and reduced their reliance on that set and reformulated their venture. If a founder was following an effectuation approach to new venture development then this would be expected.

It is also possible that the LTW founders are being observed at an earlier stage of development than the Invest Ottawa founders. The LTW founders reported lower causation scores than the Invest Ottawa founders that were statistically significant. The Invest Ottawa group of founders reporting higher causation scores could be further along with defining their ventures and be closer to executing a more concrete venture development plan. This would also be consistent with our observations.

6.2 Linking Results with Literature

An area for further research identified in the effectuation literature is related to insights into how effectuation can be taught to would be entrepreneurs. Our study advances this knowledge by exploring the links between the LTW business ecosystems based training and the new venture development approach used by founders in the LTW incubator. Statistically significant results were observed for LTW founder's reduced reliance on causation strategies and their responses to ecosystem training. This result suggests a link between the LTW training approach and reduced causation measures offering a new insight into how entrepreneurs could be trained to follow effectuation strategies.

The effectuation sub-construct measures for the LTW incubator exceeded the known benchmark measures for expert entrepreneurs in every case. While we did not execute tests to determine equality between the measures and the benchmarks we do see results that would indicate the LTW founders are following effectuation processes. For the LTW founders we see strong support for effectuation with reduced causation measures. These are intriguing results as no research to date has shown that the elements of effectuation and causation can be independently influenced or shown any information about how changes in one element could affect the other. Few researchers have tried to measure and test effectuation and causation and the results presented here provide new insights for this theory using the behaviours of real founders building real businesses.

The business incubation literature identifies incubators as assisting new firms with early development and acting as a systematic accelerator of the entrepreneurial process. The findings of our research support this idea as both of the incubators studied had founders that exhibited two key characteristics of expert entrepreneurs. Founders from both incubators were observed to have measurements of the effectuation sub-constructs of Affordable Loss and Flexibility that were greater than those observed in expert entrepreneurs.

7 Conclusions, Limitations & Suggestions for Future Research

7.1 Conclusions

The objective of this research was to examine how the training services provided by incubators affect the approach to new venture creation utilized by the company founders.

The research used a survey and newly defined scales for causation and effectuation to measure the approach to new venture development used by the founders of firms in two different technology business incubation programs. The student t-test and Chi-Squared tests were used to isolate statistically significant differences in the founders training, approach to new venture development and to explore dependencies between level of business ecosystem training and approach to new venture development.

This research suggests the following:

- 1) The business ecosystem training by the LTW incubator increased the business ecosystem knowledge of founders in the LTW incubator.
- 2) The LTW business ecosystem training reduced the founder's reliance on causation approaches to new venture development.
- 3) The LTW founders embodied the effectuation sub-constructs of Affordable Loss and Flexibility more than the other dimensions.
- 4) It is difficult to observe diversity and complement usage or consideration in early stage ventures as they have not developed to a stage where the founder can differentiate this and articulate it clearly.

When we compared the effectuation measures for the LTW founders with the benchmarks we only tested to determine if the LTW measure were greater than the benchmarks. The LTW measure for the effectuation sub-construct of experimentation is greater than the known benchmark but the difference is not statistically significant. The LTW measure for experimentation may well be equal to the benchmark and that would indicate the LTW founders are exhibiting the behaviours of expert entrepreneurs in this dimension. Similarly, for the effectuation sub-construct of pre-commitments the LTW measure exceeded

the benchmark measure by 0.01. Again, the LTW measure for experimentation may well be equal to the benchmark and that would indicate the LTW founders are exhibiting the behaviours of expert entrepreneurs in this dimension as well. If tests were conducted that confirmed these hypotheses then the LTW founders would be meeting or exceeding the benchmarks for all the effectuation measures.

This study is based on research in the areas of:

- 1) Business ecosystems
- 2) Technology incubation
- 3) Effectuation and causation

The literature in these streams was summarized and a table that outlines the commonalities between the streams was presented.

A methodology was developed and followed to measure the level of business ecosystem training and approach to new venture development using a survey of two incubators.

7.2 Limitations

There are a number of limitations related to the findings of this research. Both samples contain results that indicate third party training increased the founders knowledge of the business ecosystems. This means that both samples have been exposed to business ecosystem knowledge and training.

As we noted earlier the LTW sample and the Invest Ottawa sample were selected from the survey results using different criteria. While both samples contain responses from founders that had not previously developed and exited a venture, the LTW sample also meets the following criteria:

- 1) Members of the incubator for at least 3 months
- 2) Attended training offered by the incubator

The Invest Ottawa sample has not been influenced by the incubator as much as the LTW sample and the Invest Ottawa sample only contains 15 responses while the LTW sample contains 32 responses. Since the Invest Ottawa responses have less influence than the LTW sample the Invest Ottawa sample may be more representative of founders that have not joined an incubator at all. However, we have no data to measure this difference. If the Invest Ottawa group spent more time in the incubator then the comparison between LTW and Invest Ottawa may have been closer as the Invest Ottawa incubator may have had a greater influence on the founders.

This result is interesting as the Invest Ottawa sample reports the incubator training did not increase the founders knowledge of business ecosystems as much as LTW incubator training but the Invest Ottawa founders reported a greater prior knowledge of business ecosystems than the founders in the LTW sample. It could be possible the early knowledge of the Invest Ottawa Founders is influencing the results we are observing.

7.3 Suggested Future Research

As our results provide insight into the usage of causation approaches to new venture development employed by the LTW founders it is thought that additional research into how these founders made their development decisions could provide additional insights into these results. Our results also showed no

statistically significant support for the elements of flexibility, experimentation or pre-commitments. Our study does not explain this result. Additional research that examines why this result is present could be helpful in designing training courses and materials that could better encourage founders to embrace these elements of effectuation.

The sample size for the Invest Ottawa incubator was based on only 15 results. A wider survey and larger sample size may confirm or refute the results we have presented here. This may be particularly compelling if further support was observed. An additional sample of non-incubated firms could further enhance our understanding of the results presented here. A sample of non- incubated firms would provide additional insight into how these types of firms develop when being operated by inexperienced founders. The firms in our Invest Ottawa sample had not been members of the Invest Ottawa incubator as long as the firms in our LTW sample. If firms that are recent members of incubators exhibit properties of non-incubated firms then these recently added firms could be a new found source of data for the study of new venture development as finding non-incubated firms for study has proven difficult in the past.

In our study we focus on the ecosystem training aspect of the incubator. In follow-up studies it is suggested that a large sample be used and that additional incubator and founder variables be measured as well. This would help to more conclusively determine a cause and effect relationship while ensuring a homogeneous sample that is large enough to provide meaningful results.

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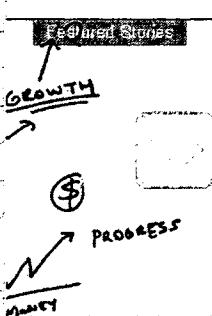
Appendix A

The screenshot shows a Microsoft Internet Explorer window with the title bar "Frequently Asked Questions - Windows Internet Explorer". The address bar displays the URL http://www.leadtowin.ca/index.php?option=com_content&view=article&id=95&Itemid=183. The page content is a presentation slide titled "Lead to Win Program Overview" dated "May 2009 Version 1a". The slide features a video player interface with a play button and a progress bar showing "1 / 22". Below the slide, there is a "sideshare" toolbar with various sharing options. The text "View more OpenOffice presentations from brianhurley." is visible. At the bottom of the slide, the question "What is the objective of the LTW program?" is asked. The answer states: "Lead to Win is a business development program. The objective of the Lead to Win program is to establish and grow technology businesses in Canada's Capital Region. The goal is for each business to generate a minimum of six technology jobs in the next three years." A note below this states: "The objective of the six-day "Phase II: Opportunity Development" component of the program is to first harden (days 1-3) and then strengthen (days 4-6) participants'". The status bar at the bottom of the browser window shows "Error on page.", "Internet | Protected Mode Off", "2:10 PM", and the date "6/14/2011".

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Appendix B

Carleton University - Technology Incubation - Survey

Introduction

Dear Participant

My name is Brian Jensen. I am a M.Sc. candidate in the Systems and Computer Engineering at Carleton University in Ottawa, Canada. My supervisor is Professor Tony Bailetti, also from Systems and Computer Engineering.

I would like to invite you to participate in my study by taking part in an online survey. This survey will explore the relationship between the training you have received and the approach you are using to build your company. The individual responses to this survey will not be published and we will not be correlating participant responses with individuals or firms. The data will be used in aggregate form to compute overall metrics for a group of respondents from a single technology incubator.

Your participation contributes to the body of knowledge on the development of new high technology businesses. There could be some social risk to you if you were to share unpopular or controversial views through the survey, then that information were to be reported through the dissemination of research results. Therefore, the survey will not collect any personal data about you or your company and I will not be able to attribute any survey responses to individuals or companies that complete or partially complete the survey. I will not identify you or your company in any presentation of the research. Any additional comments you provide in the survey will not be reported in any of the research findings.

Only I and the thesis committee members will have access to the raw data and field notes. The survey data will be retained by me in a secure format and location: digital information on computer hard drives and flash drives and physical artifacts including documents and files will be stored in a locked access controlled office. Results will be reported mainly in summary form.

The survey data will be held on a server located in the USA. Once the study is complete the electronic data generated by the survey will be permanently deleted. An electronic backup copy may exist in the USA for up to 12 months after deletion. A hardcopy of the raw results will be retained by me. The servers for the online tool are based in the United States and the information on them can be accessed by US federal authorities under the authority of the Patriot Act.

I would be delighted to share the results of this study with all participants and you are welcome to contact me for those results. I can be reached at gjensen@connect.carleton.ca

This project has been reviewed and cleared by the Carleton University Research Ethics Board. You are welcome to address concerns or questions to the ethics chair Professor Antonio Gualtieri, Office of Research Services, Carleton University, Ottawa, Ontario K1S 5B6; 613.520.2517 or ethics@carleton.ca

Questions may also be directed to my thesis director Professor Tony Bailetti, Systems and Computer Engineering, Carleton University, bailetti@sce.carleton.ca

***1. Please indicate if you wish to participate under the conditions described above and select next to continue.**

- I wish to participate.
- I do not wish to participate. (You will automatically exit survey)



Canada's Capital University

Carleton University - Technology Incubation - Survey

Section 1

This survey considers firms that are associated with technology business support programs offered by Carleton Lead-To-Win and Invest Ottawa (formerly OCRI) . For the purposes of this study we refer to these programs as incubators.

*2. Which business assistance program (incubator) is your firm associated with?

- Carleton Lead-To-Win
- Invest Ottawa/OCRI

*3. Was your firm associated with your incubator before January 1, 2012?

- Yes
- No

*4. Select the answer that best describes your knowledge and understanding of business ecosystems prior to attending any training sessions offered by the incubator or any other external 3rd party training sessions.

- | | | | | |
|---------|-----------------------|-----------------------|-----------------------|------------------------|
| Answer: | No understanding | Basic understanding | Strong understanding | Complete understanding |
| | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

*5. Was your firm incorporated before or after January 1, 2009?

- Before
- After

*6. Have you attended training offered by the incubator? (Note: This can be any type of training offered by the incubator)

- Yes
- No

*7. I attended training sessions offered by the incubator that increased my knowledge and understanding of business ecosystems .

- | | | | | | |
|---------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Answer: | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
| | <input type="radio"/> |

Carleton University - Technology Incubation - Survey

Section 2

***8. Have you previously founded and successfully exited a high technology venture?**

- Yes
- No

***9. While your firm has been a member of the incubator have you attended any training offered by external 3rd parties?**

- Yes
- No

***10. Some ventures obtain their core intellectual property (IP) from third parties such as government labs or corporate spin-offs while other ventures develop their own IP.**

Have you developed your own intellectual property?

- Yes
- No

***11. I attended training sessions offered by the external 3rd parties that increased my knowledge and understanding of business ecosystems .**

Answer:

- | | | | | | | | | | |
|-------------------|-----------------------|----------|-----------------------|-----------|-----------------------|-------|-----------------------|----------------|-----------------------|
| Strongly Disagree | <input type="radio"/> | Disagree | <input type="radio"/> | Undecided | <input type="radio"/> | Agree | <input type="radio"/> | Strongly Agree | <input type="radio"/> |
|-------------------|-----------------------|----------|-----------------------|-----------|-----------------------|-------|-----------------------|----------------|-----------------------|

Carleton University - Technology Incubation - Survey

Section 3

In all the sections that follow we ask that you consider the start-up phase of your venture and indicate the degree to which you agree or disagree with each of the following statements.

* 12. We analyzed long run opportunities and selected what we thought would provide the best returns.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

* 13. We developed a strategy to best take advantage of resources and capabilities.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

* 14. We designed and planned business strategies.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

* 15. We organized and implemented control processes to make sure we met objectives.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

* 16. We researched and selected target markets and did meaningful competitive analysis.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

* 17. We had a clear and consistent vision for where we wanted to end up.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

Carleton University - Technology Incubation - Survey

Section 4

In all the sections that follow we ask that you consider the start-up phase of your venture and indicate the degree to which you agree or disagree with each of the following statements.

* 18. We designed and planned production and marketing efforts.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

* 19. We experimented with different products and/or business models.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

* 20. The product/service that we now provide is essentially the same as originally conceptualized.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

* 21. The product/service that we now provide is substantially different than we first imagined.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

* 22. We tried a number of different approaches until we found a business model that worked?

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

Carleton University - Technology Incubation - Survey

Section 5

In all the sections that follow we ask that you consider the start-up phase of your venture and indicate the degree to which you agree or disagree with each of the following statements.

***23. We were careful not to commit more resources than we could afford to lose.**

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

***24. We were careful not to risk more money than we were willing to lose with our initial idea.**

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

***25. We were careful not to risk so much money that the company would be in real trouble financially if things didn't work out.**

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

***26. We allowed the business to evolve as opportunities emerged.**

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

***27. We adapted what we were doing to the resources we had.**

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

Carleton University - Technology Incubation - Survey

Section 6

In all the sections that follow we ask that you consider the start-up phase of your venture and indicate the degree to which you agree or disagree with each of the following statements.

*28. We were flexible and took advantage of opportunities as they arose.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

*29. We avoided courses of action that restricted our flexibility and adaptability.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

*30. We used a substantial number of agreements with customers, suppliers and other organizations and people to reduce the amount of uncertainty.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

*31. We used pre-commitments from customers and suppliers as often as possible.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

*32. We considered including the sale of complementary products, services and technologies early in the development of our venture.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Answer:	<input type="radio"/>				

Carleton University - Technology Incubation - Survey

Final Section

Select "Done" to complete survey.

In all the sections that follow we ask that you consider the start-up phase of your venture and indicate the degree to which you agree or disagree with each of the following statements.

***33. The sale of complementary products, services and technologies is a key element of our business model.**

Strongly Disagree Disagree Undecided Agree Strongly Agree
Answer:

***34. Key Stakeholders are defined as a start-up technology firm's key customer, supplier, partner for commercial development (distribution), investor and partners for technology development.**

How many Key Stakeholders are/were involved in the launch of your venture?

- Zero
- 1 to 3
- 4 to 6
- 7 to 9
- 10 to 12
- More than 12

Carleton University - Technology Incubation - Survey

*35. How many different types of key stakeholders are involved with your venture?

(Select all that apply to your venture)

- Capital - Providers of capital
- Technology - Providers of technology
- Infrastructure - Providers of infrastructure
- Market Access - Providers of access to markets and customers
- Delivery Service - Delivery/installation of your market offers
- Market Expertise - Expertise related to markets and customers
- Technology Expertise - Expertise for technologies related to your offer
- Operational Expertise - Expertise related to operating your business
- Distribution Expertise - Expertise related to distributing your offer
- Infrastructure Expertise - Expertise related to infrastructure management
- Complementary Services - Services sold alongside or with your offer
- Complementary Products - Products sold alongside or with your offer
- Complementary Technology - Technology sold alongside or with your offer
- Other (please specify in box below)

Selecting done will submit your answers and exit the survey. Thank - you for your time.