### ATHABASCA UNIVERSITY

# MODELING ABSORPTIVE CAPACITY FOR OPEN INNOVATION IN THE SOFTWARE INDUSTRY

BY

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#### **Approval Page**



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#### **Approval of Dissertation**

The undersigned certify that they have read the dissertation entitled

# MODELING ABSORPTIVE CAPACITY FOR OPEN INNOVATION IN THE SOFTWARE INDUSTRY

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In partial fulfillment of the requirements for the degree of

#### **Doctor of Business Administration**

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### Dedication

This work is dedicated to my family, my mother Meera, my wife Nisha, my daughters Shreya and Anushka, my sister Tanuja and my brother Anil, his wife Sujatha and their son Anish, all of whom have supported me throughout this endeavour. Thank you all for being so accepting of the times I needed to lock myself into this work. I can only hope that my newfound free time will give back some of what I lost with each of you.

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I would also like to acknowledge all of the firms and participants in the study. You all shared details of your companies and your own views on innovation that proved invaluable in allowing me to come to the conclusions in this work. I can only hope that supplying you with my findings will in some small way compensate you for all you have given to me.

#### Abstract

In today's fast paced world, software companies face constant challenges to keep up with their competitors and meet the changing needs of their clients through innovation. While large software companies have significant resources for innovation, small and medium companies lack resources and must innovate more efficiently. These companies are also key to the innovation cycle, often making leading-edge discoveries that large companies cannot achieve. Without the resources to develop ideas internally, these companies must find innovation ideas from any source available. These small and medium software companies must be able to effectively find, internalize and exploit innovations. This is called Absorptive Capacity and defining how small and medium software companies can maximize innovation performance using absorptive capacity is the focus of our study. Absorptive capacity is made up of the following:

- 1. Finding the right innovation
- 2. Understanding and absorb the knowledge
- 3. Exploiting the innovation to drive success

Thus, finding strategies to maximize absorptive capacity is the key to successful innovation for these firms. Our study will focus on finding the most effective absorptive capacity strategies for small and medium sized Canadian software firms.

Based on the available literature, the key elements that define how firms can choose the most optimal strategies for absorptive capacity are:

- Type of Innovation
- Breadth of the Knowledge Search
- Depth of Knowledge Search
- Partnering strategy

- Knowledge intake strategy
- Knowledge sharing strategy

In the study we interviewed 54 small and medium sized Canadian software firms that were engaged in External Open Innovation. The interview covered the areas above.

The results showed key relationships between the variables that resulted in the following outcomes:

- Firms Doing Radical Innovation Use External Solutions
- Firms Doing Incremental Innovation Work in House
- Centralized R&D Organizations Prefer Finding Solutions Not Knowledge
- Custom Development Firms Source Innovations and Integrate
- Product Based Firms Source and Share Ideas and Build in House

These outcomes offer an opportunity to guide firms on how to best absorb knowledge as part of their innovation process. This will help these firms absorb knowledge and build innovations based on them, and successfully enhance their futures and their ability to compete.

*Keywords*: Absorptive Capacity, Open Innovation, Innovation, External Knowledge, Small and Medium Software Companies, Strategies, Knowledge Acquisition, Searching for Knowledge, Exploiting Knowledge, Absorbing Knowledge

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#### **Chapter 1. Introduction**

#### Background

Today's software companies face increased competition as a result of globalization, increased availability in government and private investment funding for new firms and increased technology proliferation. In short there are more players competing for every dollar from clients that are more technology savvy. A study of Mexican small and medium software firms by Cima et al found that innovation is a key predictor of firm competitiveness and performance (Cima et al, 2018), p178. As a result, there is simultaneous pressure on those in the industry to both shorten their innovation cycle and to deepen the value delivered from that innovation to their clients. Clients want their software to continue to grow the benefits they derive and if that return cycle is not fast or deep enough then the client will move to new software. In fact, Lafabi and Williams determined that small and medium companies were positioned well against their larger competitors, as their clients trusted them more and welcomed them to engage in innovation (Lafabi and Williams, 2018, p268). This has driven the need to study how small and medium software companies innovate, so that we can help them become more competitive against their global, large, resource rich counterparts.

This has put a new focus on how software companies innovate. Traditionally software development innovation was done in house, behind closed doors until the software was ready for introduction to market. Over time firms began to involve partners earlier in the cycle, first through the release of test versions (beta testing) and later through partnered development in a model called Open Source Software Development. Open Source Development solicits external developers to add their ideas and code to a public or freely owned product. An example of this is Linux, which

has a consortium of developers, each of whom is free to add functionality and features to the product. The resulting product is then freely available to the market. Open Source has proved to be a great way to grow a product, however the free nature of the resulting software creates limits the potential for this to drive revenue growth for the originating company (Tushman and Lakhamni, 2012). This has created challenges for the proliferation of open source as an innovation methodology. There is now resistance on developers and firms wishing to contribute to open source projects as the opportunities for tangible gain are limited to either sale of related, non-open source products or services, or cost reduction through placing a platform in open source mode and no longer having to innovate on it internally.

All of these shifts have led to the creation of a new model of innovation; Open Innovation is a new model gaining notoriety as the next evolution of innovation (Chesbrough, 2003). It allows for companies to spread beyond traditional Closed Innovation, where ideas were germinated in a research lab, brought through development and prepared for market launch by that lab and then handed to an internal line of business to launch and derive benefits from them.

By contrast, Open Innovation offers two distinct ways for companies to innovate. For the purposes of our work we will focus on the externally sourced, which allows for companies to bring in externally sourced ideas and knowledge (Chesbrough, 2003). These ideas can vary in their stage of development, from early in ideation to fully developed products in adjacent, or even competing markets. This leads to the firm needing to perform varying degrees of product development activities to bring the ideas to completion, potentially doing some or all of the following activities; development, integration and market launch to derive benefits from externally sourced innovation (Chesbrough, 2003, p 21-23). This opens the doors of innovation to partners, giving the firm the

ability to gather the best ideas and internalize them, preventing them from becoming competing products.

Thus, externally sourced open innovation offers the potential for a firm to take a middle of the road position between traditional closed innovation and open source, allowing for the use of ideas or knowledge versus awaiting and making use of completed open source solutions. However, the Externally Sourced model faces a key challenge. While there is no shortage of outside ideas in the market, there is a lack of a defined model to allow this knowledge to be brought into a firm and be utilized to improve the core platform of the firm, either through integration into existing core applications, or through replacement of core offerings (Orucevic-Alagic and Host, 2008, p7). Without this avenue of bringing outside ideas into the core platform, firms are left to internal methods to advance their core platforms, closing them to the benefits of using outside resources to complement their internal knowledge. The lack of a consistent, repeatable model makes the use of external ideas more costly and may yield inconsistent results. For a firm to receive the benefits of Open Innovation they must be able to consistently source and internalize ideas. In a study of small and medium software firms in India, Okada found that firms could enhance their ability to innovate by sharing knowledge, bringing in knowledge and people into firms, and using this to build internal mechanisms feed this knowledge into the innovation process (Okada, 2016, p 89). The sourcing, internalization and exploitation of ideas is called Absorptive Capacity (Cohen and Levinthal, 1990). It is through the use of absorptive capacity that we believe the small and medium software firms will be able to drive innovation and competitiveness. This will be the focus of our study.

#### Context

To put the relevance of Canadian software and computer services firms (henceforth referred to as Canadian software firms) and their associated research and development in context let us examine some key statistics on the sector. In Canada software companies are included in the Canadian Information and Communications Technologies (ICT) sector. For the purposes of our study, in either the development of "off the shelf" software products that are sold to clients, or those firms that engage in providing custom software development to clients. To put this in context, based on the 2018 Canadian ICT Sector Profile by Statistics Canada (Statistics Canada, 2018, p4) there are over 37,000 companies that fall into the software and computer services industries. The vast majority of these (35,500) employee fewer than 10 people. The ICT Sector generated \$86.6 B in GDP in 2018, which was approximately 4.5% of the total Canadian GDP, and the Software and Computer Services Sector generated \$74.5 B in 2018, growing 5.9% from the previous year.

Turning to the relevance of research and development (R&D), in 2018 the ICT sector was the largest R&D sector in Canada, with over \$6.2 B being spent. Of this the Software and Computer Services sector represented 58%, or \$3.6 B and had the highest single year growth at 6.3% (Statistics Canada, 2018, p6).

Statistics Canada also studied innovation in the sector, finding that innovation in the ICT sector was higher than the full economy, with 94% of firms surveyed stating they were performing innovation versus 79% for the full economy. In the same study, ICT firms stated the biggest risks to innovation as:

- 1. Risk and Uncertainty
- 2. Lack of Skills

#### 3. Internal Financing

Of note, these same firms stated that intellectual property rights were not obstacles (Statistics Canada, 2018, p8)

Based on this we can see that the largest opportunity to influence the ability to innovate in software firms is to focus on the small and medium firms that make up over 95% of the software and computer services sector (35,500 of 37,000). In particular, identifying ways that small and medium software firms can increase their ability to innovate and enhance their competitiveness through:

- Identifying strategies that allow small and medium Canadian software firms to overcome the risk and uncertainty inherent in innovation
- Identifying strategies to allow small and medium Canadian software firms to grow their skills
- Identifying opportunities and processes so that small and medium Canadian software firms can innovate in spite of limited resources

Based on this our study will focus in particular on how small and medium Canadian software firms can effectively use absorptive capacity to utilize external knowledge and innovations to enhance their ability to innovate and increase their ability to compete.

#### Aim of this Work

Simply put, the aim of this work is to identify the absorptive capacity strategies that small and medium software companies in Canada have used to take advantage of external open innovation to drive their innovation performance higher and achieve firm success. In order to understand this our work will study the following:

1. Whether external open innovation will lead to increased competitiveness in small and medium Canadian software firms

- 2. If absorptive capacity is a key factor in helping small and medium Canadian software firms to take advantage of external open innovation
- 3. What are the absorptive capacity factors and associated strategies that small and medium Canadian software businesses have successfully used in their innovation processes

This will allow us to build off the work of Okada, Lafabi and Williams, and Cima et al by defining the factors that allow small and medium software firms to innovate and enhance their competitiveness (Okada, 2016, Lafabi and Williams, 2018 and Cima et al, 2018). By studying these three areas we will be able to show firms in the small and medium Canadian software market how to potentially enhance their innovation performance.

As we focus on how software firms can take advantage of external innovations and ideas, the key will be how these firms are able to find these innovations, internalize the knowledge and build these innovations into their products and services. These three elements represent the definition of Absorptive Capacity (Minshall et al, 2016, Smit, Abreau and Degroot, 2010). Thus, the ability of firms to practice and enhance absorptive capacity represents the key to taking advantage of external knowledge in their innovation process and thus extending their reach in building better products and services. Further we will narrow our study to small and medium sized firms, where we believe this absorptive capacity becomes even more critical. These firms are limited by size and resources, and thus the ability to take advantage of external knowledge potentially represents an opportunity for these firms to enhance their ability to compete against larger firms that have the resources to do their own research and development and bring these innovations from ideation to market implementation.

#### **Research Questions**

As stated above, the aim of our study is to ascertain how small and medium Canadian software firms can increase their absorptive capacity to allow them to take advantage of externally sourced

innovations to drive their innovation performance higher and achieve firm success. As this is a complex topic, made up of three key concepts, externally sourced innovation, absorptive capacity and innovation performance, it is necessary that we break this down into multiple questions in order to complete our study. Based on this we need to study the following components of our aim:

- 1. Whether external open innovation lead to enhanced innovation performance?
- 2. Whether absorptive capacity is a key factor to the success of external open innovation?
- 3. What are the strategies and factors that lead to enhanced absorptive capacity?

Our methodology will be to first research the concepts in general based on available literature. Once we have understood the concepts, we will use this knowledge to define our study methodology, questions and execute our primary research. The primary research will seek to apply the concepts to our small and medium Canadian software companies.

First, we will examine if a firm benefits from making use of external knowledge and innovations. Understanding this question requires a review of the literature on Open Innovation and what has been termed External Open Innovation (Chesbrough, 2003, p 21-23).

Second, we will review literature to study how absorptive capacity can facilitate external open innovation. This connection is key to understanding the relationship between how a firm finds and internalizes the knowledge and their ability to execute an external open innovation strategy.

Third, we will delve into the factors that drive absorptive capacity. In order to understand and study firm's absorptive capacity we need to be able to break down this concept into the key variables that drive it. This allows us to then take these variables and form questions to gather data from the firms studied and effective understand what absorptive capacity strategies are successful in which context.

Once we have understood these concepts from the available literature on absorptive capacity and on external open innovation, we will then define our study of Canadian small and medium software firms, seeking to answer the following research questions:

- 1. Does external open innovation create opportunities for small and medium firm's Canadian software firms to increase their competitiveness?
- 2. What is absorptive capacity and what role does it play in external open innovation for small and medium Canadian software firms?
- 3. What are the factors that influence the effectiveness of absorptive capacity in small and medium Canadian software firms?
- 4. What strategies do Small and Medium Canadian software firms use to increase their absorptive capacity?
- 5. What is the relationship between these strategies and the increase in absorptive capacity for small and medium Canadian software firms?

The answers to these questions will be detailed from our study of small and medium Canadian software companies. Our study will explore the absorptive capacity strategies that the participating firms use to further their aim of utilizing external open innovation to enhance their innovation abilities and their competitiveness. The analysis of the data gathered in responding to the five research questions will allow us to meet our aim and understand how small and medium Canadian software firms can increase their absorptive capacity to allow them to take advantage of externally sourced innovations to drive their innovation performance higher and achieve firm success.

#### Significance of the Study

#### **Practical Significance**

From a practical perspective, this study stands to offer several key benefits to the software industry and small and medium Canadian software firms. First and foremost, it offers an

opportunity for small and medium software firms to enhance their ability to compete with larger firms by enhancing their ability to take advantage of external knowledge from open innovation. This concept was proven by many studies over the last few years. Okada showed that small and medium software firms in India would enhance competitiveness networking with other firms and sharing knowledge, as they do in the external open innovation process (Okada, 2016). Kiveau et al showed in a study of small and medium media firms that in addition to innovation, small and medium firms needed to engage in collaborative research and linkages with organizations in order to compete (Kiveau et al, 2019, p323). Lastly, Cima et al showed in their study of Mexican small and medium software firms that innovation practices and mechanisms that foster innovation drive competitiveness (Cima et al, 2018, p188).

However, in order to assist our small and medium Canadian software firms, we must help them maximize their innovation, knowledge sharing and networking abilities so they can overcome their financial limitations and compete (Lafabi and Williams, 2018, p278). This will be achieved by providing these firms with an understanding of the strategies that could be successfully used to absorb knowledge would allow these firms to utilize their limited resources to their utmost and stay competitive in the marketplace. It would allow them to take in knowledge and speed up their innovation process, lowering their innovation costs and potentially generating revenue from these innovations faster, which would lend to a longer period of revenue growth before competitors catch up.

Second, this study will also afford small and medium firms the opportunity to develop relationships with partners and competitors that they are engaging with in identifying and assimilating external knowledge. These relationships will in turn open the door to more collaborations, thus potentially driving more innovations and enhancing their revenue

opportunities. This will align with the findings of Westerlund et al, who stated that small firms must design business models that leverage collaboration and networking in order to compete (Westerlund et al, 2017, p9).

Lastly, this study has the opportunity to benefit the market at large by allowing for a firm to use this additional channel for innovations to develop additional features and products for delivery to their clients. This will allow the market to benefit from additional innovations, brought to market faster and at a lower cost. This should enable more clients to take advantage of these innovations.

#### **Theoretical Significance**

From a theoretical perspective, this study will also benefit the research into absorptive capacity by filling a key gap in identifying the factors that drive absorptive capacity for small and medium Canadian software firms. While there is a large body of research into open innovation and the relationship with innovation performance and absorptive capacity, there is very little practical study into how absorptive capacity is defined and can be maximized. This research will offer a window into understanding these relationships, through the lens of our small and medium Canadian software firms. This can serve as a starting point for broader research into other types of firms, which will build towards a more generalizable result and fill the research gap.

#### **Chapter 2. Review of the Relevant Literature**

#### Introduction

As we seek to understand how Absorptive Capacity can enable Canadian software firms to enhance their innovation performance through external open innovation it is critical that we understand key concepts inherent in this question. The concepts are:

- External Open Innovation how do firms implement external open innovation and use it to benefit their innovation performance.
- What is Absorptive Capacity and how is it related to external open innovation once we accept that external open innovation is beneficial, we must understand how this external knowledge is utilized, which is conceptually defined as absorptive capacity.
- What are the factors that drive absorptive capacity what are variables that define an organizations level of absorptive capacity and how do they contribute to having external open innovation drive innovation performance.

Once these concepts are understood we will then review the studies done to date on absorptive capacity so that we can confirm the gap in the literature that we will seek to fill with our study. Based on the findings from the literature we will then be able to define our study of software firms to confirm our literature review findings and move forward to research and answer our research questions in order to deliver on the benefits of our study.

#### **External Open Innovation**

#### Introduction

As we said earlier, for the purposes of our work we will focus on the externally sourced, which allows for companies to bring in externally sourced ideas and knowledge. These ideas can vary in their stage of development, from early in ideation to fully developed products in adjacent, or even competing markets. This leads to the firm needing to perform varying degrees of product

development activities to bring the ideas to completion, potentially doing some or all of the following activities; development, integration and market launch to derive benefits from externally sourced innovation (Chesbrough, 2003, p 21-23).

Before we dive into studying absorptive capacity and the factors we utilize to enhance it we must ensure that we understand the benefits of external open innovation on the firm's innovation and company performance. We must understand the benefits that firms can realize by performing external open innovation, and also understand any barriers they must overcome. This is necessary information in achieving our aim to show that absorptive capacity is the mitigating factor between external open innovation and innovation performance. Once we have understood this, we will then discuss how to implement open innovation effectively so that firms can position themselves for enhancing their absorptive capacity.

#### **Benefits of External Open Innovation**

There are some very key benefits to firms who adopt an External Open Innovation strategy. Looking first at newer research into external open innovation, in their 2015 work entitled Open Innovation in SME's: a systematic literature review, Hossain and Kauranen (2015, p69) concluded that SME's need to balance collaboration and the need to avert their biggest concern, protecting their intellectual property. As a result, the authors believe that SME's prefer to collaborate with their customers versus suppliers or competitors (Hossain and Kauranen, 2015, p69).

The authors also found another key benefit of Open Innovation to SME's is that it shows the value of their technology and making them appeal to be purchased by larger firms (Hossain and Kauranen, 2015, p69). In addition, in their work the role of open innovation and absorptive capacity in innovation performance, Rangus et al (2016, p39) studied companies operating in Slovenia to look into how absorptive capacity and open innovation contribute to innovation

performance. Their findings showed a direct relationship between open innovation and innovation performance, showing the firms practicing external open innovation were able to enhance their innovation opportunities and the results of these innovations (Rangus et al, 2016, p52).

This new research confirmed prior findings in the field. First, while initially viewed as a way of reducing internal R&D costs, Chesbrough and Crowther (2006, p229) found that internal R&D costs do not decrease, instead they are maintained as open innovation sourcing of external ideas serves more as a complement to internal R&D rather than an outsourced replacement. They instead propose the benefits as growth and revenue potential. Parida et al (2012) quote a study by Lichtentaler, Lichtentaler and Frishammar (2009) that proposes non-monetary metrics such as increased customer satisfaction and acquisition of new knowledge (Parida et al, 2012, p289). Further, Parida et al (2012, p289) also propose a unique value to SME's in that External Open Innovation allows them to level the playing field with larger firms, by being able to integrate new external innovations that large firms have the opportunity to discover themselves with their significantly higher innovation budgets.

Another avenue of benefit is the potential for increase in productivity for R&D, such as the 60% seen by Procter & Gamble from their Connect and Develop program (Gronlund et al, 2010, p106). Part of this it seems is related to the increased speed to market of ideas as the External view allows for partially developed ideas to be brought in house and thus be brought to market with less requirement of the firm's own R&D resources.

In the case of vertical collaboration, engaging customers in the innovation process potentially develops more integrated solutions that enhance customer value. This in turn can have the effect of increasing the unique value to the clients and enhancing client retention (Dyer and Singh, 1998).

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Lastly, a major benefit for external open innovation is breadth of resources that the firm now has access to. A practical example of this is cited by Dodgson, Gann and Salter in their study of Procter & Gamble cited that while the firm had over 7500 employees in their R&D function worldwide, there were over 1.5 million researchers working on similar areas of science and technology at levels equal to or better than the firms internal expertise (Dodgson et al, 2006, p337). This wealth of available knowledge is a significant opportunity for the innovation process, provided organizations can capitalize by developing this avenue and bringing the knowledge back to their own use cases.

#### **Barriers to External Open Innovation**

While the benefits of open innovation seem clear and high, there are some clear barriers that firms need to overcome to be able to take advantage. First, Hossain and Kauranen raised that for SME's in particular, protecting their intellectual property is their biggest concern (Hossain and Kauranen, 2015, p69). Further, from previous studies we also see the barriers listed below:

- Cost the management of alliances, networks and integration of outside ideas all carry cost in terms of resources and time. This cost needs to be allocated but such collaborations have been shown to have high transaction costs and thus push smaller firms to take a more conservative approach and focus on horizontal collaboration when diversifying their markets. (Parida et al, 2012, p302)
- Not Invented Here this is the primary barrier to firms bringing in ideas from external sources. Companies and individuals have a natural apprehension to ideas that they did not come up with, always preferring those that were developed internally (van de Vrande et al, 2006, p348).

• Corporate Culture - in implementing open innovation there is a culture of collaboration, openness to learning and knowledge sharing that is critical to success. Referring again to the Procter & Gamble example, this was a change made over many years and through interim steps prior to reaching their final Connect and Develop networking strategy (Dodgson et al, 2006, p338). The firm moved through a decentralization of R&D functions first, then formed a separate organization for technology acquisition called a TAG (Technology Acquisition Group) and then built a global network of Technology Entrepreneurs (Dodgson et al, 2006, p339, Gronlund et al, 2010, p106).

These barriers are key ones that need to be overcome for our External Open Innovation and Absorptive Capacity strategies to be effective.

#### **Enabling External Open Innovation**

So, based on our introduction, if we assume that Open Source is not the answer to move innovation in the software industry forward then what is the right model. A key limitation of the Open Source model is that it requires development of code as a complete solution and does not typically bring the knowledge back in house. A model that allows for the knowledge to be brought in house by a firm and exploited would offer the best of both worlds, using outside resources to help drive idea generation and task completion, but then bringing that knowledge back in house for introduction into the core products.

In their 2012 work, Tushman and Lakhani (2012, p12) looked in depth at the development of the Apple Operating system. After several failed attempts via internal R&D, Apple purchased Next and took the core of their operating system from the Next base (Tushman and Lakhani, 2012, p 12). But this base included components built via Open Source. Today the authors note that

OS/X contains components from over 180 different open source projects, which form the open source Darwin operating system. Yet Apple can take this product and make it proprietary for their own use through the exclusion of their proprietary graphical user interface from any open source initiative. This represents one way of enabling Externally Sourced Open Innovation, protecting a portion of the product with intellectual property and maintaining it via Internal R&D.

A second key item required to enable Open Innovation is the identification of knowledge brokers. In their work "Innovation and Virtual Environments: Towards Virtual Knowledge Brokers", Gianmario Verona, Emanuela Prandelli and Mohabir Sahney (2006, p765) state that the key to recruiting the appropriate resources to Open Innovation projects is the knowledge broker, this role is key in taking the defined needs of a firm and putting them together with the right user / developer to best meet the need in an open innovation paradigm. This matching function is critical in meeting the fast timelines and specialized knowledge required to drive the open innovative to a swift end. This role has moved to be more virtual with the advent of globalization and the Internet, but with the increase in markets and technologies it is also more critical. The authors present a model taking this key role virtual and extending it beyond the more traditional networking and design, to facilitating a constant flow of knowledge and information to foster longterm relationships and continuous innovation.

The last key component of implementing a successful open innovation strategy is tooling. With the increase in both virtual collaboration and democratization of users (von Hippel, 2008, p2), it is key that these virtual team members be given sufficient tools to innovate and collaborate with their peers on the Open Innovation teams. The relatively new proliferation of open application programming interfaces by software firms allows users of their applications to develop

their own add-ons and integration with the firm's applications. This creates a new channel for external innovations to become active participants in open innovation initiatives.

In summary, while Open Source allows firms to get ideas from external sources, the resulting product is Open, costing the firm control over the product. The move to Open Innovation makes it possible for a firm to pull in external ideas within their products and offer this new offering in the Marketplace. However, this approach requires the move to be made as part of a clearly thought out and articulated strategy to ensure that a level of proprietary knowledge is maintained to confirm a separation point. As the innovation is developed and external knowledge is sourced and integrated the necessary tools for absorptive capacity are required to ensure success. Alma Orucevic-Alagic and Martin Host study this in the work on how to make open source successful. The authors discuss the need for defining strategy up front on how to manage the open initiatives by defining the product strategy as bringing knowledge back in house, putting in place the tools necessary and ensuring that there was sufficient complexity and geographic dispersal to support the choice of open for the initiative. Without this the model fails as resources will fall back into old habit of Open Source, each person out for themselves (Orucevic-Alagic and Host, 2008, p7).

#### Summary of External Open Innovation

Now that we have examined the existing literature on external open innovation, we have confirmed that external open innovation has the following benefits for the firm:

- 1. Increased innovation performance
- 2. Business growth
- 3. Revenue potential
- 4. Increased customer satisfaction and stickiness through vertical collaboration

- 5. Allowing SME's to level the playing field with larger firms by increasing R&D productivity
- 6. Increasing breadth of knowledge available to the firm
- 7. Enhancing the value of the SME's R&D, making them more attractive for acquisition

These benefits clearly show that external open innovation enhances the firm's performance and

value. At the same time there are barriers that need to be offset to realizes these gains, such as:

- 1. The cost of managing alliances
- 2. The lack of acceptance of external knowledge (Not Invented Here)
- 3. Corporate culture that does not promote openness and learning
- 4. Protection of intellectual property

Thus, in order to be successful in implementing external open innovation firms need to be able to mitigate the costs of alliances, protect their intellectual property and ensure they put in place a culture of openness and learning in their innovation processes.

This can be partially accomplished in multiple ways:

- 1. Managing the development of external knowledge through seeding the process
- 2. Use of knowledge brokers to help find the right match of knowledge to meet the firms needs

3. Putting in tooling and process to ease the absorption and exploitation of the knowledge Based on these strategies we can successfully answer our first question and show how to best implement external open innovation to lead to potentially improved performance. The next step is to define the role of absorptive capacity and how it can be used to achieve this potential.

#### What is Absorptive Capacity

#### Introduction

Now that we have confirmed that external open innovation has the potential to drive increased innovation performance, we now need to confirm how to maximize this relationship and the innovation performance. To do this we will use the existing literature to define absorptive capacity and show that there is a positive relationship between external open innovation, absorptive capacity and innovation performance.

#### **Definition of Absorptive Capacity**

As we look towards the beginning of the concept of Absorptive Capacity, Cohen and Levinthal's 1990 seminal work on this topic, entitled "Absorptive Capacity: A New Perspective on Learning and Innovation" is widely recognized to be the seminal work on this topic (Parida et al, 2012, p290). They define Absorptive Capacity as the "ability of a firm to recognize the value of new, external information, assimilate it and apply it to commercial ends" (Cohen and Levinthal, 1990, p128). They view this as critical to its innovative capabilities and suggest it is largely a function of the firm's level of prior, related knowledge.

The discussion on how to build absorptive capacity within a firm starts with building it for the individuals who are part of the firm. Key factors that impact an individual's ability to absorb knowledge are their prior related knowledge, their background and their ability to learn (Cohen and Levinthal, 1990, p128). These factors all give an individual the basic skills and shared language necessary to understand the new external knowledge. Further the prior knowledge also allows the individual to understand the benefits of the external knowledge, thus yielding the motivation to assimilate it. In addition, the ability to learn offers the tools and techniques necessary to internalize the new knowledge (Cohen and Levinthal, 1990, p128).

#### Figure 1

Model of Sources of a firm's Technical knowledge (Source: Cohen and Levinthal, 1990, p141)



From the diagram above you can see that Cohen and Levinthal (1990) view absorptive capacity as a step in the R&D process that is added to a firm's own R&D, and to their knowledge on competitors and industry to form the body of the firm's technical knowledge.

Building on this, the authors go on to state that simply exposing individuals to knowledge will not yield internalization. There is an intensity of effort required to enable retention. Thus, firms must not only plan for learning but also for working with the knowledge, through continued R&D or some form of joint venture with the external party (Cohen and Levinthal, 1990, p131).

Another key point made by Cohen and Levinthal (1990) is that while a firm is a collection of individuals, absorptive capacity of a firm is simply not the sum of the absorptive capacity of all of

their individuals. One must keep in mind the second key component of the definition, the ability to apply the knowledge to commercial ends. This requires the firm to have developed strategies for pervading the knowledge through its units so that it can be used to generate business value (Cohen and Levinthal, 1990, p131). Similar to R&D, which requires integration to the business, absorptive capacity also includes a measure of how the knowledge will pervade across the required sub-units, for example, how does the required knowledge get to the Sales and Servicing arms of the organization. At an organizational level, experience is again key. If a firm has a large network of active internal and external relationships, then the organization will develop and maintain the processes necessary to engage these networks and exchange information with them. This will strengthen absorptive capacity of the firm (Cohen and Levinthal, 1990, p134).

This recognition of the necessity to absorb the knowledge back into the firm to ensure successful recognition of business value has driven firms to ensure they consider the cost of assimilating and exploiting the knowledge (Cohen and Levinthal, 1990, p139). Firms were found to either gravitate towards ventures where accessing the generated knowledge were low, or to recognize that the actual participation in the venture only represented part of the cost, and any business model should allow for the cost of absorptive capacity (Cohen and Levinthal, 1990, p140).

Looking to a more modern definition, Smit, Abreu and de Groot define absorptive capacity as "identifying, adapting and commercializing innovative products and services that originate from both" (Smit, Abreu and de Groot, 2010, p1).

In the context of open innovation most authors agree that absorptive capacity has three key components (Minshall et al, 2016, Smit, Abreu and DeGroot, 2010, Lichtenthaler et al, 2009):

1. The search for open innovation opportunities

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- 2. The ability to bring the relevant external knowledge into the innovation process
- 3. Commercialization or introduction of the innovations to the market

Similarly, Huseyin Ince, Salih Zeki Imamoglua and Hulya Turkcan (2016) state that "absorptive capacity enables the firms to obtain the information necessary, allows firms to make the external knowledge useful, to take opportunities in the market, to come to a leading position and to develop new capabilities. Technological innovation capabilities and absorptive capacity are critical factors of innovativeness and thereby competitiveness" (Ince et al, 2016, p769). They suggest absorptive capacity has three dimensions:

- 1. Recognizing value of external new knowledge
- 2. Assimilation
- 3. Applying it.

The authors go on to make a direct linkage between high levels of absorptive capacity and high levels of innovativeness. However, this area appears to be an opportunity for further study, as it seems a relatively new area of study given the recent shift in the software industry from Open Source, which had little or no absorptive capacity requirements, to Open Innovation where the value is defined in the firm's ability to bring the knowledge in house.

Others have expanded on this to add the interrelations between firms as a fourth component (Vanhaverbeke, Varseka and Van de Vrande, 2007, Hyuk Jo and Park, 2017). Hyuk Jo and Park (2017) found that the development of building trust with their network and sharing their values and goals will foster their ability to exploit external innovations and knowledge, thus showing the development, maintenance and use of their vertical network drives external open innovation (Hyuk Jo and Park, 2017, p4157). This confirms that the use of vertical network is an element of

absorptive capacity and driving the ability to take advantage of external knowledge and innovation, thus facilitating exploitation of the knowledge, facilitating commercialization and driving innovation performance (Hyuk Jo and Park, 2017, p4158).

One other view on the definition of absorptive capacity comes from recent work from Song el al (2018) who studied available literature on absorptive capacity. Based on their study they identified 3 dimensions of absorptive capacity, absorptive effort, absorptive knowledge base and absorptive process (Song et al, 2018, p2343). They found that absorptive effort had the lowest effect on innovation performance, leading to the idea that the knowledge base and processes of the firm are far more directly related to the innovation performance (Song et al, 2018, p2344). The authors also identified an issue that they called the ambiguity problem, which was rooted in confusion over the meaning and nature of absorptive capacity (Song et al, 2018, p2369), identifying a gap in the existing research that our study can potentially fill. The authors also found that this definition aligns with the other research they studied, in that the knowledge base is the existing knowledge in the firm plus the newly found external knowledge, and the absorptive process is the process of internalizing the knowledge and exploiting it (Song et al, 2018, p2369). Based on the existing literature we can clearly define absorptive capacity as having the following key factors:

- 1. Searching for and recognizing the value of external new knowledge
- 2. Assimilation of the external knowledge into the firm
- 3. Exploitation of the external knowledge by integrating it into the firm's products
- 4. Engaging with the firm's network, both in the search for knowledge and in the exploitation
- 5. Developing a culture of openness and the processes to bring in outside knowledge

Now that we have a well-defined view of what absorptive capacity is, we can move to confirming the relationship between absorptive capacity, external open innovation and innovation performance.

#### Linkages Between External Open Innovation and Absorptive Capacity

Our next step is to explore the fact that absorptive capacity is the mitigating factor in enhancing the effectiveness of external open innovation in driving innovation performance.

#### **Overall Relationship**

Looking at recent studies we see that there are a number of studies that have focused on understanding the relationship between external open innovation, absorptive capacity and innovation performance.

In their work on the role of open innovation and absorptive capacity in innovation performance, Rangus et al (2016) studied companies operating in Slovenia to look into how absorptive capacity and open innovation contribute to innovation performance (Rangus et al, 2016, p39). Their findings showed a direct relationship between these three factors, showing further that absorptive capacity is the mediating factor for external open innovation and innovation performance (Rangus et al, 2016, p52). Further the authors conclude that to be successful in innovation organizations should open their innovation performance and develop their absorptive capacity (Rangus et al, 2016, p54). This study showed that absorptive capacity mediates open innovation in enhancing a firm's innovation performance (Rangus et al, 2016, p55).

In their work on absorptive capacity and innovation, Gkypali et al (2018) found that a firm's absorptive capacity plays a key role in integrating and filtering external knowledge from R&D collaborations (Gkypali et al, 2018, p1). Their study of Greek R&D manufacturing firms showed that absorptive capacity mediates the effects of R&D collaborations and exporting

activities on innovation performance (Gkypali et al, 2018, p24). Further, the external search strategy for finding R&D collaborations is directly related to innovation performance (Gkypali et al, 2018, p25).

Pereira and Leitao (2018) studied 571 Portuguese firms and found that acquisition of external R&D and acquisition of external knowledge affect firm's innovation generation (Pereira and Leitao, 2018, p1). External knowledge in their study took many forms, from equipment, software, licenses, employee training, cooperation with competing firms and cooperation with labs and universities (Pereira and Leitao, 2018, p9). Their study showed that there were positive effects on innovation from external R&D acquisition, external knowledge, cooperation with competing firms and cooperation with consultants (Pereira and Leitao, 2018, p10). The study also identified a need for additional research on the firm level characteristics that drive absorptive capacity (Pereira and Leitao, 2018, p15). The authors stated as an opportunity for future research that modelling firms' open innovation strategies to absorb external knowledge and establish technology transfer activities (Pereira and Leitao, 2018, p15). This is one of the key gaps that we will seek to fill with our study of small and medium Canadian software firms.

Adding to the work on factors that drive absorptive capacity, Deepak and Subrahmanya found that external factors around network and relationships / associations played an important role in the binding of knowledge into clusters so that firms can utilize these clusters of knowledge to drive innovation performance (Deepak and Subrahmanya, 2017, p14).

Based on these studies we can see that the relationship between external open innovation, absorptive capacity and innovation performance has been proven. These studies clearly show that absorptive capacity is the driver of maximizing innovation performance impacts from external open innovation.

#### Impact of Search Breadth and Depth on Type of Innovation

Based on studies we can show a relationship between different levels of knowledge search breadth and depth and type of innovation.

#### **Types of Innovation**

This is based on innovation being defined in terms of two broad categories,

- 1. Radical or Discontinuous Innovation
- 2. Incremental Innovation

In their work on external open innovation, Init Parida, Mats Westerberg and Johan Frishammar (2012) defined "Radical Innovation as the firm's ability to develop products that are new to the work or industry". They go on to define Incremental Innovation as the ability to develop products that are new to the firm" (Parida et al, 2012, p285). The authors go on to say that the radical innovations carry with them the opportunity to create a dominant market position, but also an increased risk of failure or higher cost of waiting for results. Incremental innovations on the other hand are more likely to be an extension of a market position through improving a current product or introducing a new product that is already known to the market (Parida et al, 2012, p285).

The relevance to our study is that the strategies to pursue radical and incremental innovations are different according to Veryzer (1998) who states that the genetics of these two innovation types are differentiated based on technological uncertainty, development time and the complexity of the development process (Veryzer, 1998, p2). Thus, when firms wish to open up
these types of innovations to external parties the open innovation activities undertaken for radical innovation will differ from those for incremental innovation (Parida et al, 2012, p285). This will lead to very different strategies for firms wishing to pursue radical or incremental innovations via opening up the innovation processes.

### **Absorptive Capacity Searches and Pursuit Strategies**

The authors defined four key methods of pursuing innovations via external open innovation (Parida et al, 2012, p285), which are described below:

- 1. Technology Scouting assessing and observing trends in order to detect opportunities and threats based on analysis of patterns of change.
- 2. Vertical Collaboration pursing partnerships with clients and suppliers to deepen vertical integration
- 3. Horizontal Collaboration pursuing partnerships from outside the firms' current value chain in an effort to extend reach to new products or markets
- 4. Technology Sourcing the buying or using of external technology through IP agreements

Through their study the authors found the following alignments (Parida et al, 2012, p298):

- Technology Scouting aligns to incremental innovations which follows since it is observing trends that already exist
- Vertical collaboration aligns to radical innovation. While the data supports this in the SME context of the study, the thought is that this is true because the clients and suppliers in this case

were potentially larger firms that used the SME's being studied to drive their own radical innovations.

- Horizontal collaboration aligned to incremental innovation. Again, while the data supports this it is possible that due to the SME context of the study this was driven by cost avoidance, with the SME's pursuing smaller, less costly partnerships.
- Technology Sourcing aligned to radical innovations. This result makes sense as SME's would seek partners or opportunities from outside of their own sphere of knowledge, thus yielding more radical ideas.

While the results of the study seem more SME specific, the knowledge that different methods of pursuit are used for different types of innovations is a key first step in defining our model for defining absorptive capacity. As discussed by Cohen and Levinthal (1990) the "ability to exploit external knowledge is a critical component of innovation activities" (Cohen and Levinthal, 1990, p128).

Other studies have also found linkages between the type of innovation and the pursuit of open innovation methods. In their work on large multinational companies, Mortara and Minshall (2011) observed several of the firms they absorbed utilized open innovation strategies to achieve ambidexterity and pursue innovation opportunities outside their traditional fields and markets, specifically as a means to defer risk of developing these radical innovations (Mortara and Minshall, 2011, p594).

One other study which focused on the concept of radical or discontinuous innovation was the work of Bessant, von Stamm, Moeslein and Neyer (2010). The authors theorized that

discontinuous innovation fundamentally presents challenges to the existing knowledge and "frame of reference" for a firm, requiring them to seek external partners to avoid trying to fit the new idea into their existing views and models (Bessant et al, 2010, p353). They found that firms pursued discontinuous or radical innovations externally as a way to decrease uncertainty, cost and risk, while getting to market quickly. This external pursuit did require significant change to status quo of the firms, defining nine innovation practices that pursuing firms would potentially need, which we will discuss in a future section of this study. Overall Bessant et al came to 3 conclusions (Bessant et al, 2010, p353):

- 1. The practices chosen will depend on the nature of the innovation processes and the firms involved.
- 2. Organizations need to have different practices for the pursuit of discontinuous innovations vs incremental innovations.
- 3. Choosing the right practices is key to avoiding making a mistaken decision.

In their work on knowledge search and absorptive capacity, Flor, Cooper and Oltra (2018) theorized from previous research that there to be a direct relationship between the breadth and depth of searches and radical innovation (Flor, Cooper and Oltra, 2018, p183). However, the findings from their study did not find a direct relationship but did find that external search depth and breadth provide ideas and resources that don't provide competitive advantage on their own but can foster it (Flor, Cooper and Oltra, 2018, p193). Further their work showed value in developing processes to develop resources and capabilities to transform external knowledge to foster radical innovation. While they could not confirm the direct effect of absorptive capacity, the developed capabilities to transform external knowledge combined with internal knowledge do

lead to radical innovations (Flor, Cooper and Oltra, 2018, p193). Thus, findings of their study did show the importance of developing processes and routines to identify external knowledge, which would then take advantage of external breadth and depth in searches and result in radical innovation (Flor, Cooper and Oltra, 2018, p193).

Overall these studies clearly show that there is a relationship between the search breadth and depth utilized to find external knowledge, and the resulting innovations.

#### **Summary**

Based on this literature we clearly see that absorptive capacity has a direct impact on the ability of external open innovation to drive innovation performance. In addition, studies also show that the breadth and depth of searches for external knowledge are also directly related to the type of innovation that firms pursue and successfully execute.

#### **Factors That Influence Absorptive Capacity**

In this section we will seek to conceptually understand the factors that drive absorptive capacity. This information will be used to identify potential items we will delve into during our study of small and medium Canadian software forms. By identifying the factors we will be able to understand the potential influencers of absorptive capacity, so that they can be used as variables we need to gather data about during our study so that our study can confirm how the firms we are studying are able to increase their absorptive capacity and with it their innovation performance. In order to understand the factors that influence Absorptive Capacity we will use the three components of absorptive capacity to review literature on each component to understand the

factors that drive them. The factors of each component will then form the full set of factors that

influence absorptive capacity. These components of the definition are:

• The Search for External Knowledge

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- The Assimilation of the Knowledge into the Innovation Process
- The Exploitation of the Knowledge as part of Innovations

#### Search for External Knowledge Opportunities

As companies practicing External Open Innovation and seek to absorb outside knowledge or innovations, the first step is to consider how they source and internalize external opportunities. The search for knowledge is the primary influencer towards successfully absorbing outside knowledge and creating innovations is to first search the market and identify the right opportunities. The search strategy utilized by a firm has been a well-documented topic in literature, with over 77,000 articles being show in response to a search on "Absorptive capacity and Search Strategy and Open Innovation". Authors have broken down search in various ways, some focusing on the contents of the search and how to narrow the results to find successful innovations while many others on breaking down a search strategy into its components.

Overwhelmingly one of the key concepts in search strategy is breaking down search into two components, breadth of the search and depth of the search. Breadth is defined as the number of external sources that one searches across (Ferreras et al, 2015), while depth is associated with the degree of importance given to each of those sources (Flor, Cooper and Oltra, 2018). Both factors become key in assessing and building a search strategy for a firm in the context of open innovation (Laursen and Salter, 2006).

One of the key works in this arena was "Open for Innovation: The Role of Openness in Explaining Innovation Performance among UK Manufacturing Firms", which has been cited almost 5000 times by other authors. One of the key items from their work is the definition of a scale for the measurement of breadth and depth, which has then been utilized by other researchers on the topic. The authors measured breadth based on how many of the following 16 sources of knowledge were used by a firm (Laursen and Salter, 2006):

## Table 1

Type of Source	Knowledge Source	
Market	Suppliers	
	Customers	
	Competitors	
	Consultants	
	Commercial Labs or R&D Institutes	
Institutional	Universities or other higher education	
	Government Research Organizations	
	Other public sector	
	Private Research Institutes	
Other	Professional conferences	
	Trade associations	
	Technical trade/ press	
	Fairs, exhibitions	
Specialized	Technical Standards	
	Health and Safety Standards	
	Environmental standards and regulations	

Knowledge Sources for Breadth of Search (Source: Laursen and Salter, 2006, p139)

The authors then defined the measurement of depth as the use of the channel by the firm, with 1 being highly used and 0 being anything less (Laursen and Salter, 2006). In their study the authors hypothesis was that breadth and depth were directly related to innovation performance, which they measured as R&D intensity. They measured the impact of breadth and depth over the product lifecycle in an attempt to show a curvilinear relationship to performance. Their findings were as follows:

 "During the early stages of the product lifecycle innovating firms need to draw deeply from a small number of key sources of information" (Laursen and Salter, 2006, p146)  In later stages, as the level of proliferation of knowledge expands to more parties that have specialized knowledge, "innovative firms need to scan across a wider number of search channels" (Laursen and Salter, 2006, p146)

Thus, the authors confirmed that both breadth and depth are key in the practice of open innovation and driving innovation performance.

Future authors took this work as a basis, building on, or challenging its conclusions, and adding the concept of absorptive capacity as a variable. Ferreras, Newell, Ernandez-Mesa and Alegre (2015) added to the study of breadth and depth the concept of Absorptive Capacity in the guise of explorative learning, transformative learning and exploitative learning. Their study found correlations between depth of search, absorptive capacity and innovation performance, citing that depth creates "patterns of interaction and mutual understanding" (Ferreras et al, 2015, p87). However, the study did not show a correlation to absorptive capacity for breadth, indicating that breadth "is more related to exploratory learning than exploitative" (Ferreras et al, 2015, p94). This indicates that while looking at a large number of sources and opportunities may lead to innovation performance it does not translate to an ability to internalize the knowledge. This indicates the presence of additional factors to allow a breadth of ideas to be internalized.

Through research in his work on capturing absorptive capacity concepts and determinants, Lewandowska (2015) stated that two key components are that absorptive capacity is cumulative and built over time, and that prior knowledge in the area is beneficial to successful absorptive capacity (Lewandowska, 2015). This identifies that a key factor is that firms will benefit from finding opportunities in which they have some basis or knowledge. Thus, while breadth may be beneficial to performance, their still must be bounds rooted in prior knowledge or past absorption to allow these ideas to be internalized and ultimately exploited to drive maximum performance.

One other key viewpoint was the introduction of the concept of the intermediary into absorptive capacity. Kokshagina, Borias and Masson (2017) introduced the concept of using an intermediary could help to drive absorptive capacity where prior knowledge did not exist. They theorized that the use of an innovation intermediary could help filter searches to focus on a particular problem in cases where the initiating firm did not have the expertise or prior knowledge to perform this activity. This focus would then allow the initiating firm to build relationships between the results and their own experiences and speed absorptive capacity without the overhead of trying to filter out things that they could not tackle. While their study was limited to a view of a single intermediary it did show promise of a relationship, "exhibiting how intermediary can accelerate absorption of the distant knowledge elements". This study also took into account the concept of potential vs realized absorptive capacity (Zahra and George, 2002), stating that the intermediary can help with potential absorptive capacity, which creates the opportunity for benefit (Kokshagina et al, 2017). However, integration is still required to realize this and turn it to benefits for the firm. One other key study area looked at the relationship of breadth vs depth to the two types of innovation we have previously discussed, incremental innovation vs radical innovation. Two studies have shown contrasting results in proving out this relation.

First, Chiang and Hung, (2010) were able to show a correlation between depth of search and incremental innovation, and between breadth of search and radical innovation. This was despite failures to show the same correlations by other authors including Laursen and Salter (Chiang and Hung, 2010). The authors believed there were two key reasons for this:

 Their work took into account more measures of innovation performance, such as revenue from new products, number of new products introduced and the frequency of new product introductions vs competitors.

2. Authors such as Laursen and Salter looked at R&D Intensity, which is a point in time measure vs looking across the full product development lifecycle.

Chiang and Hung theorized that these factors offered a more complete picture, legitimizing their result.

Flor, Cooper and Oltra (2018) studied the correlation between breadth and depth in external searches and radical innovation. They built on Zahra and George (2002), and used similar measures for breadth and depth, but expanded on the measure of innovation (R&D intensity) to also include firm size and age as control variables. However, their study was unable to prove out a correlation between either breadth or depth and radical innovation in high-technology firms (Flor et al, 2018). Their conclusions indicated that while breadth and depth might be part of successful radical innovation and the resulting competitive advantage, more was needed to build sustainable strategies. The potential and realized absorptive capacity needed "devoted efforts and efforts to intensify awareness of potential partners and develop capabilities that facilitate transformation and exploitation of this knowledge" (Flor et al, 2018, p191).

Based on this we can see that understanding both the breadth of the search, or the net that is cast to find knowledge, and the depth of knowledge that is being sought as the key elements to building a successful absorptive capacity strategy. Searching for the right knowledge informs the rest of the process and the resulting innovations.

#### Integration of the External Knowledge into the Innovation Process

The second component of the definition of absorptive capacity is the integration of the external knowledge into the innovation process. The research on searching for new innovations, in particular the work on breadth and depth leading to innovation performance, we see that authors such as Ferreras et al (2015) stated that absorptive capacity, and the absorbing of the external

knowledge is a key element to bridge from the search to success. Achieving this absorbing of knowledge requires the firm to have a defined strategy for bringing the knowledge back in house and ensuring that resources of the firm are able to successfully operate and continue to grow the fruit of the innovation. The study of what these potential strategies are and the factors that can identify which strategy to use to lead to successful innovations is the core of our study.

In a study focused on the software industry we can examine the 2005 work "Absorptive Capacity in the Software Industry: Identifying Dimensions That Affect Knowledge and Knowledge Creation Activities" in which the authors conceptualized Absorptive capacity as the "ability of the firm to effectively use external knowledge" (Matusik and Heeley, 2005, p549). Since this is the key to bringing the innovation in house, it is key to the success of the innovation. One of the major issues the authors have found is that rather than measuring these factors individually, researchers have tried to apply a single measure. Instead the authors propose a model of using both collective and individual elements to measure capacity, looking at how individuals internalize knowledge as well as the collective organization. Specifically, the rigidness or porousness of the firm's organizational boundaries is a huge factor in their ability to bring knowledge in - the more rigid, the less likely they are to be successful. This creates a correlation between the degree of openness of the organizational and their ability to integrate knowledge.

A key study in the integration of knowledge was the work of West and Bogers (2014). In this work the authors detailed key components of an absorptive capacity strategy (West and Bogers, 2014):

1. Obtaining innovations from external sources

2. Integrating

- 3. Commercializing (discussed in our next section)
- 4. Interaction between the firms and its collaborators

The authors further break down obtaining into constituent parts – "sourcing, enabling, incentivizing and contracting" (West and Bogers, 2014, p6). The linkage between the components is shown on the following diagram:

## Figure 2

Components of Absorptive Capacity (Source: West and Bogers, 2014, p816)



This clearly shows one key to success in the integration phase is the two-way nature of the linkages, a key reason West and Bogers expanded the model from the three traditional elements to add the interactions (West and Bogers, 2014).

Another factor documented by West and Bogers is the contracting and licensing component of acquisition. This introduces a dependency between the ability to integrate the knowledge and the firm's ability to negotiate required terms and intellectual property rights into their contracts (West and Bogers, 2010).

In this same vein, Christensen, Olesen and Kjaer were cited by West and Bogers as identifying that one other method to acquire and assimilate knowledge is to acquire the knowledge supplier and then cut off external ties (Christensen, Olesen and Kjaer, 2005). This eliminates the management and contracting of the external firm and helps manage the culture changes that can become barriers in the previously cited discussion on NIH (Not Invented Here).

Overall the authors view absorptive capacity as an ongoing routine activity, taking in knowledge from a domain that is related to their current knowledge base. This reduces the cost and effort associated with the activities. When the firm wishes to engage on a new knowledge area then a dedicated effort is required to build specialized strategies to bring in this knowledge and manage the change. This must be built over time and often can force a decision between current operations and the new opportunity (Cohen and Levinthal, 1990, p137). While some firms have looked at the option of purchasing the required base knowledge externally through firm acquisition or hiring of specialized employees, the authors feel this is only part of the puzzle. This offers a seed for the knowledge but given the earlier discussion on pervading the knowledge across the organization the firm will still require a strategy to share this knowledge across its sub-units and must budget for the appropriate resources and associated costs. Lee and Allen (1982) examined this in their work on integrating new technical staff and their findings were that considerable time lags are associated with the integration of new technical staff, particularly those concerned with process and product development. The successful integration of complex and sophisticated technological knowledge requires an existing internal staff of technologists and scientists who are both competent in their fields and are familiar with the firm's needs, procedures, relationships and goals (Lee and Allen, 1982, Cohen and Levinthal, 1990, p149). Thus, the

integration of these new staff in the organization would still require the knowledge to exist and be developed in the firm.

#### Aligning the Organization to Optimize Absorptive Capacity

A key factor in ensuring the organization is able to maximize absorptive capacity and fully integrate the external innovation into their own products and services is ensuring the organization is aligned for success. The target here is to align on an organizational model that supports the integration, growth and development of the external idea without de-evolving back fully to the costly and time-consuming Innovation Lab model where the organization stands up a separate organization. As discussed by Chesbrough (Chesbrough, 2003, p21-22) this model slows down innovation and increases costs, and the result could be that ultimately companies miss the window to integrate the external innovation in an efficient manner. Taking too long or costing too much would decrease the value of the potential integration and open the opportunity up to competitors. The key is striking a balance, where the organization supports the nurturing and development of the ideas without the cost of re-integration of the innovations back into the organization.

In their work Dahlander and Gann (2010) state that their research indicates that Openness and Internal R&D must coexist in a balance. They say that "much of the literature views R&D as a necessary complement to openness for ideas and resources from external actors" (Dahlander and Gann, 2010, p701). They go on to state that there is a "variation in the extent to which they can screen, evaluate and assimilate external inputs to the innovation process" (Dahlander and Gann, 2010, p701). One key factor is that "research has shown that firms need competencies in areas related to their partners' to assimilate and co-develop ideas that originate from external sources" (Dahlander and Gann, 2010, p701). Lastly, they argue that Openness is not new, rather what has occurred is that the balance has shifted (Dahlander and Gann, 2010, p701). This shift will require a new organizational model to support it, somewhere between the completely external model of Open Source and the fully internal model of the Internal R&D Innovation Lab.

In his work on open innovation, Huizingh (2011) states that there are two dimensions when defining innovation models, the process and the outcome. His expansion of the model to a 2X2 matrix allows for the differentiation between an Open Process creating a Closed Product vs. Creating an Open Product, again opening the opportunity for an organization model that aligns with this spectrum. In the table below we can clearly see the model we are seeking to define is the model required for what Huizingh defines as Private Open Innovation.

### Table 2

Various ways of innovation based on the openness of both the process and the outcome of innovation (Source: E Huizingh, 2011, page 3)

Innovation	Innovation Outcome			
Process	Closed	Open		
Closed	Closed Innovation	Public Innovation		
Open	Private Open Innovation	<b>Open Source Innovation</b>		

Chesbrough, Gassmann and Enkel (2010) take an interesting view, they define the external partner network as more of a network of Virtual R&D teams and thus restate the challenge of organizational model as one of managing dispersed virtual R&D teams. These teams are more difficult to energize, coordinate and enable in their knowledge creation. The authors state that "the operational functioning of open innovation depends on firms' ability to manage decentralized innovation processes and often includes participants who are not even on the company's payroll" (Chesbrough et al, 2010, p219). The authors also capture the fact that while these "external" virtual teams need to be managed there is also a push to internationalize R&D, meaning internal virtual

R&D teams are also being created, further driving home the need for research into a model that balances all parties ((Chesbrough et al, 2010, p215).

So, it is clear that while the model may not yet be defined, there is a direct linkage between finding the right organizational model to facilitate the open innovation and the success of that innovation. Thus, we need to add to our primary research data gathering on the organizational model used in both cases of success and failure to define the models that facilitate successful innovation.

#### **Exploitation of the Knowledge in Innovations**

The last element of absorptive capacity is the ability to commercialize the innovation, exploiting it to drive gains for the firm. This was defined by West and Bogers as having two key elements, value creation and value capture (West and Bogers, 2010). Value creation is tied to the innovation generating revenue / benefits for the firm. Common measures are revenue growth, revenue attributed to radical innovations or new products or the number of new products created (West and Bogers, 2010).

The second factor cited by West and Bogers is Value Capture, which they define as cost reduction, although this is stated to be a less frequent goal and is not seen to be an outcome of open innovation (West and Bogers, 2010, Chesbrough, 2003). In fact, Faems et al go as far as stating that external open innovation and the required absorptive capacity in fact increase costs (Faems et al, 2010).

In another study on the commercialization of innovation, Zahra and George stated that exploitation of an innovation is an "organizational capability that is based on routines that allow firms to refine, extend and leverage existing competencies or create new ones by incorporating acquired and transformed knowledge into its operations." (Zahra and George, 2002, p190). The

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authors go on to define the concepts of Potential Absorptive Capacity and Realized Absorptive Capacity. They believe that both of these contribute to competitive advantage.

In the diagram below, Zahra and George show that Potential Absorptive Capacity is based on the acquisition and assimilation of knowledge, while Realized Absorptive Capacity is created through the transformation and exploitation of the knowledge to generate an innovation. They believe the key is in choosing the right innovation to take advantage of (Zahra and George, 2002). **Figure 3** 

Breakdown of Absorptive Capacity (Source: Zahra and George, 2002, p192)



Of particular note, Zahra and George also stated that exploitation of knowledge requires social interaction mechanisms to share knowledge to "promote mutual understanding and comprehension (Zahra and George, 2002, p194).

Based on these learnings, absorptive capacity has four dimensions:

- 1. Recognizing value of external new knowledge
- 2. Assimilation of the knowledge
- 3. Application of the knowledge to provide solutions
- 4. Linkage of this application to the company's network of clients and solution providers

#### **Other Factors from the Literature**

In addition to the factors that influence the components of absorptive capacity, the available literature identifies several other factors that influence absorptive capacity. The other factors also have to be considered for inclusion in our study to confirm if they influence absorptive capacity in small and medium Canadian software firms. The first of these factors is firm size. Statistics Canada (2018) defines business types based on employee count as follows:

• Small businesses are businesses with 1 to 99 employees;

- Medium-sized businesses are businesses with 100 to 499 employees;
- Large businesses are businesses with 500 employees or more.

There are key differences between Small and Medium Enterprises (SME) and their larger corporate counterparts. As a part of their study of 252 High Tech SME's, Parida, Westerberg and Frishammar stated that SME's are challenged vs Large companies based on their size, limited financial resources, lack of a multidisciplinary competence and less structured approach to innovation (Parida et al, 2012, p284). However, as stated by Christensen, Olesen and Kjaer (2005), these SME's also typically possess specialized, deeper knowledge in their field, and are faster to react to market changes. This enables the SME to be more nimble in the pursuit of open innovation opportunities vs larger firms that have barriers in their speed to react, their culture and in particular the Not Invented Here issue (Chesbrough and Crouther, 2006, p234) that prevent them from being able to react to external opportunities the same way. While the focus of the Christensen study was consumer electronics firms, this result was also seen in the studies from Chesbrough and Crouther, and Parida, Esterberg and Frishammar.

Parida, Esterberg and Frishammar also note that most prior studies focused on large companies and avoid SME's (Parida et al, 2012, p284), they feel this is done as the focus on many of these prior works has been on open source and technology licensing as two primary types of open innovation. However, the growth of open innovation to include networking, alliances and collaboration has opened the door to a more all-encompassing review that includes firms of all sizes, especially small and medium firms, who the authors fed have been underrepresented in studies to date. The study also needs to cover all participants, employees, contract workers and external partners.

The authors go on to state that SME's actually have more to gain from open innovation, that it potentially levels the playing field against larger competitors by giving the SME access to resources via collaboration and networks that previously would have only been possible for large firms with the ability to buy those resources (Parida et al, 2012, p284). These newfound resource opportunities give SME's the ability to add to their deep knowledge in one area and form a betterrounded view, filling their own technological gaps (Parida et al, 2012, p284). This allows for increased performance from innovation from the SME's. It enables them to stay competitive against larger firms that have the internal resources necessary to previously outperform the SME. Where previously an SME would have been unable to pursue Technology Scouting activities due to lack of resources, they can now take advantage of opportunities via the formation of alliances (Parida et al, 2012, p284).

Other authors have similarly identified potential SME opportunities. In their work on alliances, Anand and Khanna (2000) identify joint ventures as an area where this openness and knowledge sharing can drive enhanced value, and that SME's are positioned to take advance of

this as their ability to make alliances will enable these types of ventures (Anand and Khanna, 2000, p305).

The key to success will be the ability of the SME to be able to build the same depth of knowledge in the new innovation area that a large company can. Christensen, Olesen and Kjaer state that small companies can at best set the agenda for the upcoming innovation based on specialized and deep knowledge, but the issue is developing the deep knowledge necessary to be an attractive player to the market (Christensen et al, 2005, p1544).

While some large companies like Procter & Gamble have been successful at driving the change necessary to succeed at Open Innovation, the barriers presented by organizational model and culture are difficult to overcome. In the case of the Connect and Develop strategy pursued by Procter & Gamble, Dodgson, Gann and Salter stated in their 2006 work "The Role of Technology in the Shift Towards Open Innovation: the case of Procter & Gamble" that the changes in Connect and Develop have not occurred overnight, instead requiring a significant culture change, which built on an in place decentralization of the R&D Structure. This clearly shows that Large Companies must make a longer, more specialized strategy for pursuit of Open Innovation to reap the benefits (Dodgson et al, 2006, p338).

Overall it is clear that the strategies and processes required to pursue open innovation will vary greatly for an SME vs a large firm, thus making this a key factor in the development of models for pursuit of Open Innovation and associated Absorptive Capacity.

### Absorptive Capacity Strategy Models

Another factor that influences the absorptive capacity is the method that companies choose to acquire the outside knowledge. Based on the literature we see the following paths to knowledge acquisition:

- Collaboration / Networks this represents the most informal model, where organizations work together to develop ideas. This can often occur between firms and universities, or two firms that have relationships of trust and past working relationships (Parida et al, 2012, p283).
- Formal Partnerships / Alliances this model documents the relationship between the firms, roles and responsibilities of each member and the value each member will receive (Gronlund et al, 2010, p118)
- Acquisitions this is the purchase of the firm or innovation by another firm Christensen et al, 2005, p1535)
- Corporate Venture Capital this is an investment model where one firm exerts influence over another in the development of the innovation through a financial inducement (Lee et al, 2010, p291)
- Option Model this model allows for a firm to seed an idea in exchange for a future stake that they can choose to exercise at a later time, allowing for better risk management (Christensen et al, 2005, p 1545)

These different options for acquisition of knowledge can also be used together by a single firm, changing the method as a firm matures (Christensen et al, 2005, p 1545).

The choice of which of these acquisition strategies to utilize is situational and will be based on a number of factors. Factors include level of uncertainty (van de Vrande et al, 2006, p347 and Bessant et al, 2010, p346), resources possessed by the firm (Ahuja, 2000, p319), level of maturity of the innovation (Christensen et al, 2005, p1545), firm size (Parida et al, 2012, p297 and Lee et al, 2010, p291) and the degree of openness (Lazzarotti and Manzini, 2009, p615).

Let us first discuss uncertainty as a factor. In their work "Choosing Governance Modes for Technology Sourcing", Van de Vrande, Lemons and Vanhaverbeke study the effect of uncertainty on governance mode choice in new business development. They focus on two classifications of uncertainty discussed by Folta (1998, p1007), first a substantial level of industry uncertainty that is outside the firm's control, and second uncertainty between partners in inter-firm relationships (van de Vrande et al, 2006, p356). Both of these have a direct impact on External innovations, for radical or discontinuous innovations in the case of industry uncertainty, and for both incremental and discontinuous in the case of inter-firm relationships. The authors use the level of uncertainty over the innovation lifecycle to define the level of investment and commitment to the innovation, and thus the governance model. The state that in the early stages of an innovation, before a business model exists, the level of uncertainty is high, and therefore other firms will seek to limit their investment in this external innovation until the "uncertainty has been reduced to a controllable level" (van de Vrande et al, 2006, p350). Put another way, innovating firms wish to keep their options open in terms of where to invest resources until its clear which idea will yield the best business value. This flexibility is a strategic asset for the investing firm, and maintaining it avoids the risk of errant and costly investments (Folta, 1998 p1008). So initial modes of engagement will be more in line with venture funding or cooperative work until such time as a business model and associated value have been defined. Then the investing firm can

move to a more contractual governance model like a joint venture or formal alliance (van de Vrande et al, 2006, p355). This contractual arrangement reduces the risk of opportunistic behavior that can occur with cooperative work. Overall the authors define the following key propositions correlating choice of governance model with uncertainty (van de Vrande et al, 2006, p353).

Proposition 1 - Under high levels of uncertainty, companies are likely to use technology sourcing modes that are reversible and have a low level of commitment such as alliances (van de Vrande et al, 2006, p353).

Proposition 2 - When uncertainty has decreased as a result of the prior investments in the development of a venture, companies are likely to use technology sourcing modes that are less reversible and involve a higher level of commitment (van de Vrande et al, 2006, p354).

Proposition 3: Under conditions of high technological distance between the investing firm and its partner, companies are more likely to choose corporate VC over strategic alliances, and strategic alliances over acquisitions (van de Vrande et al, 2006, p357).

Proposition 4: When technological distance between firms has decreased as a result of learning investments, companies are more likely to choose acquisitions over strategic alliances, and strategic alliances over corporate VC (van de Vrande et al, 2006, p357).

Proposition 5a: The more prior cooperation between the firms involved in external technology sourcing, the lower the information asymmetry and the more likely companies will choose acquisitions over strategic alliances, and strategic alliances over corporate VC (van de Vrande et al, 2006, p358).

Proposition 5b: The more prior cooperation between the firms involved in external technology sourcing, the higher the level of inter-firm trust and the more likely companies will choose corporate VC over strategic alliances and strategic alliances over acquisitions (van de Vrande et al, 2006, p358).

Proposition 6: When a technology is new and its application potential is still unknown, companies will have an incentive to delay commitment. As a result, they will be more likely to use corporate VC over strategic alliances, and strategic alliances over acquisitions. These propositions will form a key portion of the model for absorptive capacity that will be tested in our study (van de Vrande et al, 2006, p359).

This factor seems to have a direct correlation to the choice of the governance model; however, this can still be influenced by other factors as typically globalization has led to increased access to external ideas and makes investments a competitive situation. Therefore, we must add the impact of other factors to ensure the appropriate model is pursued.

The second factor to examine is resource availability. The ability of a firm to pursue an alliance for example is based on their ability to bring appropriate knowledge assets to the alliance to make them an attractive partner, as alliances are exchanges of knowledge (Lee et al, 2010, p291). Other situations may lend themselves to more pure financial needs, thus creating opportunities for Corporate Venture Capital type models. A second factor the authors raise is also retention of resources. A small firm with deep knowledge may prefer a relationship with a university versus one with a competitor to address the fear of giving away knowledge to a competitor (Lee et al, 2010, p292). Another prime example of this is vertical collaboration where clients and suppliers will partner with companies that have deep knowledge to build solutions that deliver potential competitive advantage without the cost of having to develop this knowledge themselves or wait

for a partner to develop the knowledge (Parida et al, 2012, p283). It should also be noted that by partnering with organizations with complementary knowledge, each organization is able to stay within their core competency, reducing the risk and cost associated with the joint development (Gronlund et al, 2010, p118).

Knowledge sharing offers a direct tie into absorptive capacity as research has shown "difficulties in joint ventures and alliances relate to the complexities surrounding inter-firm knowledge transfers" (Anand and Khanna, 2000, p297).

Another key asset or resource that firms can offer is legitimacy and status. As studied by Baum, Calabrese and Silverman, companies entering a new market, or startups can seek alliances that offer them immediate legitimacy as a means to develop their market and enhance their value to clients (Baum et al, 2000, p268). In particular they looked at biotechnology startups where the opportunity to form alliances offered these new firms the opportunity to be immediately trusted and gain operating experience that would normally take years to develop (Baum et al, 2000, p270, Ahuja, 2000, p334).

The third factor is the level of maturity of the innovation. Christensen, Olesen and Kjaer studied the consumer electronics industry and defined a correlation between governance model and the maturity of the innovation. Said another way, as the innovation matures, needs of the originating firm change. In the initial stages the firm seeks specialized and deep knowledge to fill their own knowledge gaps, and thus seek alliances or cooperation with firms that can offer this knowledge (Christensen et al, 2005, p1542). As the innovation continues to mature and approaches operationalization, needs shift and the firm will seek to align with companies that can offer this knowledge and associated resources, which may be larger firms, already in the market (Christensen et al, 2005, p1535). As the product of the innovation becomes ready for market, this

can shift again towards acquisition as the originating firm seeks to recoup their investment and avoid the costs of competing with larger firms.

The fourth factor is the size of the firm. This has been discussed in previous sections; both in terms of the resources SME's can offer (deep knowledge) vs the resources of as large firm (multi-disciplinary and financial). SME's also tend to come with less risk of competition with the originating firm, preferring to stay within their core competency (Lee et al, 2010, p291) and derive pure business value from the relationship vs large firms who might either seek acquisition or a competitive position (Parida et al, 2012, p289). Larger firms also can add potential complexities around culture and processes, where changes are required to form alliances, yet this type of change can be costly, both financially and in terms of time (Mortara and Minshall, 2011, p586-587).

The last factor to be studied is the level of openness as defined by Lazzarotti and Manzini (2009). The authors defined a framework that measures the level of openness of an innovation strategy in terms of two variables:

- 1. Partner Variety The number of partners with which the company collaborates
- 2. Innovation Funnel Openness The number / type of phases that the company opens to external contributions

Based on the spectrum of values for these two variables the authors identify four degrees of openness (Lazzarotti and Manzini, 2009, p623):

- · Closed Innovator Low partner variety and low number of open phases
- Open Innovator High partner variety and high number of open phases
- Specialized Innovator High partner variety and low number of phases
- Integrated Innovator Low partner variety and high number of phases

The authors tested this framework with 52 companies, and the results identified key characteristics firms would need to build into their strategy to pursue that level of openness (Lazzarotti and Manzini, 2009, p625). This in turn in forms the appropriate governance model. Some key findings of their study were:

- Closed innovators limit their risk and cost across most areas but also will be limited in terms of the types of innovations they can take advantage of, and thus the associated business value.
- 2. Open innovators maximize the exploitation of external opportunities but must dedicate large quantities of resources to the management of this channel.

 Specialized and Integrated models allow for exploitations of certain opportunities but limit the resource requirements.

### Table 3

Open	Main	Level of	Technical	Commercial	Creativity	Innovation	Organizational	Risk of	Level of	Managerial
Innovation	External	Internalization	Risk	Risk	and Risk	Emphasis	and	Spillover	Managerial	Style
Model	Success				Sharing		Managerial		Competence	
	Factors				0		Complexity		1	
							and			
							Transaction			
							Costs			
0.0.0.0	Tashualasiaal	High	High	High	High	Dadiaal	Useb	High	High	Highler
Open	Technological	пign	пign	підп	пign	Radical	нign	нıgn	підп	Highly
Innovators	Leadership									Participative
	Technological	Medium-High	Medium-	Medium-	Medium-	Incremental	Medium-High	Medium-	High	Participative
Specialized	excellence,		High	High	High			High		
Collaborators	Service, Time,									
	+ others									
Integrated	Quality.	Medium-Low	Medium-	Medium-	Medium-	Incremental	Medium-Low	Medium-	Medium-	Mainly top-
Collaborators	service time		Low	Low	Low			Low	Low	down
Collaborators	brand +		LOW	LOW	LOW			LOW	LOW	uown
	othere									
	others									
Closed	Quality,	Medium-Low	Medium-	Medium-	Medium-	Incremental	Medium-Low	Medium-	Medium-	Mainly top-
Innovators	service, time,		Low	Low	Low			Low	High	down
	brand,									
	technological									
	excellence +									
	othore									
	Uniers				1					

Modes of Open Innovation (Source: Lazzarotti and Mancini, 2009, page 633)

The table above allows companies to match their current situation and desired investment to choose the openness level they wish to implement. This will in turn beget the Managerial Style required to maintain this level of openness and tie back to the model of open innovation pursued.

### Learning Culture and Ability

Jasimuddina and Naqshbandi (2019) studied SME's in France and their findings showed that absorptive capacity is characterized by a high-level learning orientation and can enable an organization to acquire new external knowledge (Jasmuddina and Naqshbandi, 2019, p902). This shows that the culture and ability for an organization to learn is critical for an organization to absorb external knowledge.

#### Horizontal Sharing Culture versus Hierarchical

In their work, Naqshbandi and Kamel (2017) found that firms with an integrative organizational culture are more able to develop capabilities to exploit external knowledge and utilize external open innovation (Naqshbandi and Kamel, 2017, p15). Further their study found that firms with a hierarchical culture that focused on control, stability and uncertainty avoidance would limit their ability to diffuse knowledge and therefore inhibit their ability to take advantage of external open innovation (Naqshbandi and Kamel, 2017, p16).

#### Number of Employees and Annual Revenue

In their work Wang et al (2019) identified that absorptive capacity was a mediating factor for innovation performance (Wang et al, 2019, p13). The authors were also surprised to find that their views on the significance of firm size, number of employees and annual revenue were not significant to the relationship of absorptive capacity to innovation performance. The authors did feel that this might be due to the scope of the study being focused on business data analytics and its transformation allowing for new firms to achieve success (Wang et al, 2019, p13). This creates the potential to re-examine these relationships in our study.

#### Summary of the Factors that influence Absorptive Capacity

Based on the literature we can see the following factors influence absorptive capacity:

## Table 4

Absorptive Capacity Component	Variable	Values
Search for Knowledge	Breadth	Technology Scouting
		Technology Sourcing
	Depth	Vertical
		Horizontal
Acquisition of Knowledge	Strategies	Open Source
		Licensing
		Hire for Knowledge
		Client Idea
		Company Acquisition
Knowledge Sharing	Strategies	Learn by Doing
		Formal Training / Meetings
Knowledge Exploitation	Type of	Radical
	Innovation	Incremental
	Product Strategy	Product centric
		Custom Development
Company Data	Firm Size	Number of Employees
	Revenue	\$\$\$ or relative
	Organization	Horizontal Sharing
	_	Hierarchical Sharing

Factors influencing absorptive capacity (Source: Author)

Based on the literature we can see that the factors influencing absorptive capacity are aligned to

the elements of the definition of absorptive capacity.

- First, we have the search component, where we see that the breadth and depth of the searches are key factors.
- The next element is acquisition of knowledge, where the firms have options for how to acquire knowledge, licensing solutions, hiring for knowledge, getting ideas from clients, Open Source solutions, Hiring for knowledge or Company acquisition.
- The third element is how the knowledge is shared within the firm, Learn by doing or Formal sharing or training.
- The fourth element is how the knowledge is exploited. This is based on two variables; the type of innovation being performed at the firm (Radical vs Incremental) and the product strategy (Selling products vs custom development).

• The last element is company factors, looking at firm size, organization type (horizontal or sharing vs hierarchical) and revenue.

These factors will form the variables we gather during our study, allowing us to analyze the factors that match up with the firm's ability to drive innovation performance in their external open innovation strategies.

## Key Themes from the Existing Literature

In looking at the literature we reviewed on External Open Innovation and Absorptive Capacity there is a definite pattern in the research that was done. Early research focused on defining the concepts of Open Innovation and Absorptive Capacity and the factors that defined each. The table below shows a list of these works:

# Table 5

# Summary of Literature Review (Source: Author)

Author	Title	Date	Contribution
Alma Orucevic- Alagic and Martin Host	Two-Phase Case Study on Implementation of Open Source Development Practices	2008	Need to define a strategy to bring knowledge back in house to make the innovation part of the product strategy
Init Parida et al	Inbound Open Innovation Activities in High Tech SME's	2012	Defined difference between Radical and Incremental Innovation, 4 ways to pursue external open innovations and size differentiation.
Veryzer	Discontinuous Innovation and the New Product Development Process	1998	Innovation types differentiated based on technological uncertainty, development time and development process complexity
Cohen and Levinthal	Absorptive Capacity: A New Perspective on Learning and Innovation	1990	Seminal work on the topic of Absorptive Capacity
Bessant, von Stamm, Moeslein and Neyer	Backing Outsiders: Selection Criteria for Discontinuous Innovation	2010	Discontinuous or Radical innovation requires external partners to avoid trying to fit the new idea into their existing views and models.
Anand and Khanna	Do Firms Learn to Create Value – The Case of Alliances	2000	Joint ventures are an area where openness and knowledge sharing can enhance value
Christensen, Olesen and Kjaer	The Industrial Dynamics of Open Innovation – Evidence from the Transformation of Consumer Electronics	2005	Defined strategic models for engaging in external open innovation. Level of maturity of the innovation is a driver for the choice.
Van der Vrande et al	Choosing Governance Modes for External Sourcing	2006	Level of uncertainty is a key factor in choosing the right model of engagement
Lazzarotti and Mancini	Different Models of Open Innovation: A Theoretical Framework and an Empirical Study	2009	Degree of openness of the firm is a driver for the choice of engagement model for open innovation
Ahuja	The Duality of Collaboration: Inducements and Opportunities in the Formation of Interfirm Linkages	2000	Resource availability is a key driver in the choice of a model for innovation
Mortara and Minshall	How do Large Multinational Companies Implement Open Innovation	2011	Showed that large firms utilized open innovation to absorb firms and drive radical innovations
Holle, Elasser, Schumaker, Lindemann	How to Motivate External Open Innovation-Partners: Identifying Suitable Measures	2016	Motivation of partners in external open innovation arrangements
Ince et al	The Effect of Technological Innovation Capabilities and Absorptive Capacity on Firm Innovativeness: A Conceptual Framework	2017	Value of absorptive capacity to the firm in making knowledge useful, defining opportunities to go to market, develop a leading position and develop new capabilities

Table continued on next page

Author	Title	Date	Contribution
Laursen and Salter	Open for Innovation: The Role of Openness in Explaining Innovation Performance Among UK Manufacturing Firms	2006	Defined measurements for Breadth and Depth
Zahra and George	Absorptive Capacity: A Review, Reconceptualization and Extension	2002	Defined the 3 stages of absorptive capacity and the concept of potential vs realized absorptive capacity. Also defined absorptive capacity as cumulative.
West and Bogers	Leveraging External Sources of Innovation: A Review of Research on Open Innovation	2014	Broke down Absorptive capacity inti Acquisition, Assimilation and Commercialization or exploitation
Chiang and Hung	Exploring open search strategies and perceived innovation performance from the perspective of inter- organizational knowledge flows	2010	Showed a correlation between breadth and depth and radical vs incremental innovation
Ferreras, Newell, Ernandez-Mesa and Alegre	Depth and Breadth of External Knowledge Search and Performance: The Mediating Role of Absorptive Capacity,	2015	Defined the different modes of learning

More contemporary research, from 2015 to 2019 focused on the interrelationship between External Open Innovation, Absorptive Capacity and Innovation Performance. This work studied various industries and worked on various hypothesis related to showing how Absorptive Capacity takes Open Innovation and makes it more efficient:

# Table 6

Author	Title	Date	Contribution
Hossain and	Open Innovation in SME's: a systematic	2015	Need absorptive capacity to mitigate
Kauranen	literature review		IP issues
Flor, Cooper and	External knowledge search, absorptive	2018	Absorptive capacity search breadth
Oltra	capacity and radical innovation in high-		and depth fosters radical innovation,
	technology firms		as does developing processes to
			transform external knowledge.
Hyuk Jo and Park	Determinants of Technology	2017	Fostering network relationships and
	Commercialization Performance of		shared goals helps exploit external
	Technology-based SME's		knowledge to drive innovation.
Jasimuddina and	Knowledge infrastructure capability,	2019	High level learning orientation drives
Naqshbandi	absorptive capacity and inbound open		innovation.
	innovation		
Naqshbandi and	Intervening role of realized absorptive	2017	Integrative organizational culture
Kamel	capacity in organizational culture-open		helps firms utilize open innovation.
	innovation relationship		
Rangus et al	The role of open innovation and	2016	Direct relationship between open
	absorptive capacity in innovation		innovation, absorptive capacity and
	performance		innovation performance.
Gkypali et al	Absorptive capacity, exporting activities,	2018	Absorptive capacity mediates R&D
	innovation openness and innovation		collaborations and innovation
	performance: A SEM approach towards a		performance.
	unifying framework		
Song et al	Search of Precision in Absorptive	2018	Absorptive knowledge base of the
	Capacity Research: A Synthesis of the		firm and process are directly related
	Literature and Consolidations of		to innovation performance.
	Findings.		
Pereira and Leitao	Absorptive Capacity and Firms'	2018	Absorptive capacity strategies have
	Generation of Innovation: Revisiting		positive effects on innovation.
	Zahra and George's Model		
Wang et al	Harnessing Business Analytics Value	2019	Networks and relationships play a
	Through Organizational Absorptive		role in the use of this knowledge to
	Capacity		drive innovation performance.
Deepak and	Absorptive Capacity, and Degree of	2017	Absorptive capacity mediates
Subrahmanya	Intra-Cluster and Extra-Cluster Linkages:		innovation performance
	A Study of Bengaluru High-Tech		
	Manufacturing Cluster		

Recent studies into Absorptive Capacity and Open Innovation (Source: Author)

It's also important to note that many of these recent works extensively cite the earlier works as key

to their body of knowledge.

#### Summary of the Literature Review

Our focus for the literature review was to explore the key concepts from our first 3 research questions in general terms, independent of firm size and industry. We will use these general concepts in the pursuit of our study of small and medium Canadian software companies.

#### Does external open innovation create opportunities to increase their competitiveness

As noted during the research there are potential benefits available to firms that can successfully implement External Open Innovation. Some key benefits are:

- 1. Growth and revenue potential from the increased innovation opportunities that come from outside sources (Chesbrough and Crowther, p229, 2006).
- Increased customer satisfaction and acquisition of new knowledge (Parida et al, 2012, p289).
- Increased productivity for R&D as External Open Innovation enables R&D to get a head start on new innovations (Gronlund et al, 2010, p106).
- Enhanced client retention and client value by engaging clients in the innovation process (Dyer and Singh, 1998).
- 5. Extends the breadth of resources that organizations can engage in their innovation process (Dodgson et al, 2006, p337).

Parida et al assessed that these benefits create a particular opportunity for Small and Medium companies to benefit, as they are uniquely positioned to take advantage of these benefits (Parida et al, 2012, p289). These firms, in particular smaller ones, would benefit greatly from the extension of their innovation process to external partners, giving them the type of breadth that larger firms

access due to their larger resource budgets. Smaller firms also stand to benefit from enhanced client retention and value, as their ability to keep their clients long term enhances their ability to stay competitive and not lose revenue to larger firms. Lastly smaller firms benefit from the increased R&D productivity, enabling them to stretch their limited R&D budgets further and potentially approach their larger competitors in terms of the innovation opportunities created. Based on these factors, in our study we will seek to confirm that External Open Innovation has the potential to significantly enhance the competitiveness of small and medium Canadian software firms.

#### What is absorptive capacity and what role does it play in external open innovation?

As discussed in the review of literature, there have been many views of the definition of absorptive capacity. The seminal work on the topic, by Cohen and Levinthal stated that Absorptive Capacity is defined as the "ability of a firm to recognize the value of new, external information, assimilate it and apply it to commercial ends" (Cohen and Levinthal, 1990, p128).

Further work broke this definition down into 3 key components when taking into account Open Innovation (Minshall et al, 2016, Smit, Abreu and DeGroot, 2010):

- 1. The search for open innovation opportunities
- 2. The ability to bring the relevant external knowledge into the innovation process (Lichtenthaler et al 2009)
- 3. Commercialization or introduction of the innovations to the market

Others have expanded on this to add the interrelations between firms as a fourth component (Vanhaverbeke, Varseka and Van de Vrande, 2007). Based on this we will define Absorptive Capacity as having four dimensions:

1. Recognizing value of external new knowledge
- 2. Assimilation of the knowledge
- 3. Application of the knowledge to provide solutions
- 4. Linkage of this application to the company's network of clients and solution providers

Based on this work absorptive capacity allows firms to identify External Open Innovation opportunities, bring the knowledge related to the opportunity in house, apply the knowledge to their products or services and convey this knowledge to their clients and partners. This allows the firm absorbing the knowledge to maximize the gains noted from the outside knowledge based on the following:

- 1. The search for knowledge casts a wide net to find optimal opportunities for innovation.
- 2. The method of bringing in the knowledge has the potential to maximize the opportunity to use this knowledge, based on how well it is understood and integrated, and at the same time limit the costs of acquiring and bringing in this knowledge, which maximizes profitability from the innovation.
- 3. Application of the knowledge has a direct influence on the revenue potential of the opportunity, effectively building the knowledge into the firms' products and services will ensure that it is positioned to drive revenue from existing clients and new prospects. In particular the integration of clients into the process enhances the potential of these clients staying with the firm longer and growing their relationship with the firm, and with-it revenue.

Based on these factors, more effective absorptive capacity has the potential to directly drive the efficiency of the External Open Innovation strategy and with it enhance the performance of our small and medium Canadian software firms.

#### What are the factors that influence the effectiveness of absorptive capacity?

Based on studies completed in the area of absorptive capacity the table below shows the factors that have been documented to impact the absorptive capacity of the organization:

# Table 7

Area	Variable	Relevance	Source
Innovation	Innovation Type	The different types of innovation lead to	Parida et al, 2012
		different levels of investment and perceived	
		gains from the innovation.	
Absorptive	Breadth of	The size of the net cast to find the knowledge	Laursen and
Capacity	External Search	will speak to the types of knowledge it is able	Salter, 2006
Search		to find and take advantage of.	
Absorptive	Depth of	The types of searches undertaken, sourcing	Laursen and
Capacity	External Search	knowledge vs sourcing partially completed or	Salter, 2006
Search		fully completed innovations will speak to the	
		cost of integration and the ability to	
		internalize the knowledge.	
Absorptive	Absorptive	The strategy used to bring the knowledge or	Christensen et al,
Capacity	Capacity	innovation into the firm will drive the	2010
Acquire	Knowledge	effectiveness and cost of bringing these	
	Acquisition	innovations in house.	
	Strategy		
Absorptive	Horizontal vs	The definition of how knowledge flows	Schultz 2001
capacity	vertical outflows	within the organization speaks to the	
Knowledge		effectiveness and cost of this knowledge	
Sharing		sharing.	
Absorptive	Value Creation	How does the firm realize benefit from the	West and Bogers,
Capacity		innovation – from revenue enhancement or	2010
Exploitation		via cost reductions.	

Table of Variables studied with relevance to the research questions (Source: Author)

Based on this our study is defined to measure the strategies that small and medium Canadian software firms use to absorb outside knowledge and thereby how effective an External Open Innovation strategy could be for the firm, enhancing their ability to compete with larger firms.

# Research Gap for our Study

The available literature is able to define Absorptive Capacity concisely, and also identifies potential strategies and variables that can be used to influence absorptive capacity. Some of the literature identified the gap that we will attempt to fill, which was termed by Song et al as the ambiguity problem, which they said was rooted in confusion over the meaning and nature of

absorptive capacity (Song et al, 2018, p2369). Pereira and Leitao also identified a similar need, for additional research on the firm level characteristics that drive absorptive capacity (Pereira and Leitao, 2018, p11). Lastly, Wang et all identified an opportunity on that there should be a significance of firm size and number of employees on the relationship between absorptive capacity and innovation performance (Wang et al, 2019, p13). These opportunities from recent literature form the basis of the gap we will seek to fill with out study. Taking these gaps and applying them to our intent to study small and medium Canadian software firms, we identify the following targeted gaps for our study to fill.

First, in order to help small and medium software companies enhance their competitiveness we will need to become more granular and identify the strategies that best fit different company scenarios or see if there is a one size fits all scenario. Small and medium software companies in Canada offer a wide variety of products and services, company sizes and organizations. Which absorptive capacity strategies are most likely to lead to success in which mix of company size, products and services offered and organization type will help to identify which paths these firms can take to identify opportunities to enhance their success and competitiveness in their market? This will be measured through interviewing firms of different size and type, and examining which strategies were successful for the different categorizations of company.

Second, we need to assess interrelationships between the different elements. This means understanding if there are matches of elements that lead to success, do companies that practice Technology Sourcing lean more towards one strategy for knowledge sharing versus another. This will be assessed by looking at interview responses across the three facets of the definition of absorptive capacity:

• How searches are done – mixes of breadth and depth

- How knowledge is brought in hiring versus licensing
- How knowledge is shared formal training versus collaboration

This will allow us to focus our learnings to understand mixes of strategies from these three areas of absorptive capacity and identify those mixes that lead to innovation performance.

#### **Chapter 3. Research Model and Study Execution**

Based on the research gap identified during the literature review and the questions we are seeking to answer from our research, the following sections will first define our study, and then discuss how the study was executed to gather the primary data.

In defining the model, we will take the concepts reviewed in the literature review and define from the variables we will study during the primary research. This will then lead to the definition of the research methodology that will be used to gather the primary data including the research methodology, the participants we will seek to study and the format for the study. Once this has been confirmed, we will then discuss the execution of the study, including how the study was executed, how participants were secured and how the data was gathered. We will conclude this section with a description of how that data gathered was coded to feed into the data analysis in the following chapter.

#### **Breaking Down the Study**

From the review of the literature we have identified the research gap we are seeking to fill is understanding the factors that drive absorptive capacity for small and medium Canadian software firms and enables these firms to successfully utilize open innovation to drive innovation performance and firm success. To fill this gap, we will engage with Canadian small and medium software firms to understand their firm characteristics, their innovation practices and the strategies they use to search for and absorb external knowledge. In order to achieve this result, we need to define the variables, we will seek to study, the method of data gathering we will utilize, how we will select firms to study and how the study will be conducted.

## **Selection of Variables**

Based on the review of the literature, we have identified variables to gather the data necessary to answer our primary research question. These variables can be divided into 3 types:

- 1. Categorization variables
- 2. Innovation Related Variables
- 3. Absorptive Capacity Factors

#### **Categorization Variables**

In order to study the data gathered from our study of Canadian small and medium software firms, it is necessary to be able to categorize the firms. To achieve this, we will utilize the following variables to categorize the responses.

**Firm size** – this allows us to capture potential nuances in variable relationships between small enterprises vs medium ones. This was utilized by Wang et al in their study, and while they did not find a relationship, the authors felt this was likely due to their study being focused on business analytics (Wang et al, 2019, p13).

**Firm age** – this variable takes into account variability in new firm's vs more established ones. Firm age speaks both to potential maturity of products and services, and the firm's processes. It also speaks to relative success based on the ability of the firm to sustain in the face of competition. **Innovation Type** – this is a key variable in managing the level of required knowledge sharing, acquisition cost and the potential output. Radical innovations, as defined by Parida et al are likely to be in areas where the acquiring firm has less inherent knowledge, therefore raising the complexity of the knowledge acquisition and assimilation. In contrast, incremental innovations by their nature build on things the firm is already acquainted with (Parida et al, 2012).

**Primary Product or Service** – this variable is specific to the software industry and categorizes firms based on whether they market off the shelf products, or custom development services as this distinction drives the innovation process and the types of knowledge a firm may source.

#### **Innovation Related Variables**

From the literature we reviewed on open innovation we have identified the 3 variables below for our study as key to defining the relationship between open innovation, absorptive capacity and innovation performance.

**Organization Type** – this speaks to the orientation of internal R&D in the organization – whether it is centralized in an incubator model vs decentralized into existing subunits. This variable speaks to potential complexity in the absorption of knowledge ((Dahlander and Gann, 2010, Huizingh, 2011).

**R&D Intensity** – this measure allows for differentiation in exploitation based on the % of the company that works on R&D, (*Zahra* and George, 2002)

**Degree of Openness** – this control speaks to the level to which the organization is opening its innovation lifecycle and speaks to the limits on knowledge acquisition – whether they are open to only new ideas vs almost fully developed products (Matusik and Heeley, 2005)

#### Absorptive Capacity Factors

Based on the definition of absorptive capacity from our research we can define variables for each of the elements of the definition, searching for knowledge, absorbing the knowledge, exploiting the knowledge and sharing the knowledge within the firm's network. Based on this we have defined the variables below to capture the factors that lead to enhancing absorptive capacity: **Pursuit Strategy** – this sets bounds around potential searches and partnerships, limiting both depth (Technology Scouting vs Technology Sourcing) and breadth (vertical partners vs horizontal). This

will feed into setting the universe for the searches that will be used to identify potential knowledge to be assessed (Parida et al, 2012).

**Breadth and Depth** – these are based on the previously discussed measurements by Laursen and Salter and are key to identifying the knowledge opportunities to be pursued for acquisition (Laursen and Salter, 2006).

Acquisition Strategy – this variable speaks to the strategy to be taken to acquire the knowledge and will speak to the ability to take in the knowledge (Christensen et al, 2010)

**Horizontal and Vertical Outflows** – This variable measures the knowledge flow between organizational units and between a unit and its leadership respectively. It is measured as the percentage of the total communication of all types across the channel and is based on the work of Schultz (Schultz 2001).

**Value Creation and Value Capture** are based on the measures outlined earlier from West and Bogers (2010), as representative of a trend to increasing absorptive capacity.

During our study we will seek to gather information from our participants which will feed into these variables and enable our data coding and analysis phases to allow us to define responses to our research questions and ultimately deliver the benefits of our study.

#### **Research Philosophy**

Given the gap we are filling is a lack of extensive study in the small and medium enterprise space, our epistemology for the study is Interpretivism. The goal is to contribute to building theory around how this segment can increase absorptive capacity based on a study of real companies built through interviews. The goal is to take these samples, study the details and draw conclusions that can be extrapolated to the broader community of Canadian software companies.

# **Overall Research Strategy**

Based on the gap identified in the literature review, the goal of the study is to interview small and medium Canadian software firms that are sourcing external ideas and innovations as part of their innovation strategy. These firms will vary in size up to 250 employees, sell both defined software products and custom development services and be firms that vary in the years that they have been in business. This variability in age, product mix and size should allow us to be able to generalize our results across the small and medium software firms across the sector in Canada.

# Target List of Companies

The target of our study was to utilize existing lists of Canadian software companies to build a universe of the companies for our study. For this purpose, we used the Info Canada listing, focusing on companies sized from 1- 250 employees, that offer their clients:

- Existing software products
- Custom software development firms
- Companies offering combined hardware and software solutions

In order to eliminate geographic, market and cultural factors from the result we will limit the target set of companies to those that operate legal entities in Canada and make their product and technology decisions in Canada.

Based on this, Statistics Canada has said there are over 35,500 companies operating in this sector (Statistics Canada, 2018, p3). However, given our target is small and medium Canadian owned software firms, our sampling must take into account the availability of data on company

size, Canadian ownership availability of contact information. In order to meet these information needs we focused on using a third party company list from Info Canada. A search of available data in the Info Canada list yielded approximately 3000 firms who fit our criteria on number of employees, Canadian ownership and available contact information.

#### Selection of Firms to Target

The primary criteria for selecting firms to study will be the degree of openness of the firm to external knowledge during their innovation process, and to discuss its innovation process in an interview. This is key as it will identify firms that will discuss innovations they have completed and how they completed this work. It also makes gaining buy in of the firm's leadership and participants easier to achieve as they are already well acquainted with the potential gains of participating and have already bypassed may of the hurdles on confidentiality.

Our targets will be Canadian software development firms that are small businesses (who are named as not being studied), and medium enterprises. We will focus on companies that have implemented open innovation and used it to take in external innovations. Initially the firms will be asked if they have implemented open innovation, executed projects to bring in external innovations and absorbed the knowledge. Respondents will be asked if they would be willing to be part of a detailed interview process and share details of their initiative and how they absorbed the knowledge. Qualified targets will then be interviewed as to project details to allow for the strategies they followed to bring the knowledge in house.

### The Qualitative Study

In order to gather data for our detailed analysis, the next step is to do detailed analysis on scenarios with firms of each size to learn more details on their Open Innovation initiatives and

their responses related to our research questions. Once firms are identified and have consented to be part of the study the method used to gather the data for the narrative will be the Interview. Using the work of Vogt, Gardner and Haeffele (2012) as a guide the interview was selected for the following reasons:

- 1. The research is looking at past events, not trying to look at future events as either an observer or influencer, eliminating observer, participant and experimental research.
- 2. We are attempting to understand relationships between different research areas, between Open Innovation, Motivation and Absorptive Capacity. Therefore, we need more detailed questioning and the ability to adapt, eliminating the survey.

Next we need to define the type of interview. The interviews will be done to define a relationship between the variables. Given this shift in interview purpose, our interviews will follow the Grounded Theory approach. The authors state that this approach allows for interview design to vary between confirmatory and the descriptive, allowing our research questions to be answered and verified as part of the interview process. As there are multiple actors involved in the narratives, we are seeking to define interviews will be done individually to ensure all perspectives are heard. A large part of the interviews will be studying not just the responses but also factoring in the context of the responder, as the parties in the innovation team will come from different contexts and these contexts and interaction points between responders will weave together into a complete narrative.

### Interview Areas

The research questions are different faces on understanding a firm's approach to successfully implementing Open Innovation and how organizations have been successful or

unsuccessful in implementing Open Innovation strategies to bring outside ideas into their firms and integrate the knowledge so it could be exploited as future innovations. With this in mind we will interview the selected firms in the following areas:

- 1. Knowledge identification how does the company search for potential knowledge to integrate this answers the questions around Breadth and Depth of the searches
- How does the firm acquire knowledge this speaks to the acquisition strategy, public knowledge from scouting, licensing, open source or hiring for knowledge.
- 3. How is knowledge shared within the organization does the firm share via collaboration technologies, formal training or push based sharing vertically from leadership.
- How open is the firm's innovation process throughout the cycle or through only certain phases
- 5. How many people work in internal R&D this is defined as the number of people at the firm performing R&D functions. Where the organization is a subsidiary of a larger parent we will focus only on the R&D and innovation done within the subsidiary.

#### Interview Structure and Questions

Now that we have defined the method, we turn to interview structure. Again, based on Vogt, Gardner and Haeffele (2012), there are multiple ways to construct the interview based on the structure of the question. Given the need to gather knowledge through probing for innovation and knowledge absorption, the most appropriate method would be to structure the interview to progressively elaborate on the structure of the questions. The interview design would be mixed, with a framework based on:

- Section 1 structured section questions on processes:
  - How does the firm search for external knowledge questions to be based on the measures of breadth and depth
  - Describe the typical process of bringing in this knowledge and using it to create innovations
  - o Does the firm use external knowledge more for radical or incremental innovations?
  - What strategies does the firm employee to acquire knowledge informal, formal partnerships, purchase of rights or IP, Purchase of the originating firm
  - How is knowledge shared within the organization what mediums are used and how much of the firm's communication is for the purpose of knowledge sharing
- Section 2 More in-depth questions to drill into particular examples of past external knowledge areas that were internalized, the resulting innovations and the value created / captured questions will gather specific detailed answers for section 1 questions. It will start with an example and then probe into how the external knowledge was found, how it was assimilated, how knowledge was shared and how the knowledge was exploited.
- Section 3 Answers to control questions
  - Size of the firm
  - Age of the firm
  - Degree of openness

- o R&D intensity
- o Organizational handling of R&D

# Interviewees

Given these are small and medium software firms, the focus will be on interviewing company leadership at the highest levels. The goal will be to interview the leader most directly responsible for innovation decisions and development. In our small to medium firms this will typically be the President or Owner of the firm. For medium sized firms on the larger side this can also be the Leader of the Technology or R&D function.

# Interview Method and Setting

There are a wide variety of methods available to conduct the interviews, for the purposes of selection I am focusing on 3 types:

- Telephone based
- Video based
- In Person

Given the target is small and medium business in the high tech – software sector we are confident that telephone based, or video-based interviews will be possible, however are prepared for face to face if required.

#### Interview Plan

Based on the Grounded Theory approach and the fact that some level of reconciliation and follow-up should be planned as we are likely looking at 2-4 calls per firm to complete the interview

and allow for an initial call and a follow up. The initial call will gather the bulk of the data, with a follow-up call to be held once the data is being analyzed.

When setting up the calls, the Informed Consent will be shared and assumed to be agreed when the call occurs. Call durations are expected to be as follows:

- Call 1 Define the narrative 30 to 45 min
- Call 2 Follow-up and clarifications 15-30 min

In addition to the interviews and discussion, the first call will include details on the ethical considerations, how identities will be kept confidential, how data will be stored, how company and product names would be obfuscated in the final paper and who will have access to raw data. On each call there will be a brief reminder of these key ethical points and on the final call as a wrap up we will review how the results will be portrayed in the final presentation.

#### **Interview Sampling**

Given the number of small and medium software firms in Canada, our target is to interview 50-65 firms. This sampling will be derived from the Info Canada companies list (a third-party list provider), which has company and contact information for over 3000 companies that fit our criteria for small and medium Canadian software businesses. These firms will be contacted to solicit participation of those practicing external open innovation. Companies were contacted and selected based on willingness to participate in the interview, agreement to the Informed Consent and willingness to share information on their innovation process.

# **Recruiting Firms and Engaging Interview Subjects**

Given the list of roles required, the recruiting strategy will need some level of top down influence to ensure participation of all parties. This will require a presentation to company

leadership / marketing of the value of the research to the industry and to the firm itself. Key to this will be definition of two aspects:

- 1. How company identity and data will be protected
- 2. How the company will benefit from the final product

The benefits will not be incentive based but more in form of marketing / publicity advantages as well as positioning in the industry as a leader in the field of open innovation which can help to motivate future innovations and allow the firm to expand their network.

The potential to recruit firm leaders to participate also needs to be a key consideration in choosing participant firms, for example highly secretive companies such as Apple are not viable targets, while companies that are more open and community based are more likely targets.

Once the firm is on board, recruiting participants will be achieved through both top down messaging and individual email and phone conversations to dispel any fears on confidentiality for the individual participants. Interview participants will be sent the Informed Consent document and asked to only participate in the study if they agree to the study terms.

#### **Data Coding and Analysis Models**

This section lays out the conceptual design of our data coding and analysis processes that we will execute once our interviews have been completed. Data coding and analysis of the interview responses from our targeted firms will be the key to proving out our research questions and filling the research gap we have defined. By understanding the combination of how firms pursue their open innovation strategies and how they maximize their absorptive capacity factors we will be able to confirm the relationship between these two components and innovation performance.

## Data Coding

Based on the variables described in section 3.2 above, we will code the interview responses manually to the appropriate variable. This will be done by encoding the interview data into an excel sheet with a column per interview question and associated variable. Some interpretation will be done by the researcher on the responses and examples that are part of a discussion. Once the responses are encoded to the appropriate variables, we will then be able to tabulate results for our analysis.

As we examine the interview questions, two new categorization variables are introduced, Number of Offices and Number of Concurrent Projects. Number of Offices was introduced to understand the complexity of knowledge sharing, with the idea that a large number of locations would require a more complex sharing strategy. Number of Concurrent Projects was added to understand the amount of innovation activity the firm was engaged in.

The coding will also break down the factors of absorptive capacity into individual variables:

- Absorption of Knowledge Strategy was broken down into individual strategies: Hiring for knowledge, Licensing and Client ideas
- Sharing of Knowledge was broken down into: Collaboration tools, Formal Training, Learn by doing, Collocation and Sharing vertically or horizontally

In addition to encoding these responses for analysis we will also retain comments related to these variables from the interviews for potential use in the analysis of results.

## Data Analysis

Data analysis will be performed by categorizing the data according to the variables and then look for themes or patterns in the data to match particular absorptive capacity factors and values to mixes of innovation variables. This will be performed manually, by using the categorization variables (Company Size, Years in Business, Type of Product, Number of Locations) to group responses and then counting the responses for Breadth and Depth of Search, Absorptive Capacity Acquisition Strategies (Client Ideas, Licensing, Hire for Knowledge), Knowledge Sharing Strategies (Learn by Doing, Formal Training, Collocation, Collaboration Tools). This will allow us to see if there is a pattern in the absorptive capacity factors that is prevalent in each category. This will allow us to ascertain which absorptive capacity factors mix best with which innovation strategies to lead to success. Based on this identification of mixes and strategies we will then be positioned to answer our research questions and recommend scenarios under which certain types of firms will be able to make use of the appropriate absorptive capacity factors to maximize their success.

#### **Summary of Research Model**

- The goal is to interview 50-65 Canadian small and medium software firms that utilize external knowledge and innovations in the development of their products and services
- Interviews will be done with company leadership
- Interviews will gather data on:
  - Company definition number of employees, years in business and products or services sold

- Innovation Organization and Process how does the company innovate, and how open is their process to external knowledge and innovations
- How do they search for the external knowledge this addresses breadth and depth of the searches
- How do they internalize the knowledge or innovations licensing, hire for knowledge, absorb and design based on the knowledge
- How do they share the information within their company formal training, collaboration tools or collocation
- Do they see this process as leading to successful innovations value creation

Based on gathering this information from the interviews we will then categorize the data based on:

- Company size
- Years in Business
- Product Suite selling products or custom development
- Type of Innovation radical or incremental

We will then analyze the data from these variables and seek to answer the research questions and look at relationships between different types of companies and their absorptive capacity strategies, thereby filling the gap in the research.

### **Study Execution - Solicitation of Participants**

Ethics approval for the study was secured in late 2018, and the target was to interview 50-65 Small and Medium Canadian Software Companies. The original target was to use a

Government of Canada database of Canadian businesses; however, the government discontinued this system in late 2018 / early 2019. This required a modification in approach.

In early 2019 the approach was refined to include the sending of an email inviting participation in the study, along with a web address for a website explaining the study, its purpose and benefits and asking prospective participants to take a qualification survey to confirm they met the criteria for participation (as per section 5.6.1). To facilitate this approach the following was completed:

- 1. Access to the Canada Companies list was purchased from Info Canada to provide contact details for Canadian Software companies.
- A website was built to explain the study, its benefits and confirm consent via the Informed Consent document.
- 3. A survey was built on Survey Monkey was built to do the qualification survey

This approach required a refinement to the ethics application and was approved in early 2019. Due to Canadian Anti-Spam legislation which prevented the companies list from including email addresses, this approach required email addresses to be pulled from the company's websites. Over the period from March to May, using the Info Canada companies list over 2,000 invitations were sent (based on how many the researcher was able to manually send) to companies, but less than 20 responses were received and only a handful of qualified participants being interviewed. This identified that email invitation was not a workable solution, requiring a second change in approach, to execute calls to qualify and book appointments using a marketing firm. Based on this the Ethics Approval was revised again and approved in June of 2019. Based on this the task of scheduling appointments was outsourced to a cold calling firm who was tasked with calling prospects from the list, explaining the study and booking appointments with those who wished to

participate. The company confirmed company size, that they were a Canadian software company and that they were willing to participate. The final qualification and interview process were then combined into a single interview call, and prior to the call all participants were sent the Informed Consent document for the interview.

#### **Interview Participants and Process**

Interview participants were confirmed to be from one of the following 3 roles, based on company size:

- (a) Owner / operator of the company
- (b) President of the company
- (c) Leader of the Technology Function

Interviews were conducted by phone and ranged from 30 min to 1hr. Questions were based on the interview guide, as defined in section 3. All notes of the interviews were typed, retained, and filed based on participant numbers. The calls were not recorded, with this decision being made based on feedback from the first set of interviewees, who were not comfortable with being recorded. Interviewees were sent the informed consent document prior to the interview appointment and

were asked to confirm that they had read this document prior to the interview.

Interviews began with baseline questions on the number of employees at the company, the number in development functions, age of the firm, number of locations and number of projects that are executed concurrently. These variables were key to being able to categorize the data as the nature of surveying Small and Medium sized software companies would lead to a large variation in size and age. Further the number of people in development roles speaks to R&D Intensity, which will help shape the level and type of innovation taking place at the company.

The interview then began to focus in on gathering information on how innovation is done at the firm. This area was more discussion on innovation process and organization, using the questions as guidelines to gather the data and ensure all key information was documented. Key areas of discussion included:

- Source of external ideas and innovations
- When in the innovation process were external ideas and innovations input
- How were these external ideas and innovations found?
- How were these external innovations shared with the rest of the organization?

The responses in these areas was then used to feed the analysis of the variables required to respond to our key research questions.

Two key learnings during the interview process is many of the interviewees were wary to share two key elements:

- 1. Financial details of the innovation results
- 2. Examples of successful execution of the process

With respect to financial details, almost all of the respondents were private companies or corporations and as a result do not share financial information. In addition, the smaller companies did not track particular revenue details to specific innovations. Lastly, given the wide breadth of company sizes, R&D team size and number of concurrent initiatives there was little to no ability to compare financial performance of innovations at one company versus another. Thus, this track was eliminated from the interview process. Instead the interview focused on discussions of

innovations where the company felt the result was positive to eliminate the presence of data related to failures from the analysis.

Second, many of the companies felt that details of particular examples represented competitive advantage and were thus wary to share that without significant redaction and obfuscation, which would have eliminated the particular gains of quoting the example. Thus, this track was merged into the process discussion, seeking backup details or examples of the process at work versus specifically asking for an end to end example.

Overall 63 interviews were completed. 9 respondents have asked to be withdrawn since the Interview phases was completed, leaving 54 interviews for coding and analysis.

#### **Data Gathering and Coding**

Given the qualitative nature of our study, the key to success was based on the coding of the interview data into variables to be used for our analysis. Interview data was gathered in written notes by the researcher taken based on the Interview Plan that is included in Appendix C. The interview was conducted based on first gathering the categorization data, number of employees, R&D intensity, years in business for the firm, product strategy (product versus custom development), number of products in market, type of R&D organization and the number of concurrent projects. The second portion of the interview was narrative focused based on a discussion of the firm's innovation process. The discussion was guided by the questions in the interview plan (Appendix C) and included discussions on how the firm performs innovation, how it searches for and finds external knowledge, how this external knowledge is shared within the company and how this knowledge is used to generate products or services for clients, leading to revenue. In addition, during the interview, many interviewees also shared examples of particular

innovations where external knowledge was utilized that led to a positive result for the firm in the opinion of the interviewee.

The narratives were then reviewed by the researcher and mapped to the interview plan questions that aligned best to the narrative element. In case any questions in the plan lacked responses, the interviewee was sent a request for additional information via email and those responses were added to the interview responses. Each completed interview document was stored based on an assigned participant number, to protect the name of the firm and interviewee, as defined in the Informed Consent and the Ethics Approval.

Note that the innovation example was used as a test for the model communicated by the interviewee and was used to fill in any gaps in the process. In some cases, the two sections were combined as the interviewee preferred to discuss their process in terms of an example versus general terms. In a few cases the interviewee was willing to share their process but was not comfortable sharing a specific example.

Once all interviews had been completed, the mapped interview responses by each participant were transcribed to a single sheet of responses. This sheet was based on the variables defined in the study model and summarized in the table on the following page. This sheet was then used for the data analysis process. A second sheet was also prepared that tracked key commentary from the narratives, which will be used to back up the analysis of the data. A copy of this sheet is included in Appendix D.

# Table 8

Variable	Definition		
Number of Employees	Total number of full-time employees at the company		
R&D Intensity	% of employees working in Development / R&D		
Years in Business	Total number of years the company has existed in its current form		
Number of Locations	Number of office locations		
Innovation Organization	Is the innovation team centralized with one individual, a small team,		
	or decentralized across R&D		
Product Based or Custom	Is the company selling defined products or doing custom		
Development	development? If product based, how many products are offered		
Number of Concurrent Projects	How many concurrent R&D projects are running at any given time		
Source of External Ideas /	Where do the external ideas / innovations of the firm come from		
Innovations			
Breadth of Search	Is the search for innovation taking place vertically in the company's		
	existing vertical chain - from suppliers, partners or clients - or		
	horizontally across a wider universe		
Depth of Search	Is the search limited to free technology options (Technology		
	Scouting) or includes licensed options (Technology Sourcing)		
Degree of Openness	Are external innovations brought into the company at any stage of the		
	development process, or only at certain stages		
Type of Innovation	Is the innovation typically performed by the firm Incremental,		
	Radical or both		
Client Ideas	Do initial ideas for the innovation come from clients		
License Solutions	Does the firm license software or portions from other companies, or		
	use open source		
External Hire for Knowledge	Does the company hire for knowledge from outside sources		
Collaboration Tools	Does the firm use software tools for sharing knowledge across the		
	company		
Formal Training	Are there formal training mechanisms in place to share knowledge		
	about the innovation		
Learn by Doing	Does the company have processes and support to learn the external		
~ 11	innovation in the course of their regular work		
Collocation	Are all the R&D employees located in a single location		
Sharing Vertical vs Horizontal	Is the sharing of the external knowledge done vertically, learned and		
	pushed down from a single person or small group, or horizontally		
	across the organization at once		
Value Creation	Does the innovation lead to benefits in the form of increased revenue		
Value Capture	Does the innovation lead to lower costs		

*List of variables captured from the interview data (Source: Author)* 

#### **Data Analysis Process**

Data was then tabulated based on looking at different factors that influence absorptive capacity:

- Firm size
- Type of Innovation
- R&D Organization
- Product Strategy
- Years in Business

By reviewing the different strategies used by firms in these categories we were able to identify patterns in the absorptive capacity choices of the firms, and thus understand the best strategy for each different category. Where a significant number of firms within a category were using the same strategies, we would be able to deduce the best strategy. For example, an examination of Product firms would allow us to see if there was a prevalent type of search being done by these firms and identify an absorptive capacity best practice for small and medium Canadian software firms that have chosen to build and sell software products versus do custom development.

#### Identifying the Key Data Elements from the Study

Now, let us now confirm how the data gathered in the interviews will be applied to answer the research questions. The following questions / data points from the interviews pertain directly to the absorptive capacity strategies being utilized in the company:

- 1. Source of the External Idea / Innovation
- 2. How did the company search for external ideas / innovations?
- 3. Do the firm license solutions or use open source software?
- 4. Does the firm do formal training / meetings to share ideas

- 5. Does the firm use collaboration software to share knowledge among teams?
- 6. Does the firm hire for knowledge in the firm of employees or contractors?
- 7. Are the employees collocated or do they work in different locations?

From these responses to these questions we will be able to determine:

- The source of the external idea / innovation
- How the external innovation was found
- The strategy for capture of the information
- How the information on the external idea / innovation was shared within the company

This allows us to confirm the Search and Assimilation elements of the definition. As discussed in the execution section, the interviews centered on what the interviewee classified as a successful innovation strategy, thereby ensuring the knowledge application (element 3). The last element, the network component will be defined from the details around the sharing of the information.

The relationship between the strategies utilized and the absorptive capacity of the firm will then be determined from the ability of the organization to absorb the knowledge through sharing, either vertically or horizontally and the value created by the innovation, i.e. was the innovation successful for the firm in the long term. Note that value created was assessed based on the view of the interviewer and not measured in an absolute dollar amount or profitability measure due to the size differences of the firms studied.

#### Chapter 4. Presentation and Analysis of the Data

In this chapter we will review the encoded data from our interviews and show the results of the analysis of the data. This analysis will allow us to assess the factors that drove absorptive capacity for the different categories of firms that were studied, based on the categorization variables identified in Chapter 3. We will then examine the study findings based on the different elements of absorptive capacity and lastly review the key themes we see in the results, allowing us to deduce which absorptive capacity strategies were successful for which types of firms. This analysis will then be used to inform our summary and findings in Chapter 5 where we will review the findings against our research questions and the practical benefits we were seeking to deliver.

#### **Analysis Baseline**

Overall 54 Canadian Small and Medium Software businesses agreed to be interviewed and have their information be published in the study. These firms ranged in size from a single employee to 170 employees and had a wide range of company history from 1 to 38 years in business.

Prior to examining the particulars of the Absorptive Capacity strategy findings at these firms we will first examine the key input variables that can impact how a firm chooses to absorb knowledge. From the initial variable definition, the key input variables are:

- Size of the firm
- Age of the firm
- Products and Services Offered by the Firm
- Innovation Structure
- Type of Innovation

Each of these factors offers potential insight into how to analyze the absorptive capacity strategies.

# Size and Age of the Firms

The table below shows the breakdown of size and age of company:

## Table 9

Table of Interview Respondents by Company Size (Source: Author)

Number of Employees	Number of Firms	Average Years in
		Business
1 to 5 Employees	13	16.4 years
6 to 10 Employees	14	16.3 years
11 to 20 Employees	12	9.7 years
21 to 50 Employees	9	16 years
51 to 100 Employees	3	33 years
More Than 100 Employees	3	20.7 years

Of particular note from the base data is that 3 firms larger than 170 employees were initially interviewed, but during the interview were found to be subsidiaries of larger multinational firms and were thus eliminated. Also, while the initial focus was to avoid the single person firms, these were included as they offered a unique view of absorptive capacity as they often used outside knowledge out of necessity and had well developed methods to retain the knowledge. The smaller firms also offered a high number of years in business, showing the potential that their strategies to build knowledge had contributed to their ability to sustain their business in a highly competitive industry.

## **R&D** Intensity

Based on the work of Zahra and George (2002), out study asked interviewees to confirm the R&D Intensity of their respective firms. R&D Intensity was measured as a percentage of the firms employees that participated in research and development of new software products. Zahra

and George had included this in their study of innovation and absorptive capacity as an influencing factor in potential and realized absorptive capacity. This factor was in addition to the inclusion of Number of Employees of the firm, which was based on the work of Flor, Cooper and Oltra (2018). The data gathered from our firms on R&D Intensity is in the table below:

#### Table 10

Number of Employees	Number of Firms	Average R&D Intensity of the
		firms
1 - 19 Employees	37	85%
21 – 55 Employees	12	65%
1 0		
55 – 170 Employees	5	42%
1 5		

Table of R&D Intensity by Size of Firm (Source: Author

From the data we can clearly see that for almost 70% of the firms, R&D Intensity does not significantly differ from Number of Employees (difference of 1-2 employees for 37 firms). Thus, the use of R&D Intensity would only truly mitigate Number of Employees for the largest 17 firms, which would not be enough to influence a majority in any factor. Therefore, we will drop this factor in favor of Number of Employees for analysis going forward and align with Flor, Cooper and Oltra (2018) in utilizing Number of Employees as a gating factor for study and categorization of absorptive capacity strategies. Based on our findings the use of R&D Intensity would be a factor to be used in the study of medium and large firms where there is likely to be more variability between the total number of employees and the number of employees performing R&D.

# **Products and Services Offered**

The firms surveyed were mixed in terms of the services they provided with some specializing in doing custom software solutions versus those that were more productized, offering one or more products. The breakdown of services offered is below:

## Table 11

Table o	f Interview	respondents	by Services	Offered	(Source:	Author)
	/		~		1	

Services Offered	Number of Firms	Average Number of	Average Years in
		Employees	Business
Custom Development	16	9.8 employees	10.9 years
Single Product	21	31.9	17.0 years
Multiple Products	17	19.0	19.5 years

This mix will provide a good basis for studying the variance in strategies for taking advantage of outside knowledge and the associated absorption of this knowledge across different firm strategies. Custom development firms would appear to have more opportunity to use outside knowledge given the fact that each solution is net new, while productized firms would need to consider the cost of integration into any use of outside knowledge. This consideration would potentially factor into the type of outside knowledge pursued and thus into the required absorption strategy.

## **Innovation Structure**

When looking at how the firms perform their innovation it is necessary to differentiate between those firms that centralize their innovation research and definition versus taking a more decentralized approach. This is done as the strategies used to find knowledge, absorb knowledge and share it will potentially differ based on this centralized versus decentralized approach as the actors doing the activities and those requiring the knowledge will be different.

# Table 12

Size of Company	Product	Based	or	Centralized Innovation vs
	Custom			Decentralized
1 to 5 Employees	Product			4 Centralized
				4 Decentralized
	Custom			5 Centralized
6-10 Employees	Product			6 Centralized
				5 Decentralized
	Custom			2 Centralized
				1 Decentralized
11-20 Employees	Product			2 Centralized
				3 Decentralized
	Custom			1 Centralized
				6 Decentralized
21-50 Employees	Product			6 Centralized
				2 Decentralized
	Custom			1 Decentralized
51 – 100 Employees	Product			2 Centralized
				1 Decentralized
Greater than 101 Employees	Product			3 Centralized
				0 Decentralized

Table of Interview Respondents by Innovation Structure (Source: Author)

# **Type of Innovation**

One last factor that we need to examine in the analysis is the impact of the type of innovation being done at the firms, Radical vs Incremental.

# Table 13

Size of Company	Product Based or Custom	Type of Innovation	
1 to 5 Employees	Product	3 Radical	
		5 Incremental	
	Custom	4 Radical	
		1 Incremental	
6-10 Employees	Product	3 Radical	
		8 Incremental	
	Custom	4 Incremental	
11-20 Employees	Product	4 Radical	
		1 Incremental	
	Custom	4 Radical	
		3 Incremental	
21-50 Employees	Product	8 Incremental	
	Custom	5 Radical	
		3 Incremental	
51 – 100 Employees	Product	1 Radical	
		2 Incremental	
Greater than 101 Employees	Product	3 Incremental	

Table of Interview Respondents by Type of Innovation (Source: Author)

This slice of the data shows a clear mix of the two types of innovation, with the Product based firms moving towards Incremental innovations as the firm size grows. This pattern shows potential that absorptive capacity needs would be more limited in these firms as incremental innovations are smaller in nature and more specialized to the product in question, therefore not as prone to needing large amounts of outside knowledge.

# **Absorptive Capacity Strategy Analysis**

During the interview process each respondent was asked about the following elements of their absorptive capacity strategy:

- 1. What were the sources of external knowledge?
- 2. What was the breadth of the external knowledge search vertically vs horizontally

- 3. What was the depth of the search, was it limited to trends and freely available knowledge (technology scouting) or did it include licensing / acquiring knowledge in the form of third-party code (technology sourcing), including using open source or license solutions?
- 4. At what stage in the innovation process is knowledge acquired
- 5. Are collaboration technologies used
- 6. Does the firm hire for knowledge?
- 7. Does the firm have formal training / meetings to share knowledge?
- 8. Are the resources collocated or dispersed?
- 9. Is knowledge shared vertically or horizontally (across team)

These responses, broken down by key categorizations of the firms will allow us to identify which particular matches of strategies are most effective with different categories of companies.

## Source of External Knowledge

When we examine the original source of the outside knowledge, all but 5 firms interviewed took their initial knowledge on what to develop from clients, either current or prospects. This is not unexpected, as smaller firms would typically lack the resources to perform their own initial survey of the market, competitors and software trends. Depending on clients to provide an initial direction offers two advantages:

1. It ensures a market for the innovation as the initial client typically is made part of the project and signs on as an early adopter. In 14 firms that sell set products, the

client not only brings the idea but stays engaged through the development of user stories and into the testing process.

2. The initial idea provides direction to the company on where to focus further research. 16 of the firms interviewed followed this path, where ideas originated from client feedback, but were internalized and research further prior to being made part of a future release.

This allows for the knowledge to be assimilated from the client as part of the project, with the handover occurring at all stages. This handover is handled as part of project documentation and project meetings and is a necessary step to the definition of the product.

# Breadth of the Knowledge Search

The breadth of the search is a key indicator of the extent to which the firm searches for outside knowledge. Breadth is defined as the number of external sources that one searches across (Ferreras et al, 2015). In the case of our respondents, all but 9 of the respondents told us that their primary sources of external knowledge were from within their vertical. For the 9 respondents that were open to looking more horizontally in their searches they had the following characteristics:

- All were Custom Development companies that were not tied to a particular vertical.
- All 9 firms were small in size, ranging from 1-15 employees.
- Two of the 9 were companies that used networks and trade associations to find new ideas and new solutions to problems and considered their projects to be Radical innovations.
- 4 of the 9 were Custom Website development firms that were truly building each solution as a one-off, but each started with set templates as the basis for design.

• The 5 not doing website development were all doing Radical innovations, building specialty solutions for clients and drawing extensively from their network of partners when building solutions.

The other 45 respondents were clear that their external information searches were limited to their vertical. The bulk of these (38 of the 45) were selling product-based services and thus primarily mining external knowledge from their clients and their direct network, preferring to stick to people that knew their products best to feed information. This trend also is indicative of the type of innovation being done as 31 of the 45 were performing incremental innovations, adding features and functions to existing products. This limited breadth may also be indicative of a lack of desire to bring in outside technologies into their products, this will be examined further when we look at the licensing and use of open source.

#### Depth of the Knowledge Search, Licensing and Open Source

In looking at Depth of Search for software companies we are considering that the outcome of a deeper search will ultimately be seen in taking on solution components, either through Open Source or Licensing of a whole or portion of a solution. The ability to be able to find these solutions, bring them into the firm, integrate them into the product and support them going forward would require a high level of absorptive capacity. Note that we have included Open Source code into Technology Sourcing given the costs of integrating third party applications and code even when free. This is a clear delineation from research and principle-based Technology Scouting where research yields freely available concepts that need to be coded in house.

Of the respondents, 24 stay at the Technology Scouting level in their searches, not going to the depth of taking on third party code but gathering and internalizing external knowledge. The characteristics of this group of respondents are below:
- 11 of the 24 are 10 employees or less, 5 are 11 to 20 employees and 8 are 21 or more employees
- Average years in business for the 24 companies is 16.3 years
- The innovation at 20 of the 24 is Incremental
- 19 of the 24 are firms developing and selling Products
- Innovation at 17 of the 24 is centralized
- At 16 of the 17 above the knowledge is pushed down vertically from a single leader or a small group in formal knowledge sharing meetings
- 18 of the 24 firms search for knowledge within their vertical

From this we can deduce that there is a direct correlation between Product firms making incremental innovations and the searches they are performing for knowledge being limited to their vertical and being focused on principles and knowledge that can be internalized more easily. This points to these firms working to integrate outside knowledge where possible, but doing it cost effectively and avoiding the costs of integration and increased support costs from having to absorb third party code.

Looking at the other 30 respondents who are open to deeper searches and taking on third party code and solutions, their makeup is somewhat different.

- 16 of the 30 are less than 10 employees, 7 are 11 to 20 and 7 are more than 30 employees
- 22 are selling Products, 17 of which are offering multiple products in market
- 16 of the 30 perform innovation in a decentralized fashion

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- 28 of the 30 take external knowledge and ideas for new development from their clients and their vertical network
- 17 of the 30 are doing Radical Innovations
- 18 of the 30-push knowledge down vertically in formal knowledge sharing meetings

Based on this we can see that the firms who are making more radical changes to their product suites, through major radical innovation or creation of new products, are doing so in part at least by taking advantage of third-party code. Given these ideas originate from the firm's clients and are typically performed as part of client engagements it allows the firms to defer at least part of the integration and potential licensing fees by billing them to the client. Based on the information from the interviews clients are more than happy to cover all or most of these costs as it allows them to receive a solution customized to their needs for a reduced rate over what they would pay for a custom system.

# Stage in which the Knowledge is Brought In

Another key element in the assimilation of knowledge from external sources and how open a firm's innovation process is. The more flexibility a firm can exhibit in their ability to take on external knowledge, the more opportunity they have to yield larger, more radical innovations. However, there is a cost to maintaining an open innovation process throughout all stages, it means that ideas introduced at later stages have the potential to cause rework and increase project costs. From the information gathered in the interviews:

• 38 of 54 respondents said that their firms are open to outside knowledge during the ideation and initial design phases of their innovation process.

- 31 are performing incremental innovation to the products they offer, which somewhat limit the scope of the level of external knowledge that may be brought in.
- The form of this knowledge is ideas that are generated by clients for 36 of these 38 firms.
- 27 of the 38 firms are 20 employees or less.
- 18 of these smaller firms limit the external knowledge they take on to ideas and technical concepts and avoid taking on third party code.

Based on this information we can deduce that the firms putting limits on their timing for taking on external knowledge are smaller firms that need to limit their costs of innovation and integration. This is achieved by only opening up the early phases of the innovation process for external ideas, minimizing the cost of taking on the knowledge and limiting potential rework that would occur if later stages were open.

# Use of Collaboration Technologies

Collaboration tools have marked a new innovation that has enabled sharing of information and stretched the boundaries of firm's technology organizations. The advent of cloud-based tools like JIRA and Slack have allowed firms to extend their boundaries to include their clients and partners, facilitating easier sharing of client requirements with development teams, collaborative development of user stories and scenarios and sharing of development demo's and test cases. This technology has enabled small firms to extend their reach and yet continue to be able to meet their timelines for development, as opposed to life without the tools where developers depended on the exchange of documents between parties to facilitate the exchange of information.

From our 54 interview respondents 34 of the firms make extensive use of collaboration technologies including JIRA (for user requirements and stories), Slack (for collaboration

throughout the project), WebEx, Lync and Zoom for sharing of demonstrations, presentations and to hold video conferences without the overhead of trying to meet onsite. Of the 20 respondents that do not make use of the tools the primary reason was size as these firms had small technology teams, with 18 of the 20 having 10 or less technology related staff. These firms made use of document-based strategies to share documents with clients, saving on the costs of the cloud-based applications and also addressing concerns about security of their intellectual property.

# Hiring for Knowledge

Hiring for knowledge is thought to be an opportunity for small firms to level the playing field by bringing in specialty skills to augment their teams. This allows firms to limit their investment in keeping up with technical trends, instead being able to tap into their network to hire partners to bring in new ideas and innovations and complete this work as part of the project. Based on the interviews conducted, it was found that 41 of the 54 respondents do not hire for specific knowledge or innovations. While some of these firms do make use of contractors (9 of the 41), the decisions on bringing in contractors and choosing the resources are made to do resource augmentation. The primary reasons these firms do not hire for knowledge are:

- 1. Firms feel that contractors would not have the necessary knowledge about their industry and solutions to be effective.
- Firms prefer to manage the work they take on to the size of their permanent team to ensure knowledge stays in house for supportability. They do not wish to overextend themselves by taking on more staff for projects, either permanent or temporary.

3. Firms feel that use of contractors is a security risk to their solutions, their code and their client's information.

#### Firm Shares Knowledge in Formal Meetings / Training

When one thinks of small and medium firms, one would typically think that these firms complete their work without the need for formal processes, preferring instead to avoid formal steps and role definition in favor of a "get it done" mentality. However, the advent of collaboration technologies has enabled firms who use these technologies to implement these processes.

Based on the interview discussions, 35 of the 54 respondents stated that their firms utilize formal meetings and training to share knowledge across their teams. In particular most of these firms detailed that they in fact have adopted the Agile development methodology, with sprints for planning, sprint reviews and weekly scrum meetings for sharing of knowledge.

# **Resource** Collocation

Based on the interviews resource collocation was determined to not be a factor as most firms were collocated by default. This is based on:

- 1. The focus on Small and Medium Software companies, meaning less employees.
- 1. The number of locations these firms had, typically a single office.
- 1. The lack of hiring of contractors (only 22 of 54 hire contractors).
- 1. Security concerns with sharing knowledge and client data outside of the firm's office.

In fact, in one specific example where the primary developer was working remotely and not typically in the office it was leading to significant issues at the firm, promoting a culture of lack

of control over what was being added to the product. In most cases, with the technology teams being relatively small and collaborative, collocation is thought to be beneficial for culture, knowledge sharing and facilitating innovation process.

### Knowledge Shared Vertically

When considering how knowledge is shared, a key element is how it is shared organizationally. Vertical sharing from leadership down to the teams carries with it a note of direction, and has an advantage in that it ensures that the knowledge is passed down and understood, and that it is internalized, versus horizontal sharing where it is more collaborative and also has more opportunity for the information to be ignored or misunderstood.

From the interview data, once we eliminate the 13 firms that are 5 employees or under and thus don't have a real horizontal opportunity, we are left with 25 of 41 respondents confirming that they share knowledge vertically from a single leader or small innovation team. This strategy seems aligned to the number of firms that centralize their innovation.

Now that we have done a base level analysis of the data, lets return to our initial theories and see if the tests were met.

# **Study Theme Findings**

#### Smaller firms will be more likely to hire contractors for knowledge

From our analysis of the interview responses we learned that while the firms we met with did utilize Technology Scouting and Sourcing, they were not likely to hire contractors or permanent staff for knowledge. Of the 54 firms interviewed, only 19 hire contractors and only 13 of those choose their contractors based on them having external knowledge that the firm is

interested in. The bulk of those are firms are over 10 employees (7 of the 13) as opposed to the smaller firms interviewed.

Based on the data we also see that the bulk of these 13 also stay in their own vertical (9 of 13) versus using this external knowledge to grow into new verticals.

#### Smaller and medium firms will be more likely to overcome Not Invented Here bias

A key opportunity for our small and medium software companies to make up ground on their larger competitors would be for them to be able to take advantage of third-party code and applications. Based on the data collected from the 54 interview respondents, we saw that 30 respondents were performing deeper searches when seeking external knowledge, practicing Technology Sourcing and looking for opportunities to use third party code, either in the form of Open Source or Licensed applications. Of these firms, 23 of the 30 were 20 employees or less (77%) and use this adoption of third-party code to make up ground on larger firms.

One other group that was in favor of licensing third party software and using open source are those firms doing radical innovations. These firms felt that the combination of saving on the costs of these innovations and speeding time to market outweighed the concerns. In one example, a firm doing development of software to manage dance competitions was able to license electronic payment processing technology and add it to their application to launch a new line of business in their app with the introduction of online shopping. Rather than spending months building this, they were able to do it in the middle of competition season, bringing this to market months earlier and drive additional in year revenue.

The firms that did not wish to use third party code were doing incremental innovation to their products and thus felt that the costs of integrating and supporting the third-party code, together with concerns about security and the lack of subject matter expertise outweighed the advantages to be gained.

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These firms were instead in favor of writing the code themselves to ensure supportability and consistency with their existing applications.

#### Mid-size firms will be more likely to license adjacent solutions to assimilate knowledge

This theme was found to be fundamentally false as the bulk of the firms interviewed were inclined to stay within their established verticals, with only 8 respondents reporting that they would search for external knowledge outside of their existing verticals. The data told us that the bulk of firms interviewed are open to external knowledge, and licensing solutions or code, but they are using this knowledge to grow their products and services within their existing verticals and not to grow these products and services outside of these verticals to adjacent areas. They were not inclined to move outside their expertise and comfort zone. In one case a respondent actually detailed an example where they expanded their product suite to a new product based on open source and entered a new market, only to have that market fail as it did not fit with their existing expertise, marketing or brand awareness.

The failure of this theme means that while external knowledge will still be sought after and assimilated, it will be easier to bring to market and take advantage of since it will be linked to the verticals and expertise that the company already has.

# More mature firms will utilize meetings or formal training to share knowledge with their teams

In this case the hope was that the maturity of firms would drive them to implement processes to enable knowledge sharing through formal meetings and training. This focus on knowledge sharing would enable firms to maximize their gains from the external knowledge, ensuring they maximized both the innovation opportunity and the supportability of the innovations created from this knowledge.

In reviewing the data 35 respondents confirmed that they utilize meetings and training to share external knowledge with their teams. In addition to that, of the 19 that didn't have such meetings as part of their process, 10 meet the need through the use of collaboration tools with resources that are primarily remote or in a separate location. Overall this means all, but 9 firms utilize formal knowledge sharing, and 8 of the 9 that do not have 3 or fewer employees.

This translates to almost all respondents having formal absorptive capacity processes in place to share their external knowledge with their teams, enabling them to maximize their gains from these innovations.

### Small and Medium Software Firms only seek and absorb knowledge as part of initiatives

In examining the 39 firms that are selling defined multi-client software products versus those doing custom software development we can see that 23 of the 39 have centralized innovation organizations and 35 of the 39 get their primary ideas for their initiatives from clients. In this way most of the respondents actually said they pass on the cost of the innovations to the clients, while retaining the intellectual property for the solution to allow it to be sold to other clients. These clients become part of the project team and form an early adopter group, often even participating in testing of the software prior to production.

Multiple respondents actually stated that their ability to do the innovation within the client initiative is an advantage over larger firms, as it gives the client the custom system development experience without bearing the cost of building the full application from scratch. In exchange for this experience and the advantages of features designed to their specifications, clients are more than happy to both help with development and cover the cost of the innovation, and also allow for any intellectual property to the changes to remain with the software firm. Most respondents indicated that their clients did not request intellectual property rights, and in the 2 cases where the

interviewed firm said that clients asked, both firms indicated they stood their ground and retained the intellectual property.

From an absorptive capacity perspective this finding allows for easy absorption of the knowledge as the project team is able to draw knowledge from the clients, assimilate it and put it in market all as part of a fully funded initiative. The knowledge being communicated is immediately reinforced during the build and implementation of the innovation for the client.

## Technology has created opportunities for higher absorptive capacity

As we have discussed earlier, collaboration tools have become widely used with 34 of 36 firms of over 10 technology staff using collaboration tools to share information with their teams, their clients and their partners. This has enabled knowledge sharing to span company boundaries and truly allow knowledge providers and the firm to be linked as one extended team. In addition, 36 of 54 forms practice some form of technology sourcing, looking both vertically and horizontally for external knowledge. And 28 of these 36 firms open up their innovation processes throughout at least the design phase and for the most part through all stages of the innovation process. This allows these forms to maximize the gains from the innovation process via the use of

technologies that ensure the knowledge is effectively shared with their teams. This will in turn ensure that the gains from the innovations are realized and the support costs are kept to a minimum.

# **Secondary Findings**

These findings are based on the responses of the interviewed subjects and have the potential to impact the absorptive capacity and innovation strategies that firms choose to execute.

# Intellectual Property (IP) Ownership is Less of an Issue

Based on comments during the interviews, respondents confirmed that clients purchasing software in the small and medium business (SMB) sector do not typically raise issues of wanting the IP associated with the ideas they raise. Respondents stated that their firms are able to work with these clients to understand that in going with their small firm and supplying their ideas, the client receives a customized solution experience at an off-the-shelf solution price. This enables clients to see this as a fair exchange for receiving a customized solution and ensuring it meets their specifications. This allows the firms to make use of these ideas in their product and make it available to other clients, thus overcoming one of the major concerns related to open innovation.

## SMB is Missing the Opportunity to Innovate

From the discussions with the respondents, small and medium firms are only innovating as part of client initiatives. While this minimizes their overhead costs related to innovation, it means they are unable to work to project where clients want to go and arrive there ahead of them, thereby shaping the market. Instead they move as their client's demand, which creates stickiness for the clients but does not fully remove the risk that a new firm, with a newly designed product does not reshape the market.

#### **Chapter 5. Summary of Results**

In this chapter we will review our overall findings against our research questions and do a more detailed review of potential strategies that firms can used to drive absorptive capacity and use to drive increased competitiveness and innovation performance. This will allow us provide firms recommendations that can be used to realize the practical benefits of our study. Prior to our final summary of our findings we will also discuss the limitations of our study and opportunities we see for future study.

#### **Summary of Literature**

From the review of the literature in section 2 we confirmed the following:

- External open innovation is related to innovation performance and allows firms to increase their competitiveness.
- Absorptive Capacity is defined as the processes firms use to find external knowledge, absorb the knowledge into their firm, exploit the knowledge and share it within their network.
- Absorptive Capacity is positively related to external open innovation in delivering enhanced innovation performance.
- The factors that influence absorptive capacity are:
  - Breadth and depth of the search for knowledge
  - Knowledge acquisition strategy
  - Knowledge absorption strategy
  - Knowledge exploitation strategy
  - Knowledge sharing strategy

These strategies and the associated values formed the basis of our study and defined the variables we gathered in the interview. Let us now review the results of our study as applied to our original research questions.

# **Research Question Results**

# Does external open innovation create opportunities for small and medium Canadian software firms to increase their competitiveness?

The data from our interviews reaffirms the conceptual information from the literature review and clearly shows that our small and medium software firms value the use of external open innovation. Most firms are engaged in multiple absorptive capacity strategies, not only taking knowledge from their clients and partners (49 of 54), but also searching for solutions via technology scouting (24 of 54) or sourcing full or partial solutions (30 of 54).

# What is absorptive capacity and what role does it play in the use of external open innovation for small and medium Canadian software firms?

Based on the literature review we saw that absorptive capacity is potentially a key component in the ability of a firm to effectively practice external open innovation. It comprised the search for the external innovation, the internalization of the knowledge or innovation, the exploitation of the innovation and the sharing of the innovation within their network of clients and partners. As we apply this to our data, we would see small and medium software firms that prioritize absorptive capacity having the following characteristics:

- Openness of their innovation process
- Sharing of information across the company
- Formal or informal training programs across the company
- Breadth of search for knowledge

Looking at these variables we see the following results:

- 1. Over 60% of the firms interviewed (34 of 54) have an open innovation process, allowing for external knowledge and innovations to come in during more than one phase of their innovation process, and 33% are open to new knowledge at any time in the innovation cycle.
- 2. Over 60% of the firms (34 of 54) formally share information vertically from their leadership to their technology teams, ensuring that the external knowledge is available to everyone.
- 3. Most firms (32 of 54) have formal or informal training programs to train their teams on the changes that are coming and the underlying solutions.
- 4. Almost all firms (46 of 54) work with their vertical partners, from clients to their partners / vendors to find external knowledge and innovations.

Based on this data we can clearly see that the majority of firms are putting into practice the key elements of absorptive capacity, working with their verticals to find information and share, internalizing the knowledge with all their technology staff and building it into their products. This confirms the literatures view that absorptive capacity is key to external open innovation.

# What are the factors that influence the effectiveness of absorptive capacity in small and medium Canadian software firms?

In order to understand the influences of effective absorptive capacity we must start with confirming which variables from the interview process are direct elements of absorptive capacity. The table below shows the variables that directly measure elements of absorptive capacity:

# Table 14

*List of variables captured from the interview data that directly influence elements of absorptive capacity (Source: Author)* 

Variable	Definition
Breadth of Search	Is the search for innovation taking place vertically in the company's
	existing vertical chain – from suppliers, partners or clients – or
	horizontally across a wider universe
Depth of Search	Is the search limited to free technology options (Technology
	Scouting) or includes licensed options (Technology Sourcing)
License Solutions	Does the firm license software or portions from other companies, or
	use open source
External Hire for Knowledge	Does the company hire for knowledge from outside sources
Collaboration Tools	Does the firm use software tools for sharing knowledge across the
	company
Formal Training	Are there formal training mechanisms in place to share knowledge
	about the innovation
Learn by Doing	Does the company have processes and support to learn the external
	innovation in the course of their regular work
Collocation	Are all the R&D employees located in a single location
Sharing Vertical vs Horizontal	Is the sharing of the external knowledge done vertically, learned and
	pushed down from a single person or small group, or horizontally
	across the organization at once

Examining this list, we see that Breadth and Depth of Search speak directly to the way that external knowledge and innovations are being found. Licensing Solutions and External Hire for Knowledge directly show how this knowledge is being brought into the company, Collaboration Tools, Formal Training, Learn by Doing and Sharing Vertical vs Horizontal relate directly to how the knowledge is being shared. Thus, examining the data on how many firms utilize each of these methods in their successful innovations will allow us to see which are the most influential in the effectiveness of absorptive capacity.

# Table 15

Variable	Interview Results
Breadth of Search	46 of 54 search and share in their vertical
Depth of Search	30 of 54 search for full or partial solutions
License Solutions	20 of 54 will license
External Hire for Knowledge	13 of 54 hire for knowledge
Collaboration Tools	34 of 54 use collaboration tools
Formal Training	34 of 54
Learn by Doing	Not a factor as all firms learn on the fly
Collocation	Not a factor as only 5 of the firms interviewed have more than 1
	location
Sharing Vertical vs Horizontal	Not a highly influential factor as 34 of 54 share vertically but only 25
	of these are greater than 5 employees

Interview results by absorptive capacity factor (Source: Author)

On the surface this tells us that the factors most influential in successful absorptive capacity are:

- 1. Vertical searching for external knowledge and innovations
- 2. Sharing of information via formal training
- 3. Building solutions by sharing knowledge with collaboration tools
- 4. Deep searches for knowledge that include potential for using open source or licensing of solutions

This also tells us that for small and medium software companies the method of sharing

(vertical vs horizontal) and collocation are not very influential due to the size of the companies, and that these firms do not hire for knowledge, with comments showing this is due to these companies reserving hiring for resources that can work on multiple projects and technologies and not to solve a single problem. More details on which factors work best by firm categorization will be seen in the detailed data analysis.

# What strategies do Small and Medium Canadian software firms use to increase their

# absorptive capacity?

When considering the data gathered from the interviews, we will group the data based on key categorical differences. These categories are:

- 1. Firms that sell products versus custom development
- 2. The R&D Organization of the firm
- 3. Type of innovation being done at the firm

These categories are based on the analysis of the data. Two other categories that were thought to influence absorptive capacity, size of the firm and age of the firm were discarded based on the analysis of the data.

# Product Strategy as a Driver of Absorptive Capacity

# Table 16

Product	# of	Search Breadth	Search Depth	Source of	Absorptive Capacity	Knowledge
Strategy	Firms			Knowledge	Strategy	Sharing
				-		Mechanism
Custom	16	9 vertical	8 sourcing	All from clients	5 hire for knowledge	7 share
		7 horizontal	knowledge	or verticals	9 license or use open	vertically
			8 scouting		source	9 share
			innovations		16 get knowledge from	horizontally
					clients	
					7 use knowledge sharing	
					sessions	
Product	38	34 vertical	12 source	All but 3 source	15 will license or use open	27 share
Based		4 horizontal	knowledge	knowledge from	source	vertically
			26 scout	clients and	11 hire for knowledge	11 share
			innovations	vertical	24 use knowledge sharing	horizontally
					sessions	-
					35 get knowledge from	
					clients	

Table of Absorptive Capacity Data by Firm Service Type (Source: Author)

Based on the data there are some key learnings:

## Product Based Firms Source and Share Ideas and Build in House

Firms producing products are more likely to source External Innovations in the form of knowledge (26 of 38 practice technology scouting), share it in meetings (24 of 38) and then internally generate innovations from this knowledge. These ideas typically come from clients and their verticals (35 of 38), with very few firms straying outside their vertical networks (3 of 38). This is indicative that Product generating firms will build in house (only 12 of 38 look at licensing) and share knowledge via internal sessions (24 of 38). These firms are also less likely to hire for specific knowledge (only 11 of 38), from the direct comments these firms feel that their knowledge of their products and markets, together with the cost of integrating outside products make it more cost effective for the firm to find outside ideas, share them with their teams and then build in house.

# **Custom Development Firms Source Innovations and Integrate**

All small and medium custom development firms get their initial ideas and knowledge from their clients (16 of 16), who come with specific thoughts on what they want and how it should work. Based on this a little more than half of these firms (9 of 16) will seek outside innovations (open source or licensing) in an effort to minimize costs of development (based on the feedback). This is done to maximize their competitiveness, believing that clients will seek the most costeffective solution.

# **R&D** Organization Type as a Driver of Absorptive Capacity

# Table 17

Table of Absorptive Capacity Data by R&D Organization Type (Source: Author)

R&D	# of	Search Breadth	Search Depth	Source of	Absorptive Capacity Strategy	Knowledge
Organization	Firms		_	Knowledge		Sharing
				_		Mechanism
Centralized	31	24 vertical	8 sourcing	All but 1 from	10 hire for knowledge	25 share
		7 horizontal	knowledge	clients or	12 license or use open source	vertically
			23 scouting	verticals	30 get knowledge from clients	6 share
			innovations		18 use knowledge sharing sessions	horizontally
Decentralized	23	19 vertical	11 source	All but 2 from	14 will license or use open source	9 share
		4 horizontal	knowledge	clients and	7 hire for knowledge	vertically
			12 scout	verticals	13 use knowledge sharing sessions	14 share
			innovations		21 get knowledge from clients	horizontally

Based on the data, for the most part the Centralized versus Decentralized nature of the R&D organization does not have any discernable impact on Absorptive Capacity Strategies except for one deduction we can draw:

# Centralized R&D Organizations Prefer Finding Solutions Not Knowledge

The majority of firms with centralized R&D organizations, where a single person or a small team do the R&D investigation and innovation, will search for licensed solutions or open source versus seeking knowledge that they need to build themselves. This indicates that size of their R&D organization is indicative of the amount of effort they will put into designing and building solutions versus purchasing solutions that require less design and build effort.

# Type of Innovation as a Driver of Absorptive Capacity

### Table 18

Table of Tosof prive Capacity Data by R&D of ganization Type (source, Tainor
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R&D	# of	Search Breadth	Search Depth	Source of	Absorptive Capacity Strategy	Knowledge
Organization	Firms			Knowledge		Sharing
						Mechanism
Radical	19	15 vertical	5 sourcing	All but 2 from	9 hire for knowledge	11 share
		4 horizontal	knowledge	clients or	15 license or use open source	vertically
			14 scouting	verticals	17 get knowledge from clients	8 share
			innovations		7 use knowledge sharing sessions	horizontally
Incremental	35	29 vertical	10 source	All but 4 from	12 will license or use open source	23 share
		6 horizontal	knowledge	clients and	8 hire for knowledge	vertically
			25 scout	verticals	23 use knowledge sharing sessions	12 share
			innovations		33 get knowledge from clients	horizontally

Based on the responses from the interviews we can deduce the following:

# **Firms Doing Incremental Innovation Work in House**

When we look at the firms doing incremental innovation, smaller changes to existing products or services, versus radical or larger innovations, we find that these firms will only use outside solutions about 35% of the time (10 of 35), and hire for knowledge less than 25% of the time (8 of 35). This indicates that they will do this work with in-house resources, using outside knowledge or solutions to point a direction versus integrating them. These firms use knowledge sharing sessions to share the external knowledge in their teams and then do the development work in house.

### **Firms Doing Radical Innovation Use External Solutions**

When we turn to firms doing radical innovation, we can clearly see these firms' source and implement either licensed solutions or open source code. Based on direct feedback these firms are seeking the best, most cost-effective solution for their clients and will seek out existing solutions that can be licensed or integrated prior to moving to build from scratch using outside knowledge.

When using these solutions, the firms will utilize support from the external solution provider, which reduces the need for knowledge sharing sessions, which only happen 37% of the time (7 of 19 firms).

## What is the correlation between these strategies and company success?

When assessing this question, we initially looked at differentiating firm success based on revenue and costs or based on the % of revenue from new innovations. However, given the variance in services provided and size of firm, these factors could not be classified and compared. Instead what we will do is discern success based on longevity on the assumption that the relative success of the firm is directly shown by the number of years they have stayed in business in the rapidly changing and highly competitive Canadian software market. The table below shows by years in business the absorptive capacity definition elements and their related variables (see 5.10.3 for the variables from the research model), as defined in our research model.

# Table 19

		Search for Knowl	edge	Shared from vertical network	How Knowledge Shared and Internalized
Firm Age	# of Firms	Search Breadth	Search Depth	Source of Knowledge	Absorptive Capacity Strategy
5 years or less	13	9 vertical 4 horizontal	2 sourcing knowledge 11 scouting innovations	All but 4 from clients or verticals	<ul><li>4 hire for knowledge</li><li>7 license or use open source</li><li>11 get knowledge from clients</li><li>4 use knowledge sharing sessions</li></ul>
6 to 10 years	10	6 vertical 4 horizontal	4 sourcing knowledge 6 scouting innovations	All from clients or verticals	2 hire for knowledge 5 license or use open source 10 get knowledge from clients 7 use knowledge sharing sessions
11 – 15 years	3	3 vertical	1 sourcing knowledge 2 scouting innovations	All from clients or verticals	1 hire for knowledge 2 license or use open source 3 get knowledge from clients 2 use knowledge sharing sessions
16 – 25 years	14	12 vertical 2 horizontal	4 sourcing knowledge 10 scouting innovations	All but 1 from clients or verticals	2 hire for knowledge 7 license or use open source 13 get knowledge from clients 5 use knowledge sharing sessions
26 plus years	14	13 vertical 1 horizontal	5 source knowledge 9 scout innovations	All but 3 from clients and verticals	5 will license or use open source 5 hire for knowledge 8 use knowledge sharing sessions 11 get knowledge from clients

Table of Absorptive Capacity Data by Age of Company (Source: Author)

Based on the data we can see that the 28 firms with the greatest longevity (16 or more years

in business) engage with their clients to bring in their knowledge and to define what new features and solutions to build. Further they also tend to stay within their own verticals when searching for knowledge, with only 3 of 28 going outside their vertical. In addition, these 28 firms rarely hire for knowledge, and for the most do not license or use open source. In summary these firms specializing in keeping their clients close, with almost all getting new ideas and knowledge from their clients, and then integrating those clients into their teams and building solutions in house. This minimizes costs and maximizes the long-term revenue potential, both of which speak to the ability to stay in business for the long haul.

#### **Resulting Strategies that firms can utilize**

Based on our study and the analysis of the results we were able to identify the strategies that successful firms used, based on the type of innovation they are executing, their product strategy and their R&D organization. These strategic recommendations show that:

- Firms Doing Radical Innovation Use External Solutions
- Firms Doing Incremental Innovation Work in House
- Centralized R&D Organizations Prefer Finding Solutions Not Knowledge
- Custom Development Firms Source Innovations and Integrate
- Product Based Firms Source and Share Ideas and Build in House

In addition, we also saw inconclusive results in the examination of the size of firm and the knowledge sharing mechanism, meaning that we did not see a direct relationship between different strategies based on the size of firm or the knowledge sharing mechanism used.

#### **Application of the Data to Drive Benefits**

Our research was successful in identifying absorptive capacity strategies that firms can utilize based on their product strategy, type of innovation and R&D Organization. Utilizing these strategies would allow firms to maximize their effectiveness in absorbing knowledge and increase their innovation performance. This creates an opportunity for firms to make changes in their processes to drive increased efficiency.

#### Helping Firms Building Products

Looking first at firms building products, and doing incremental innovation on these products, our strategies tell us that these firms should practice technology scouting, identifying external knowledge, bring it in house and use this knowledge to build in house innovations. This would be in contrast to sourcing partially or fully completed solutions. From the data we can see

that there are 13 product firms doing incremental innovation that are practicing technology sourcing, bringing in solutions and performing integration to build these into their products. Our research tells us that if these firms were to focus on sourcing knowledge and building in house they would realize benefits by lowering integration costs and produce better quality products s they would be able to meld this knowledge and their experience and market information into a better quality product. This finding is aligned to the comments of the firms following this strategy, many of whom had eschewed using open source or licensing in favor of sourcing knowledge because they felt that the developers of the innovation did not know their product or their market, leading to a substandard product.

#### Helping Firms Doing Radical Innovation

Second, our research tells us that firms doing radical innovations should focus on sourcing solutions and integrating them versus trying to source knowledge and build in house. The comments from the firms following this path suggest that they felt that this path minimized their time to market, by avoiding time consuming integration, and it worked because the radical innovations did not require in depth knowledge of what had come before. Our data tells us there are 4 firms that would potentially benefit from changing to this strategy, as today they are engaged in radical innovations on their products but are trying to build in house. In one case they have spent over a year in building a radical new product, trying to do it in house versus adopting more readily available components.

## Aiding Custom Development Firms

Our third opportunity to drive improvement is in looking at firms doing custom development versus those building products. The research findings tell us that these firms maximize absorptive capacity and innovation performance by sourcing solutions, not knowledge.

Comments from these firms tell us that they win business based on price and minimizing project delivery time versus delivering a perfect solution but at a higher cost and time to market. Based on our data we have 5 custom development firms that would potentially benefit by shifting to technology sourcing and using licensing of solutions or open source versus the knowledge scouting that they do today.

# **Benefiting Firms with Centralized R&D Organizations**

Our next opportunity is driving benefits for firms with centralized R&D organizations. We see from our findings that centralized R&D organizations prefer to source solutions not knowledge. This is done primarily because the centralized R&D organizations have a small team performing the innovations, so it is more efficient to have this group focused on finding and integrating solutions versus the longer cycle time required to take knowledge and turn it into exploitable innovations. Our data tells us there are 17 firms that have centralized R&D organizations are practicing sourcing of knowledge versus our recommended strategy of sourcing solutions. While this would seem to be a large number, let us look at the data a little deeper. These firms average 12 R&D employees per firm, thus utilizing technology sourcing and then building in house is likely a significant draw on these resources as seen by the fact that 12 of these firms are only able to work on 1-3 initiatives at a time. This means that they would be able to drive more revenue and do more concurrent initiatives by shortening their time per project and resources required per project, which would be a direct result of sourcing partial or complete solutions.

# Driving Longevity in Newer Firms

Turning to how we can enhance firm's longevity, our results also show that firms can derive success, as measured through longevity in the market, through sourcing external knowledge from within their vertical and delivering solutions within their vertical versus trying to expand

horizontally. The data tells us there are three firms from our study that currently are relatively new (in business an average of 4 years), who practice finding and sourcing ideas from outside their vertical and source solutions. The data tells us that these firms would benefit by shifting to sourcing knowledge and ideas from within their vertical. Based on the comments from the survey, we are able to see that firms see significant benefits in staying within their vertical and sourcing knowledge. These benefits come from innovation efficiency, cost control and ability to capitalize on their knowledge. They will also see enhanced revenue by increasing their client retention, forming long lasting relationships versus trending towards one project per client. These relationships carry additional benefits through lowering the cost of client acquisition, as the comments from our interviewees with the highest longevity is that they build long standing, multi project relationships with their clients.

# Summary of Study Applications and Benefits

Based on the scenarios described above we can see that there are direct benefits to the firms interviewed by changing their strategies to align with our findings. They will be able to innovate more efficiently, drive more revenue and decrease their innovation costs. One of our future steps is to release this study to the firms interviewed so they can make use of the findings, and we would be able to see if they do derive the benefits we foresee.

#### **Generalizability of the Results**

As we look at how the data can be applied to benefit firms, we must also confirm that the results are generalizable across small and medium Canadian software forms. In the case of our study generalizability is a function of the breadth of firms studied. Based on the characteristics of our respondents we can see that:

- Size of firm is fairly evenly split for small and medium firms, with an average of 22 employees per firm, and 26 of 54 respondents being greater than 15 employees.
- Product Strategy is reasonably split, with 16 custom development firms, 21 offering one product and 17 offering multiple products.
- Firm age and maturity was well represented, with 29 of 54 firms having been in business for greater than 15 years.

Based on these representations of key classification variables we can deduce that our respondent set had good representation across the spectrum of small and medium software sector, where based on publicly available information the average number of employees across the sector is 12 employees (Statistics Canada, 2018).

### Limitations of the Study

Based on the scope of the study, the participants and the methodology there are several limitations from the study that need to be considered when looking at future study opportunities and utilization of the results.

### Using Years of Service as a Proxy for Success

In looking at how to measure relative success in the community of firms we interviewed, we were unable to utilize revenue as a proxy for innovation success, since revenue would be tempered with the size of the market and the size of the firm. These two measures speak to the potential reach of the firm to earn revenue. Simply put, a one or two person firm would be limited in terms of their revenue potential, regardless of how good an innovation would be. While the use of years of service made sense given the variability in the size of our firms and the cross country nature of the markets, the use of years of service does not take into account the ups and downs a firm might encounter based on good and bad innovation decisions. Future studies should seek to find a better relative indicator of innovation success that respondents would be willing to share.

# Lack of Variability in Number of Locations

One potential complicating factor in the sharing of information and the strategies required to absorb knowledge is the number of locations. Having to deal with the geographic and potentially cultural issues inherent in sharing information might force firms to more rigid forms of sharing, perhaps more towards formal training. Or it could push them to be unable to share and make the knowledge more regional or geographically limited. However, of our study respondents only 5 respondents had more than one location. Future studies should focus on firms on the higher side of medium, which would likely add more locations and complexity to be studied and overcome.

# **Areas for Future Study**

Below are three areas that should be studied further to determine if they would enhance firm's ability to absorb knowledge and thus make better use of Outside- In Innovation. These areas are based on the interview data and comments.

# Improve Open Source to Address Supportability into the Network

One of the major issues raised with the use of open source software is the supportability of the software. In many cases respondents stated that they felt it would be easier and less costly to rewrite the code versus using open source code written by third parties. The addition of an optional support contract element to the open source system would serve two major purposes:

> It would allow for companies to make more use of the open source code, saving potential costs from either the rewriting of the software from scratch, or the costs of learning the code to be able to support it when they integrate it into their products.

2. It would offer a monetary incentive for those writing code through the optional support fees. This would both ensure a higher quality of code being posted and also likely lead to more developers opting to create open source code.

In this way small and medium firms would be more inclined to make use of open source code, and thus open up new avenues of innovation and new opportunities to absorb knowledge.

# Improve Research Credits

Based on the interview data today's small and medium businesses are not innovating outside of direct client initiatives. Through the creation of increased research credits for small and medium businesses there is an opportunity for the government to open up innovation opportunities for these firms, thereby increasing their staying power in a highly competitive industry. The growth of these companies would then lead to increased taxation revenue that could potentially pay for the tax credits.

## Creation of an SMB Software Marketplace for Licensing

There are two major apprehensions that firms stated with licensing of software solutions from other firms:

- The unknown of the developer and company who created the product to be licensed. In today's global world, ensuring that you feel comfortable with solutions you license and the firms that created them is key.
- The costs of integration of the licensed solution into the existing products being sold by the form.

In order to overcome these two issues, we suggest the creation of a generic software marketplace through which software vendors could offer their solutions, both via complete standalone products

or via API's that would facilitate easy integration. While such marketplaces exist for subsets of the industry, like Google and Apple App stores, creating a similar store for business solutions and API's would allow firms some level of reliance on the solutions they are purchasing. This would allow firms to take better advantage of these external innovations and facilitate gathering knowledge on these solutions as well as getting support for the solutions. This would facilitate higher absorptive capacity and a more efficient innovation process and save costs for companies that today are ignoring license opportunities and writing the code in house.

# **Chapter 6. Final Conclusions**

Overall based on our study of available literature and the interviews conducted with 54 Small and Medium Canadian Software development firms we have been able to confirm that the literature and our study findings are aligned on the responses to our research questions.

First, external open innovation creates opportunities for small and medium Canadian software firms. The literature and our findings agree that sourcing knowledge from within their vertical network and also that they take in technical knowledge, open source code and full solutions from the market.

Second, that absorptive capacity is defined as the search for knowledge, the ability to internalize and share the knowledge, build it into products and services and share it work a firm's network. This definition was affirmed from the available literature and from the data showing that of our 54 firms, over 60% showed clearly that they practiced strategies to achieve each element of the definition.

Third, we have shown through the literature review that the following factors influence the effectiveness of absorptive capacity:

- Breadth and Depth of Search
- Internalizing of Knowledge through Licensing and Hiring for Knowledge
- Sharing of Knowledge through Collaboration Tools, Formal Training, Collocation and Learning by Doing
- Sharing Information Vertically through the firm and through the firm's network

The data from the interviews affirmed that the most influential were:

- Vertical searching for knowledge
- Use of formal training and collaboration tools
- Deeper searches that secure open source and licensable solutions

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Fourth, that the strategies that firms choose for their absorptive capacity are corelated to key elements of the firms Product Strategy and their Type of Innovation. These categories will determine which absorptive capacity strategies are best used by firms to optimize their ability to use External Open Innovation and thus their ability to compete with larger, R&D focused firms. Using these strategies will enable these firms to:

- Maximize revenue opportunities from innovation
- Limit their costs for R&D and development of innovations
- Enhance their client relationships to improve client retention
- Improve their opportunity to achieve longevity in the market

Based on our research, the key elements that define how firms can choose the most optimal strategies for absorptive capacity are:

- Type of Innovation the Firm is Engaged In Radical or Incremental
- Breadth of the Search for External Knowledge Are firms looking within their vertical or horizontally
- Depth of the Search for Knowledge Are firms sourcing knowledge or solutions
- Partnering strategy staying within their vertical or sharing horizontally
- Strategies used to bring in the knowledge Hiring for Knowledge, Licensing Solutions, Partnering with Clients
- Strategies used to share the knowledge Knowledge sharing sessions, vertical sharing or horizontal

The data from the interview process showed some key relationships between the variables that resulted in the following outcomes:

- Firms Doing Radical Innovation Use External Solutions
- Firms Doing Incremental Innovation Work in House
- Centralized R&D Organizations Prefer Finding Solutions Not Knowledge

- Custom Development Firms Source Innovations and Integrate
- Product Based Firms Source and Share Ideas and Build in House

Lastly, we can also show from the interview data that firm success, as shown through longevity, is enhanced by sourcing external knowledge from within their vertical and delivering solutions within their vertical versus trying to expand horizontally. They also rarely hire for knowledge or license solutions. By doing this, they increase stickiness with their clients and retention of these clients, thereby enhancing their revenue and longevity.

As per our original objective, we have closed our identified research gap, and the outcomes clearly offer a roadmap of absorptive capacity strategies to firms based on their Product, Innovation Type and R&D Organization. This will help these firms enhance their ability to absorb knowledge and build innovations based on them, and successfully enhance their futures and their ability to compete against larger firms.

# References

Ahuja, G. (2000). The duality of collaboration: inducements and opportunities in the formation of interfirm linkages. Strategic Management Journal, 21(3), 317–343.

Anand, B. N., & Khanna, T. (2000). Do firms learn to create value? The case of alliances. Strategic Management Journal, 21(3), 295–315.

Baum, J. A. C., Calabrese, T., & Silverman, B. S. (2000). Don't go it alone: alliance network composition and startups' performance in Canadian biotechnology. Strategic Management Journal, 21(3), 267–294.

Bessant, J., Stamm, B. Von, Moeslein, K. M., & Neyer, A.-K. (2010). Backing outsiders: selection strategies for discontinuous innovation. R&D Management, 40(4), 345–356.

Blackman, A. (2016). *How your small business can compete with a large competitor*. Envatotuts+. https://business.tutsplus.com/tutorials/how-your-small-business-can-compete-with-a-larger-competitor--cms-27138

Canto, A. M., Pazos, P., & Cima, F. (2018). Internal drivers of competitiveness for micro and small software development companies in South-Eastern Mexico. *International Journal of Technological Learning, Innovation and Development, 10*(2), 176. Chesbrough, Henry, (2003). Open Innovation The New Imperative for Creating and Profiting from Technology. Harvard business School Publishing Corporation

Chesbrough, H., & Crowther, A. K. (2006). Beyond high technology: early adopters of open innovation in other industries. *R&D Management*, *36*(3), 229–236.

Chesbrough, H., Enkel, E., & Gassmann, O. (2010). The Future of Open Innovation. *R&D* Management, 40(3), 213–221.

Chiang, Y. H., & Hung, K. P. (2010). Exploring open search strategies and perceived innovation performance from the perspective of inter-organizational knowledge flows. *R&D Management*, 40(3), 292–299.

Christensen, J. F., Olesen, M. H., & Kjær, J. S. (2005). The industrial dynamics of Open Innovation - Evidence from the transformation of consumer electronics. Research Policy, 34(10), 1533–1549.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity: A New Perspective on and Innovation Learning. *Administrative Science Quarterly*, 35(1), 128–152.

Dahlander, L., & Gann, D. M. (2010). How Open is Innovation? Science Direct, (Feb).

DeFeo, C., Harding, J., & Wood, R. (2016). User Communities and the "Dark Energy" of Open Innovation. Proceedings of The 11th European Conference on Innovation and Entrepreneurship 15-16 September 2016, 913–920.

- Deepak, C; Subrahmanya, M. H. B. (2017). Absorptive Capacity, and Degree of Intra-Cluster and Extra-Cluster Linkages: A Study of Bengaluru High-Tech Manufacturing Cluster. *Graduate Student Research Conference in Business and Economics*, 1, 1–18.
- Dodgson, M., Gann, D., & Salter, A. (2006). The role of technology in the shift towards open innovation: the case of Procter & Gamble. R&D Management, 36(3), 333–346.
- Dyer, J. H., & Singh, K. (2000). Creating and managing a high-performance knowledge-sharing network: the Toyota case. Strategic Management Journal, 21(3), 345–367.
- Faems, D., De Visser, M., Andries, P. and Van Looy, B. (2010), Technology Alliance Portfolios and Financial Performance: Value-Enhancing and Cost-Increasing Effects of Open Innovation. Journal of Product Innovation Management, 27: 785-796.
- Ferreras-Méndez, J. L., Fernández-Mesa, A., & Alegre, J. (2016). The relationship between knowledge search strategies and absorptive capacity: A deeper look, Technovation, 54, 2015–2017.
- Flor, M. L., Cooper, S. Y., & Oltra, M. J. (2018). External knowledge search, absorptive capacity and radical innovation in high-technology firms. *European Management Journal*, 36(2), 183– 194.
- Folta, T. B. (1998). Governance and uncertainty: the trade-off between administrative control and commitment. Strategic Management Journal, 19(11), 1007–1028.
- Gassmann, O. (2006). Opening up the innovation process: towards an agenda. R&D Management, 36, 223–228.
- Grönlund, J., Sjödin, D. R., & Frishammar, J. (2010). Open Innovation and the Stage-Gate Process: A Revised Model for New Product Development. California Management Review, 52(3), 106–131.
- Gkypali, A., Arvanitis, S., & Tsekouras, K. (2018). Absorptive capacity, exporting activities, innovation openness and innovation performance: A SEM approach towards a unifying framework. *Technological Forecasting and Social Change*, *132*(January), 143–155.
- Hannen, J., Antons, D., Piller, F., Salge, T. O., Coltman, T., & Devinney, T. M. (2019). Containing the Not-Invented-Here Syndrome in external knowledge absorption and open innovation: The role of indirect countermeasures. *Research Policy*, 48(9), 103822.
- Holle, M., Elsesser, L., Schuhmacher, M., Lindemann, U., & Situation, A. I. (n.d.). How to Motivate External Open Innovation-Partners : Identifying Suitable Measures. 2016 Portland International Conference on Management of Engineering and Technology (PICMET).
- Hossain, M., & Kauranen, I. (2016). Open innovation in SMEs: a systematic literature review. Journal of Strategy and Management, 9(1), 58–73.

- Huizingh, E. K. R. E. (2011). Open innovation: State of the art and future perspectives. *Technovation*, 31(1), 2–9.
- Ince, H., Imamoglu, S. Z., & Turkcan, H. (2016). The Effect of Technological Innovation Capabilities and Absorptive Capacity on Firm Innovativeness: A Conceptual Framework. Procedia - Social and Behavioral Sciences, 235(October), 764–770.
- Jasimuddin, S. M., & Naqshbandi, M. M. (2019). Knowledge infrastructure capability, absorptive capacity and inbound open innovation: evidence from SMEs in France. *Production Planning and Control*, *30*(10–12), 893–906.
- Jo, D. H., & Park, J. W. (2017). The determinants of technology commercialization performance of technology-based SMEs. *KSII Transactions on Internet and Information Systems*, 11(8), 4146–4161.
- Kim, W. C., & Mauborgne, R. (2007). *BLUE OCEAN STRATEGY*. Wordpress. http://visipramudia.wordpress.com/
- Kiveu, M. N., Namusonge, M., & Muathe, S. (2019). Effect of innovation on firm competitiveness: The case of manufacturing SMEs in Nairobi County, Kenya. *International Journal of Business Innovation and Research*, 18(3), 307–327.Kokshagina, O., Le Masson, P., & Bories, F. (2017). Fast-connecting search practices: On the role of open innovation intermediary to accelerate the absorptive capacity. *Technological Forecasting and Social Change*, 120, 232– 239.
- Labafi, S., & Williams, I. (2018). Competitiveness of small media firms. *Contributions to Management Science*, *November*, 263–282.
- Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. Strategic Management Journal, 27(2), 131–150.
- Lazzarottil, V., & Manzini, R. (2009). Different Modes of Open Innovation: a Theoretical Framework and an Empirical Study. International Journal of Innovation Management, 13(4), 615–636.
- Lee, D. M. S., & Allen, T. (1982). INTEGRATING NEW TECHNICAL STAFF : IMPLICATIONS FOR ACQUIRING NEW TECHNOLOGY \*. Management Science, 28(12), 1405–1421.
- Lee, S., Park, G., Yoon, B., & Park, J. (2010). Open innovation in SMEs-An intermediated network model. Research Policy, 39(2), 290–300.
- Lewandowska, M. S. (2015). Capturing Absorptive Capacity: Concepts, Determinants, Measurement Modes and Role in Open Innovation. *International Journal of Management and Economics*, 45(1), 32–56.
- Lindegaard, S. (2015). Innovation: The 7 Key Differences Between Big and Small Companies. Linkedin.
- Lichtenthaler, U. (2008). Opening up strategic technology planning: extended roadmaps and functional markets. Management Decision, 46(1), 77–91.
- Matusik, S. F., & Heeley, M. B. (2005). Absorptive Capacity in the software industry: Identifying dimensions that affect knowledge and knowledge creation activities. Journal of Management, 31(4), 549–572.
- Mortara, L., & Minshall, T. (2011). How do large multinational companies implement open innovation? Technovation, 31(10–11), 586–597.
- Muzamil Naqshbandi, M., & Kamel, Y. (2017). Intervening role of realized absorptive capacity in organizational culture–open innovation relationship: Evidence from an emerging market. *Journal of General Management*, 42(3), 5–20.
- Okada, A. (2016). Small Firms in the Indian Software Cluster: Building Global Competitiveness. In *Upgrading Clusters and Small Enterprises in Developing Countrie* (2nd ed., pp. P85-107). Routledge.
- Orucevic-Alagic<sup>\*</sup>, A., & Martin, H. (2016). A Two Phase Case Study on Implementation of Open Source Development Practices within a Company Setting. *SEKE*.
- Parida, V., Westerberg, M., & Frishammar, J. (2012). Inbound Open Innovation Activities in High-Tech SME's: The Impact on Innovation Performance. *Journal of Small Business Management*, 50(2), 283–309.
- Pereira, D., & Leitão, J. (2018). Absorptive capacity and firms' generation of innovation -Revisiting Zahra and George's model. *GEE Papers*, 96(February), 1–27.
- Rangus, K., Drnovšek, M., Di Minin, A., & Spithoven, A. (2017). The role of open innovation and absorptive capacity in innovation performance: empirical evidence from Slovenia. *Journal of East European Management Studies*, 22(1), 39–62.
- Schaarschmidt, M., Kortzfleisch, H. von, & Walsh, G. (2015). How Do Firms Influence Open Source Software Communities? A Framework and Empirical Analysis of Different ..., (August).
- Sharma, S., Sugumaran, V., & Rajagopalan, B. (2002). A Framework for Creating Hybrid-OSS Communities. Information Systems Journal, 12(1), 7–26.
- Shulz, M. (2001). The uncertain relevance of newness: organisational learning and knowledge flows. *Academy of Management Journal*, 44(4), 661–681.
- Smit, M. J., Abreu, M. A. and Groot, H. L. (2015), Micro-evidence on the determinants of innovation. Pap Reg Sci, 94: 249-272.

- Song, Y., Gnyawali, D. R., Srivastava, M. K., & Asgari, E. (2018). In Search of Precision in Absorptive Capacity Research: A Synthesis of the Literature and Consolidation of Findings. *Journal of Management*, 44(6), 2343–2374.
- Tushman, M. L & Lakhani, K. (2012). Open Innovation and Organizational Boundaries : The Impact of Task Decomposition and Knowledge Distribution ... Open Innovation and Organizational Boundaries : The Impact of Task Decomposition and Knowledge Distribution on the Locus of Innovation, (May).
- Van De Vrande, V., Lemmens, C., & Vanhaverbeke, W. (2006). Choosing governance modes for external technology sourcing. R and D Management, 36(3), 347–363.
- Vanhaverbeke, W., Van de Vrande, V., & Cloodt, M. (2008). Connecting Absorptive Capacity and Open Innovation. *Ssrn*, 1–22.
- Verona, G., Prandelli, E., & Sahney, M. (2006). Innovation and Virtual Environments : Towards Virtual Knowledge Brokers Innovation and Virtual Environments : Towards. Organizational Studies, 27(6), 765–788.
- Veryzer, R. W. (1998). Discontinuous Innovation and the New Product Development Process. Journal of Product Innovation Management.
- Vogt, W. P., Gardner, D. C., & Haeffele, L. M. (2012). *When to Use What Research Design*. New York, NY: The Guildford Press.
- Vogt, W. P., Vogt, E. R., Gardner, D. C., & Haeffele, L. M. (2014). *Selecting the Right Analysis for Your Data*. New York, NY: The Guildford Press. Retrieved from www.guildford.com
- Von Hippel, E. (2008). Democratizing Innovation: The Evolving Phenomenon of User Innovation. International Journal of Innovation Science, 1(1), 29–40.
- Wang, S., Yeoh, W., Richards, G., Wong, S. F., & Chang, Y. (2019). Harnessing business analytics value through organizational absorptive capacity. *Information and Management*, 56(7), 103152.
- West, J. (2003). How open is open enough? Melding proprietary and open source platform strategies. Research Policy, 32(7), 1259–1285.
- West, J., & Bogers, M. (2014). Leveraging external sources of innovation: A review of research on open innovation. Journal of Product Innovation Management, 31(4), 814–831.
- West, J., Vanhaverbeke, W., & Chesbrough, H. (2006). Open Innovation : A Research Agenda. Open Innovation: Researching a New Paradigm, (October 2005), 1–15.
- West, J., & Lakhani, K. R. (2008). Getting Clear About Communities in Open Innovation. Industry & Innovation, 15(2), 223–231.

- Westerlund, M., Isabelle, D. A., Rajala, R., & Leminen, S. (2017). Networks, business models, and competitiveness in small Finnish firms. *International Journal of Business and Globalisation*, 18(1), 9–26.
- Zahra, A. S., & George, G. (2002). Absorptive Capacity : a Review, and Extension. *The Academy* of Management Review, 27(2), 185–203.
- Statistics Canada. Small, Medium-sized and Large Businesses in the Canadian Economy: Measuring Their Contribution to Gross Domestic Product in 2005. Retrieved from <u>http://www.statcan.gc.ca/pub/11f0027m/2011069/part-partie1-eng.htm</u>

Statistics Canada, 2018 Canadian ICT Sector Profile, Retrieved from <u>https://www.ic.gc.ca/eic/site/ict-</u> <u>tic.nsf/vwapj/ICT Sector Profile2018 eng.pdf/\$file/ICT Sector Profile2018 eng.pdf</u>

## **Appendix A: Ethics Approvals**

Athabasca University RESEARCH CENTRE

#### **CERTIFICATION OF ETHICAL APPROVAL**

The Athabasca University Research Ethics Board (AUREB) has reviewed and approved the research project noted below. The AUREB is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS) and Athabasca University Policy and Procedures.

Ethics File No.: 23246

<u>Principal Investigator</u>: Mr. Suneel Ghei, Graduate Student Faculty of Business\Doctorate in Business Administration

<u>Supervisor</u>: Dr. Anshuman Khare (Co-Supervisor) Dr. Dwight Thomas (Co-Supervisor)

Project Title: Modeling Absorptive Capacity for Open Innovation in the Software Industry

Effective Date: January 16, 2019

Expiry Date: January 15, 2020

#### **Restrictions:**

Any modification or amendment to the approved research must be submitted to the AUREB for approval.

Ethical approval is valid *for a period of one year*. An annual request for renewal must be submitted and approved by the above expiry date if a project is ongoing beyond one year.

A Project Completion (Final) Report must be submitted when the research is complete (*i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

#### Approved by:

Date: January 16, 2019

Hussein Al-Zyoud, Chair Faculty of Business, Departmental Ethics Review Committee

> Athabasca University Research Ethics Board University Research Services, Research Centre 1 University Drive, Athabasca AB Canada T9S 3A3 E-mail rebsec@athabascau.ca Telephone: 780.675.6718

Athabasca University RESEARCH CENTRE

### **CERTIFICATION OF ETHICAL APPROVAL - RENEWAL**

The Athabasca University Research Ethics Board (REB) has reviewed and approved the research project noted below. The REB is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2) and Athabasca University Policy and Procedures.

Ethics File No.: 23246

Principal Investigator: Mr. Suneel Ghei, Graduate Student Faculty of Business\Doctor of Business Administration (DBA)

<u>Supervisor</u>: Dr. Anshuman Khare (Co-Supervisor) Dr. Dwight Thomas (Co-Supervisor)

**Project Title:** 

Modeling Absorptive Capacity for Open Innovation in the Software Industry

Effective Date: January 6, 2020

Expiry Date: January 05, 2021

#### **Restrictions:**

Any modification or amendment to the approved research must be submitted to the AUREB for approval.

Ethical approval is valid *for a period of one year*. An annual request for renewal must be submitted and approved by the above expiry date if a project is ongoing beyond one year.

A Project Completion (Final) Report must be submitted when the research is complete (*i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

#### Approved by:

Date: January 06, 2020

Carolyn Greene, Chair Athabasca University Research Ethics Board

> Athabasca University Research Ethics Board University Research Services, Research Centre 1 University Drive, Athabasca AB Canada T9S 3A3 E-mail rebsec@athabascau.ca Telephone: 780.675.6718

## **Appendix B: Study Informed Consent**

# Modeling Absorptive Capacity for Open Innovation in the Software Industry

## **ONLINE PARTICIPANT CONSENT FORM**

Principal Researcher:	
Suneel Ghei	]
Suneel ghei@dba.athabascau.ca	l

Supervisor: (if applicable) Dr. Dwight Thomas Dwight.thomas@fb.athabascau.ca Dr. Anshuman Khare anshuman@athabascau.ca

You are invited to participate in a research study to define strategies for how Small and Medium Canadian Software Companies can successfully bring outside knowledge into their companies and absorb it for use in their innovations. I am conducting this study as a requirement to complete my Doctorate in Business Administration. The study will focus on companies that have between 5 and 499 employees, and are Canadian Software Companies, and exclude those companies that are subsidiaries of other international firms. This exclusion is being made to eliminate firms whose policies may be influenced by other countries.

As a participant, you are asked to participate in this study by participating in an interview to discuss your companies innovation strategy, projects where you have made use of external knowledge and how you were able to successfully absorb this knowledge. Participation will take approximately one hour of your time, with the possibility of an additional thirty minute follow-up call. The interview call will be recorded and the participant can request the recording to be deleted at any time once the data has been encoded.

This study will allow us to build a strategy for companies to use to successfully internalize external knowledge. As a participant you will receive a copy of the study, all conclusions and research. This will allow your company, who already uses external knowledge, to potentially improve your processes for management and sharing of this knowledge and thereby improve your innovation process. Involvement in this study is entirely voluntary and you may refuse to answer any questions or to share information that you are not comfortable with. The identity of you and your company will not be recorded in the study as all participants will be assigned a code for all data identification. In addition, all interview responses will be categorized and analyzed as numerical data, thereby ensuring that individual answers cannot be discerned. Based on these measures we do not foresee any risks from your participation.

You may withdraw from the study at any time up to the data analysis phase by contacting the researcher. You will be provided a copy of this consent form for your records.

No hard copy data will be printed. All electronic data will be kept in a password protected computer on an encrypted and password protected hard disk. All information and records will be destroyed by confidential shredding; electronic records will be deleted, when all project requirements have been met, by the end of calendar 2020.

If you have any questions about this study or require further information, please contact Suneel Ghei or Dwight Thomas using the contact information above.

This study has been reviewed by the Athabasca University Research Ethics Board. Should you have any comments or concerns regarding your treatment as a participant in this study, please contact the Office of Research Ethics at 1-800-788-9041, ext. 6718 or by e-mail to rebsec@athabascau.ca.

Thank you for your assistance in this project.

## **CONSENT:**

The completion of the interview process is viewed as your consent to participate.

## **Appendix C: Interview Plan**

### Objective

The focus of the interview is to understand how the company being studied handles the absorption of knowledge from outside sources as it relates to the companies innovation process. The study spans the full innovation lifecycle, so the outside knowledge can be anything from concepts or ideas all the way to finished products. The interview will focus on past initiatives to understand the following:

- What was the innovation
- What stage of the innovation lifecycle was the initiative at when the knowledge was assimilated
- What was the source of the outside knowledge
- What was the form of the knowledge
- What was the strategy for bringing the knowledge into the company
- How was the knowledge absorbed
- Was the resulting innovation successful

This knowledge will be used to drive variable values for the data analysis.

An interview was chosen to allow for this data to be gathered in more detail

### How will the Interview be Conducted

Interviews will be conducted by audio conference or in person, based on firm preference and geographic constraints. The expectation is that there will likely need to be two sessions scheduled, a first interview that is planned for 45 min to 1 hr and a follow up 30 min session for any clarifications.

In addition to the interviews and discussion, the first call will include details on the ethical considerations, how identities will be kept confidential, how data will be stored, how company and product names would be obfuscated in the final paper and who will have access to raw data. On each call there will be a brief reminder of these key ethical points and on the final call as a wrap up we will review how the results will be portrayed in the final presentation

## Handling and Storage of the Interview Data

There are three key elements to the handling and storage of the data:

- Confidentiality
- Encoding
- Obfuscation

Confidentiality will be maintained through the use of participant codes. Every participant will be assigned a code and their responses will be stored against this code. A single hard copy table will be maintained of which interviewee corresponds to which code, and this will only be used for the purpose of identification for any follow-ups. Once the data analysis is underway all detailed interview data and notes will be secured in a password protected folder on the students workstation. Encoding will be performed on the verbatim responses to categorize them into numeric values for data analysis. This will remove tone and response details that could be used to separate different responses and make some form of identification possible.

Obfuscation will then be done to view data as a group vs individual numeric responses. By doing this it will be impossible to discern individual responses. Based on this the data will be fully secured with no risk to determining who gave which responses.

## **Interview Questions**

The interview will be structured into categories or areas as follows:

Baseline Company Questions

- Firm's Innovation Process and Integration Points for External Knowledge
- Case Studies of Projects where Knowledge was Externally Sourced

Breaking down each section, the Baseline Company Questions are:

- 1. Size of the firm
- 2. Age of the Firm
- 3. Leadership Structure -
- 4. Number of Products in the Market
- 5. Number of New Projects in Development
- 6. How is knowledge shared across the company is there formal training / communication

As the discussion moves to the Innovation Process and External Knowledge, the questions will turn to:

- 1. Description of the process used to build new innovations / products / services
- 2. Timeline from Ideation to In Market
- 3. How are initiatives resourced
- 4. At what stage is external knowledge brought in
- 5. How is external knowledge sourced / found
- 6. What strategies are used to bring in external knowledge
- 7. Describe the process used to integrate the external knowledge into the company

The last section of the interview focuses on past projects where externally sourced knowledge /

innovation was integrated. This will allow us to gather all variables. Questions in this area are:

- 1. Describe the innovation process used for the project
- 2. Does this represent an incremental innovation or a radical innovation
- 3. How was the external innovation found
- 4. At what stage was the external innovation brought into the firm

- 5. What strategy was used to acquire the knowledge partnership / alliance, license the knowledge, acquire the company, hire employees with the knowledge
- 6. How was the knowledge integrated into the firm and shared with employees training, communication, osmosis, etc
- 7. What was the cost of acquiring the knowledge
- 8. What was the cost of integration
- 9. How long was the project lifecycle to bring the innovation to market
- 10. How does this compare to other initiatives
- 11. What was the result of the initiative

# **Appendix D: Key Interview Comments**

The table below shows key comments received from various interviewee's, many of which are utilized within the paper. A copy of all interview notes, and the researcher summary of data table has been stored by the researcher for later use in responses.

## Table 20

# Table of Interview data (Source: Author)

Participant	Interviewee Role	Number of Employees	R&D Intensitv	Years in Business	Key Comments
	Owner				Innovation based on finding a client willing to take on the project. Do choose the client based on getting the best client willing to work with them. They get a custom solution at a SasS price.
1	Owner	20	50	35	work with mem. Iney get a custom solution at a saas price. Bring in sturff that is well supported or has been, when bringing in an edge case package they make a note and stay on it to support it. Keep track of updates to stay in line with supported. As part of modularization they constantly change the packages to maintain supported versions.
2	Owner	15	80	10	to maintain supported versions. Make a microcomputer to run a printer for the food industry that goes inside their systems. Serves multiple clients. Some may
3	Owner	2	100	10	have some custom features. Client asks for a feature. No real formal process. Innovation includes externally sourced components to pull in pre-built functionality, integrating with a piece of equipment they
4	Owner	64	20	32	will purchase libraries and encapsulate. Plan time into the research process, through Spike or MVP to drive knowledge input. Also support staff on extra curricular study to increase external knowledge.
5	Owner	6	50	32	Ideas coming from network, referrals. Also have a lead service bring ideas. Many don't work out, need to do the due diligence Try to generalize the problem to extend the application, otherwise can't monetize.
6	President	1	100	17	Heavily dependent on owner - use some prebuilt resources - don't want to reinvent the wheel. Add in own design adjustments add in business requirements.
7	Owner	24	85	19	Quality Management system is very important to the company, have clients that audit them so the code is typically all built in house. Have purchased open source code in the past but now too difficult to integrate code.
	Owner	24	100	18	Dance competition software company taking in the ability to process credit card transactions. Integrating a third party product into their product to allow purchase and pickup of the product when the doors open at the break
8	CEO	-	100		Have looked at other people that are doing similar research and work to understand how thay did it to san if that can be applied
9		1	100	3	Most of the external input from client up front. Will bring them in to test where budget allows. Use all open source
10	Co-owner	17	85	10	Will work to reuse where it makes sense so they can use money to innovate new stuff.
	Owner	-		_	Une of the Keys is to be a continuous learning environment. Blogs, trends, learning new technologies are all keys to separating successful consultants from those that fall behind. Different for large firms who do the same thing for a longer period of time, they steamed over time.
11	Swher	2	100	5	Often will need to draw on existing solutions, using plug ins from wordpress, etc. Sometimes paid solutions, others are free.
12	Owner	18	100	5	Mostly finished products. Need to work to understand the plug in – usually they solve 90% of the problem and need to change the last 10%. Mostly open source so documented.
13	Vice President Dev	6	100	23.5	One example was making a PDF file. Many different solutions. Researched methods compatible with their Python framework, look at supportability, how active is the open source project, how many contributors, is it maintained.
					Open Source, leveraging other libraries, licensing these libraries and partner with the company. Integrated a library at a license. Goal is to find a win/win. Stay away from per use license, try to do cross pollination deals – I give something and I get
14 15	Owner Owner	170	30 100	26 6	something. Some are home runs and some are bunts, but non-monetary exchanges pay off best.
16	Owner	8	80	2	External knowledge is just in time knowledge – develop a mission package for the contractor, build architecture and solution, and build a package for the contractor. Contractor gets 2 days to review and confirm if it will work.
17	Owner	1	100	20	Looks at job, does assessment and then brings in the experts for that job. Thinks they are more flexible than most large companies who try to use their own staff and "bone up" on the technology.
18	Service Desk Mana	6	100	13	Best example is the AG Expert Field – started from a basic idea – broad strokes to get MVP out. Then each release incorporate
19	Software Engineer	22	100	38	user feedback through research, driving new features and new releases. No cost to the external knowledge from a purchase perspective
					Now use a group of VAR's as partners to understand what's needed – offer courses on how the product works, brings up questions. These questions can lead to creative ideas of what to add, this drives the start of the innovation process. Its all
20	President	3	100	20	incremental innovation. An example is building a CSV input – did research and used the outbound CSV as a baseline. Did idea from a client for another project but wrote IP licensing up front. Used it as a production test and then commercially re-
21 22	Owner Owner	38	50	23	developed
23	Owner	8	80	8	Took client suggestions and developed into feature in house. Clients can't grasp it until they see it. Mostly developed in house
24	Owner	8	100	10	Everyone is involved in the development Get ideas from Eacebook user groups, etc to see what people think. Get ideas from evisiting clients on tools and then assess if it
25	Owner	•	100	26	will fit others. No formal business case initially, do it by feel and then once you get 6 or 7 potential agreements, then work on formal marketing, study, pricing to turn.
25	Owner	32	80	3	Product ideas from the service practice, what if moment. Based on what is learned from clients, interviews, model accorded
27	Owner	38	50	23	Identify the gap, interview clients and use those as requirements to drive innovation.
	0	-			onsure of future prospects, market for services they provide is closing rapidly. Did gap technologies, access to data, extraction and providing a UI – for clinicians. This was done to fill a gap that large companies couldn't fill. Large companies entering the manage and the arguming of delivery
28	Owner	2	100	21	space on the promise of delivery. Used to be that large organizations reach out to small companies for innovation help - they partner with these small companies - large company has access to a lot of knowledge marketing, ats to feed the small company. New the small
29	IT Manager	15	67	4	company takes the idea, locks down the IP and assimilate the idea into the product
	Owner		100		rypromy nave statis 36% of the team. One time needed a data recovery person – need a local business, network of company's they use. Typically not in situation they don't understand, they bring the solution into their realm with the collaborative assigns. This allows you to understand that you can addiver before assigning the solution into their realm with the collaborative descent of the solution into the
30		15	100	8	Biggest deal for enterprise mobility was them against IBM, they were more expensive and still won the deal. Won on integrity,
31	Marketing Manage	12	100	4	innovation. Get paid with the satisfaction that they solved the problem; the solution was cool and the client was happy.
32	CEO	32	50	3	Each person does their research, but if they find an issue they tag it as a spike that drives a separate research path. These
33		10	80	9	Discuss can be based on a lack of knowledge on a particular component of a change in solution. One driven by earned value – which is usually construction based. Had an idea from a customer to collaborate on the solution. Built is assumed in which the average construction based.
	550				punction with the customer. Customer wanted the solution, wasn't concerned about the IP so was able to structure it to keep the IP and take the product to market. Open to sharing, but typically clients not able to monetize the idea. Have done deale to give requestions to clients
34 35	CEO Conf	75 15	40	31	uears to give royanies to chents. Large companies look for small companies that vetted out the idea and then buy them
					Single biggest mistake is listening to customers. Started a company 26 years ago, think about the idea that Jobs had – it wasn't what customers wanted – they wanted incremental. To do transformative you have to not be clouded by their views – might be
36	Owner	11	60	9	fresh and new but its not going to lead to something big. Don't know if its possible to be a visionary Have also brought in ideas and licensed – but almost always were mistakes. When they adopted outside products they did
37	CEO	5	60	30	not have full control or knowledge. One example where they took a product, built integration and the company went backrupt. In some cases ideas failed.
					Then they assign the work to the appropriate partners or inside resources. Partners are selected based on skill level. Find the best solution and control costs at the same time. Little less control when the teams are offshore and have to manage geo-logistic
38	Owner	16	100	12	work. Higher value work stays in partners that are more controllable to avoid these geo-political risks. When working an idea you need to assess – be prepared to have patience to put in on the shelf. Get the patent and shelve it, there
30	Owner	10	100	26	you can either build it later or park it till someone else did it. Second option is to make the market but that takes courage. Its not money, its being steadfast.
35	Co-founder	20	- 100 FO	13	Project where had no knowledge - started with research. Used companies that did it before. Use companies to do parts based on their experience
40	Owner	20	30	12	Most important factor is people want innovation but don't want change, this way the innovation comes without a change
41	S When	112	/0	18	Educate people there is an innovation process. Get exposure to trends, do lightening talks on the future trends in the
42	President	5	100	22	insustry, ensure you have opportunities for ideation, do exercises or design sprints, clustering exercises to have people thin about the future and where things will go in 5 years, how do you identify what the future will be about.
					Typically projects are joint ventures so there is a special process to manage this approval process. Originally did it on internal knowledge and built, then didn't work but needed to hire a sme. Changed process to hire a sme and make them a champion,
43	VP of Sales	35	85	17	they will stay through launch and then help start sales and talk clients. Knowledge can come via a request – broad in nature. Can also start with a business challenge that matches solution. R&D
44 45	Project Manager Owner	140 15	50 80	18 3	also does targeted work, where they offer a 4-6 week early engagement for free as a POC. Consistently good to have someone in house and learn, contractors are hit and miss.
					Dev is a one person shop. He does his own innovation including the external needs to license / integrate. Too much building and not enough licensing. Saves some monthly fees but costs time and energy. No other dev team to do the work so things
46	President	8	25	16	wait. Putting in processes to get more input from others into that process Knowledge was taken in through the project to get to the status we have today. Now lean on new customers and users to
47	Owner	8	50	26	continue to expand the capabilities. One of the customers going with them has a different angle. So its more like custom dev except they retain the IP. Need to work fast to ensure competitors don't get their first. 2 years from ideation
		5			Working within an ERP, lacked expertise in using the dev tool. Contracted a resource from the company for 3-4 months to do the work and do knowledge transfer. Was very expensive but necessary because it was the first time. Have had occasions
48	President	55	75	36	where postulated on a tool but hit a long learning curve and had to change tracks.
					Never prought in mird party software to do parts of this. Conscious decision. For example they got asked by a recruiting firm to take on and integrate a tool they had built to add functionality. Chose not to follow up because of concerns around comparibility and multity of the needed at the code. The cost of integration would be take built to be the state
49	Owner	5	100	30	companying and quality of the product and the code. The cost of integration would be too high, look and feel alignment, technology platform not compatible.
50	CEO	10	60	26	very concerned about the security of the concept and ensuring that no one has the full suite of what's being built. Values that over any efficiency / effectiveness that might be derived from more sharing.
				_	Testa is one of their customers, came to them to use their technology because they couldn't build the innovation fast enough. Employees of Tesla went looking for solutions, found Routezilla and started using it. Faced with decision to buy out Routezilla, the test because down in the publication of the solutions of the solution of th
51	Director of Techno	10	50	7	but got bogged down in the philosophy to build the software themselves by reverse engineering. Use Open source first, then purchase if can't find a solution. Don't want to reinvent the wheel, someone else has built it and we
52	Owner	35	33	16	should use it. Built here is good for security and security products, but outside of that its foolish. In security, bringing in things without understanding would compromise.
					Gone through the overhead of hiring employees but that's also difficult. Now stick to consultants from North America. This is because of the midset they have for development vs overseas counterparts. Often will now do himself unless its knowledge /
53	Owner	1	100	29	skill he lacks. Would love a network of advisors to offer ideas and advice on how to solve a problem.