Implications of The Rate of Organizational Learning on Value Capture in the Digital Economy

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Two newly introduced information technology products from the same firm were expected to do well, yet one product failed while the other thrived. Why? To answer this question, we built a firm-level system dynamics model of the adoption of information technology products with a focus on firm-level allocation of investments to marketing, technology and to the reduction of other switching costs. We also modeled the firm's ability and rate of learning from customers. The firm-level model was validated against revenue data and management interviews. We identified implications of designing a positive user experience and of adopting a culture of relentless and rapid business experimentation. The various scenarios supported by the model illustrated that, in order to survive and compete in the digital economy, information technology firms need to shed a comfortable yet myopic focus on existing capabilities and develop business strategies validated through "fail fast, learn fast" experiments. Furthermore, in order to thrive and achieve a sustainable competitive advantage, these firms also need to effectively disseminate the knowledge gained through business experiments throughout the organization.

Keywords: customer experience, lean start-ups, information technology, organization learning, product adoption, innovation, competitive dynamics, business experiment.

1. Introduction

This study is derived from the author's most recent graduate thesis (Vernon 2011) and inspired by an academic paper summarizing "*important building blocks in the application of system dynamics to corporate strategy*" (Weil 2007). In an increasingly competitive environment where competitive advantage can be more readily replicated, outsourced and therefore commoditized, technology firms must focus on designing and managing customer experience as a sustainable means of capturing and retaining value. We reviewed the business literature on competitive dynamics, technology strategy and innovation. We selected important papers from an extensive survey of academic research on technology adoption and innovation management to inform the design of a system dynamics model. We explored several scenarios using the system dynamics model in order to address the challenges of market entry and new product introduction in information-intensive businesses such as digital media outlets, information providers and financial services[1].

2. Literature survey of technology adoption

> *"Until businesses understand, anticipate, and respond to the psychological biases that both consumers and executives bring to decision making, new products will continue to fail" (Gourville 2006)*

[1] Going forward, when referring to *information technology products or services*, we shall use the shorthand of *products*.

We surveyed and chose academic papers that delivered relevant insights into the challenges faced by technology firms when entering into new business sectors. While we identified a few highly cited strategy frameworks, such as Porter's five forces (Porter 1996), we ultimately selected prior work that resonated with our personal and professional experience and that were still under-represented in formal business education in the aggregate. In this section, we summarize key findings and highlight the concepts that were integrated into the original system dynamics model.

2.1. Dynamic capabilities framework

> *"We worry that fascination with strategic moves and Machiavellian tricks will distract managers from seeking to build more enduring sources of competitive advantage. The approach unfortunately ignores competition as a process involving the development, accumulation, combination, and protection of unique skills and capabilities" (Teece, Pisano, and Shuen 1997)*

Teece and Pisano build upon the resource-based view of the firm to define a dynamic capabilities framework that delivers an alternate and improved approach to strategic management over Porter's competitive forces and Shapiro's game theory approach (Wernerfelt 1984). This framework is presented as better suited to build "*competitive advantage in increasingly demanding environments*". The digital economy is an acceleration of the pace of competition. A static view of competitive advantage is inadequate for survival.

Pisano describes that the limitation of Porter's five forces is to assume that the firm is altering its position in the industry, whose structure plays "a central role in determining and limiting strategic action"(Teece and Pisano 1994). A firm is blindsided then, when competition arises from adjacent industries and from firms with radically different business models. In technology markets, this scenario is now the norm rather than the exception.

Shapiro's game theory approach to strategy works well when competitors are "closely-matched" and assumes that advantage can be achieved by exploiting the manager's intellectual ability to excel at game theory. The dynamic capabilities framework emphasizes the importance of assessing, understanding and responding to market dynamics, "*when time-to-market and timing are critical, the rate of technological change is rapid, and the nature of future competition and markets difficult to determine*". The dynamic capabilities framework is built from the resource base view of the firm (Wernerfelt 1984).

The authors define the term capabilities to emphasize "the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment"(Teece and Pisano 1994). This paper helped us identify the important dynamic capabilities for the adoption of technology products. It highlights the importance of corporate agility.

> *"Capabilities cannot easily be bought; they must be built. From the capabilities perspective, strategy involves choosing among and committing to long-term paths or trajectories of competence development." (Teece and Pisano 1994)*

2.2. Familiarity matrix

From "Entering New Businesses: Selecting Strategies for Success" (Roberts and Berry 1985), we retain the two "basic strategic questions":

- Which product or markets should a firm enter?
- How should the firm enter these product–markets to avoid failure and maximize gain?"

Many new entrants to a product or market fail despite significant investments. Roberts and Berry propose a framework, the familiarity matrix, for selecting a successful entry strategy when considering a new business area. Figure 1 illustrates the familiarity matrix and the proposed entry strategy as a function of the firm's location on the matrix. The first step in using the proposed framework is to acknowledge and understand the firm's familiarity with the market and with the technology. The firm locates its position on the 3 x 3 technology–market familiarity matrix as illustrated in Figure 1.

Roberts and Berry propose a set of business development strategies for each location on the familiarity matrix. For instance, in the base/base location, the firm may consider the full range of proposed entry strategies by the authors: internal development, joint venturing, licensing, acquisition, and minority investment of venture capital. All these options are valid from a corporate familiarity standpoint although other factors may also influence the entry strategy decision.

The most attractive mechanism is internal development in order to fully leverage the familiarity with the underlying technology and market. This approach assumes an acceptable rate of development with internal resources to meet the demand of the marketplace. This option is possible when internal resources are matched to the need of the new product or market entry. The risk of failure increases as the firm's familiarity with the market and the technology decreases.

Consequently in the new unfamiliar/unfamiliar position, the firm's best approach is to consider a minority investment as a venture capital in order to establish a window to the unfamiliar area. Another strategy may be an educational acquisition with venture capital investment into a firm for which the market/technology is base/base. The purpose of an educational acquisition is to bring on board talent with the adequate level of familiarity of both the market and technology. This approach may be needed in an environment where the target technical talent is scarce and competitors are aggressively recruiting in the same talent pool. The educational acquisition approach presents risks including the possibility of losing key talent after the acquisition in the event of significant culture mismatch. Figure 2 illustrates the various levels of corporate involvement that are associated with each entry strategy.

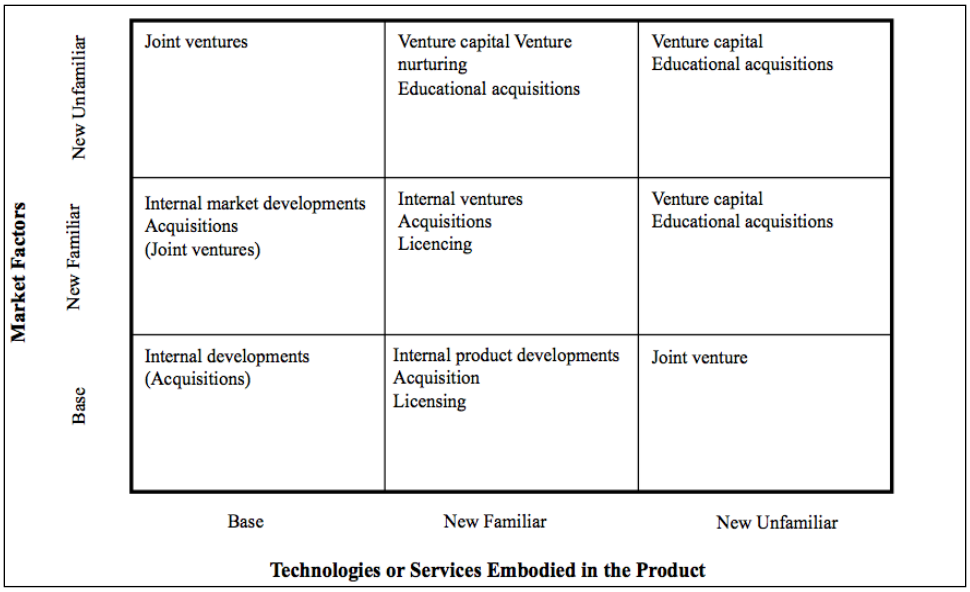

Figure 1 - Familiarity Matrix – Proposed Entry Strategies

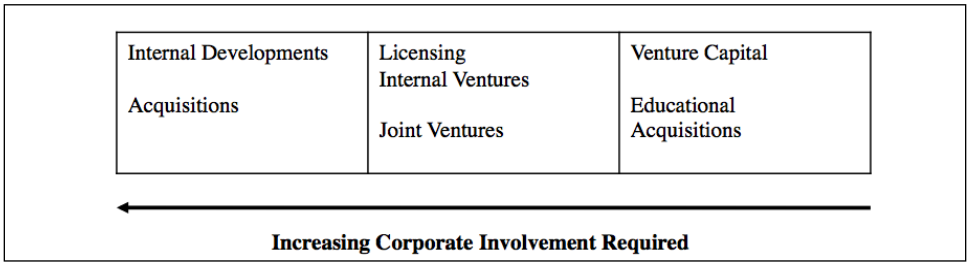

Figure 2 - Spectrum of Entry Strategies

The concept of familiarity with both the market and technology is presented in the context of corporate strategy as described by the structure of the firm (joint venture, acquisitions) and its investments strategies (internal development, venture capital, licensing).

In this research, we identified the critical success factors in product design and development for a firm to increase its familiarity with a new market and/or a new technology. One mechanism for increasing the odds of success in market entry and new product development is to better understand the underlying dynamics of the relationship of the firm with target customers in the new market, and of the relationship of users with the newly introduced technology-based product. A recommended approach to better understand customers in a rapidly changing technology market is to leverage continuous business experimentation to discover rather than plan how to build sustainable competitive advantage. The data-driven and iterative approach to better understanding customers is described in the book "Lean start-up" (Ries 2011). This approach reduced the negative consequences of the 9x effect presented in the next section.

2.3. The 9x effect

A important study that defined key dynamics in our paper is "Eager Sellers, Stony Buyers" (Gourville 2006). Gourville introduces the key concepts of loss aversion, perceived benefit and switching costs. "*Companies assume that consumers will adopt new products that deliver more value or utility than existing ones*." Firms tend to over-estimate the relative benefit of the new

product. In particular, technology firms measure performance improvements in a set of parameters that are perceived by them to be important and often under-estimate not only the inherent technical trade-offs resulting from the desired performance improvement but also underestimate the strong preference of customers for the incumbent product.

Gourville argues that Everett Rogers' concept of "relative advantage" (Rogers 1995) as the single most important driver of new product adoption is incomplete, as Rogers' theory does not take into account the "psychology of gains and losses". Gourville's theory of new product adoption describes four principles that are summarized as follow:

- Consumers make decisions about a new product not on its actual relative benefit over the incumbent product but on its perceived value.
- Consumers evaluate a new product in comparison to the incumbent, which they overvalue.
- Relative benefits are treated as gains but any shortcomings are treated as a loss for the new product.
- "Losses have significantly greater impact on people than similarly sized gains". This phenomenon is called "loss aversion".

Consumers often value the incumbent product significantly more because of loss aversion. As a result, they tend to stay with the incumbent product even when there may be a better alternative. Innovations always demand a trade-off. Successful technology firms must understand the trade-off from the customer's perspective in order to adequately reduce barriers to adoption of the new product.

Two examples include:

- E-books provide easy portability but customers are giving up the durability of paper books (Gourville 2006).
- Mobile insurance claim apps allow for streamlined claim reporting but customers are giving up the reassuring interaction with a human insurance representative.

Gourville introduces the concept of the "9x Effect" to quantify the cumulative effect of the overly optimistic perception by the firm of its innovation and of the overly pessimistic average behavior of the consumer when presented with the new product.

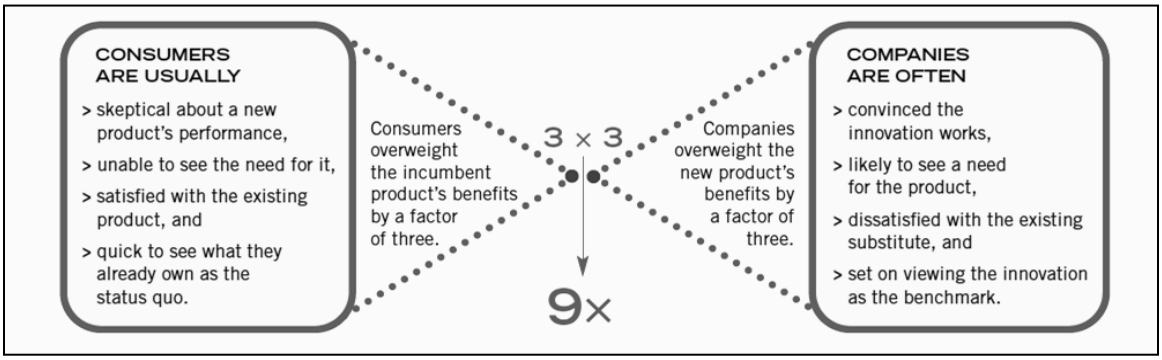

Figure 3 - The 9x Effect (Gourville 2006)

The implications of the 9x effect are captured in a framework to assess the rate of adoption and market penetration for a given product. "While companies can create value through product

changes, they can capture it most easily by minimizing the need for consumers to change. As the chart shows, that dynamic leads to four types of innovations" (Gourville 2006). We refer to this framework as the Gourville framework, as shown in Figure 4.

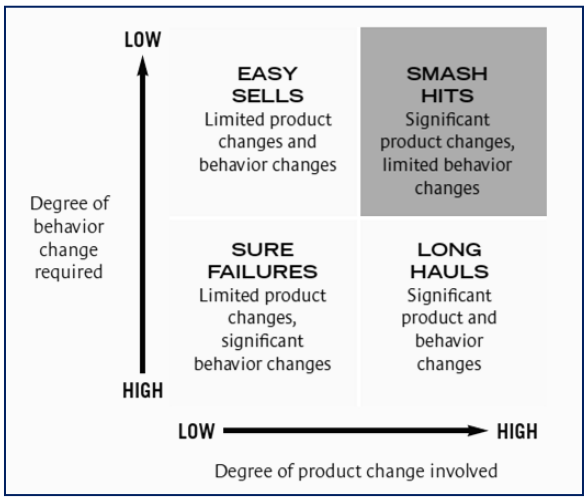

Figure 4 - The Gourville Framework – Capturing Value from Innovations (Gourville 2006)

- **Easy sells:** The most common new products fall into this category. They offer limited benefits for the consumer and the company. The benefit of the new product over the incumbent is small but at the same time, little behavior change is required from the consumer.
- **Sure failures**: This category describes products that offer limited benefit over the incumbent product and yet require significant behavior changes. Technologists who are overly enthusiastic about their innovations tend to go-to-market with products that deliver significant performance improvement but not in the category that is necessarily most valued by the consumer. In addition, the consumer may need a significant behavior change to use the new product. If the consumer perceives the improvement as minor, they will find it difficult to give up, an existing network, status, and/or ease of use are difficult sacrifices to make for a perceived minor improvement.
- **Smash hits:** Some innovations deliver significant benefits to the consumer but require minimal behavior changes. These products stand the best chance of both short-term and long-term success. Such products result in rapid adoption supported by a positive word-of-mouth effect that accelerates their success in the market place.
- **Long hauls**: "Many new products offer technological leaps, creating great value. However, they also require significant behavior change" (Gourville 2006). These products require a different go-to-market strategy. Such a product may be a great investment and enable the firm to establish a leading position in the market. However, the firm needs to be patient and ready to invest in helping the consumer learn the required behavior.

  Technology firms often launch products in this category when hoping to launch a "smash hit" because of the 9x effect. They overvalue the benefit and undervalue customer experience and real switching costs, which in turn results in much slower (or no) adoption of a new technology product. By contrast, when firms anticipate the slow adoption, they

can design strategies that address customers' resistance to change behaviors or launch products that are perceived by customers as 10x better than the incumbent's.

2.4. Dynamics of social factors in technological substitutions

Dattée and Weil (Dattée and Weil 2005) expand traditional diffusion models of technology innovation beyond an epidemic structure in order to take into account the decision-making process of the consumer and more importantly to fully account for market heterogeneity (Dattée and Weil 2005).

Market heterogeneity is the key concept that is retained for our purposes from this paper. Consumers and markets are heterogeneous when adopting new technology-based products. Dattée and Weil built a system dynamics model of technological substitution to incorporate sociological and psychological factors at the individual and market level. The system dynamics model illustrates the "delay to perceive the true performance value of the technology". This delay may not only be explained by an information delay - information about the new technology is not instantaneously available to the consumer - but also by "the system of personal constructs biased criteria or even selective exposure" that prevents the consumer from perceiving the true impact of the new technology (Dattée and Weil 2005).

Another input into market heterogeneity is the consumer's perception of the riskiness of choice alternatives and the individual's degree of risk aversion. "*Evaluating innovative products in terms of measurable performance attributes could be seen as limited because it does not delve deeply into customers underlying motivations*" (Dattée and Weil 2005). Different levels of risk aversion, loss aversion and information asymmetry contribute among other factors to the existence of several categories of adopters: technology enthusiasts, early adopters, mainstream adopters, pragmatics, late majority and laggards.

Each category of adopters has a different set of motivations and behaviors in reaction to different sets of information about the product, the technology and the firm. These varying perspectives result in market heterogeneity. When a firm recognizes the importance of social factors in technology adoption, a firm can better target the right category of early adopters in order to effectively leverage their relevancy and credibility as enthusiasts for the rest of the market. In addition, the firm must set realistic expectations during the initial phase of product launch to prevent risks such as "giving up too soon, overconfidence, and the risk of technological spark that fails to achieve mainstream takeoff" (Dattée and Weil 2005).

The concept of market heterogeneity is an important one to incorporate in our model of adoption of new technology products. More complete and useful models of technology product adoption shall incorporate the sociological and psychological factors that feed into the consumers' decision to adopt a product and into their attitude towards the firm. The firm may employ different strategies to increase the effectiveness of the word-of-mouth and diffusion of information regarding the benefit of the new product when it better understands the makeup of the market it is addressing. The firm must also take into account the heterogeneous behavior of users when they consider adopting the new product.

2.5. Dynamics of innovative industries

This paper analyzes the dynamics of innovative industries using a conceptual system dynamics model which is by design "generic and simple" (Weil and Utterback 2005). The

abovementioned system dynamics model provided a starting point and an element of structure to the one developed for this paper. Furthermore, this paper delivers a comprehensive and elegant supply-side, industry-level view of technology adoption thus providing the inspiration for our demand-side, firm-level focus on innovation as an attempt to deliver complementary analysis. In particular, we attempt to answer selected questions from the next steps section:

- "How do the decisions of established firms and start-ups differ?
- What roles do social and contextual factors play?
- Are dynamics different for services?" (Weil and Utterback 2005)

We describe below Weil and Utterback's dynamic model and identify the key concepts that feed into this paper. The integrated conceptual model is shown in Figure 5. While this view is at the industry level, we retain the concept of research and development (R&D) productivity, R&D expenditure and level of technology. These concepts are also applicable at the firm level. Technology firms invest in R&D with R&D expenditure. An R&D organization has a productivity that is characteristic of its organizational structure, culture and industry. The goal of R&D is to increase the level of technology, which in turn increases the benefit of a new product. The benefit of a new product is defined by increased performance and/or decreased cost in comparison to the incumbent product.

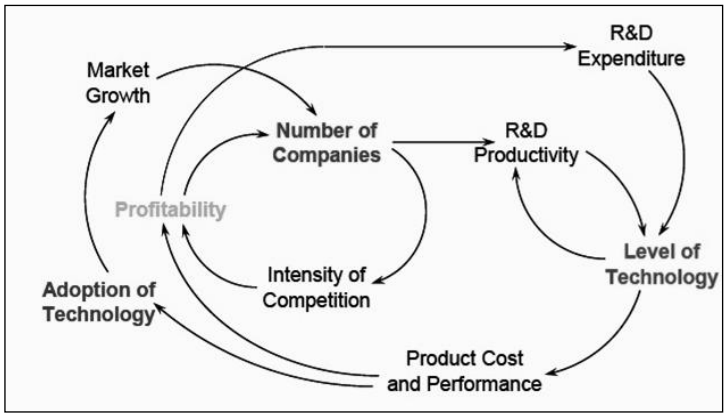

Figure 5 - Integrated Conceptual Model (Weil and Utterback 2005)

Weil and Utterback also discuss the factors feeding into the user's willingness to adopt. These factors include the perceived level of risk in the early stages of the technology and the quality and quantity of information available. As more users, specifically "reference users" adopt, the quality and quantity of information improves, thus encouraging the next category of users to adopt. The "reference users" legitimize the new product and reinforce a notion of "must-have" that can also be either initially created with marketing by the firm or be an emergent property of the "reference users" interaction with the new product. The perceived benefit of the new product is either improved by marketing and/or positive word of mouth that is initiated by an influential "reference users" group.

The five papers referenced in this section 2 capture several important considerations that a technology firm should take into account when deciding how and when to launch a new product. While each one provides insights, separately they only partially address the important strategic decision of new market entry or new product launch. By combining important aspects of each of these frameworks into an inclusive, cohesive and dynamic model, we can not only

help firms decide whether or not to launch a new product or service but also how they should go about doing it.

3. Definitions

3.1. Word of mouth

Two effects are spread by word of mouth: network effect and bandwagon effect. Network effect is the effect that one user has on the value of the product for other users. For instance, the adoption of the telephone illustrates the concept of network effect: the more users, the more valuable the telephone network. The bandwagon effect refers to the increased preference of users for a product as more people start adopting it. As more people purchased IBM products, more people chose to buy IBM products because of the increased reputation that the brand carried. As the old adage went *"Nobody ever got fired for buying IBM equipment"*.

These effects are also illustrated by the data on adoption of Enterprise Resource Planning (ERP) software in the 1990's in the automotive industry (Léger et al.). Although our system dynamic model combines both effects into an aggregate word of mouth effect, we describe the important difference between the two effects with the example of an ERP system.

- **Network effect**: "the adoption of a given ERP system will be positively influenced by the use of that same ERP system by trading partners" (Millaire et al. 2009) "Network effects can be quite powerful, where the value increases non-linearly as a function of the number of users" (Weil and Utterback 2005). Since automotive manufacturers may share some suppliers and contract manufacturers, the adoption of the ERP system by early adopters triggers the adoption by other firms that seek to replicate the benefits captured by the first adopters. In the example of the automotive industry, "ERP implementation is part of a larger attempt to increase profitability"(Millaire et al. 2009).
- **Bandwagon effect**: "the adoption of a given ERP system will be positively influenced by peer influence (imitation)" (Millaire et al. 2009). Marketing by the firm may jumpstart the bandwagon effect by targeting the "reference users" therefore causing other users to want to imitate them. However, word of mouth is a more credible mechanism to sustain the adoption rate of the new product. "Decision makers seek legitimacy more than efficiency"(Millaire et al. 2009). The bandwagon effect implies that trust in the vendor and its' brand are important factors in the adoption of new technology products.

3.2. Customer experience design

> *"Customer experience encompasses every aspect of a company's offering—the quality of customer care, of course, but also advertising, packaging, product and service features, ease of use, and reliability." (Meyer and Schwager 2007)*

We expand the definition of customer experience design beyond the relationship between the user and her current graphic screen interface to include all aspects of "the social side of technology—the complete customer experience" (Weil 2007). Customer experience design includes interface design considerations such as design choices for information visualization, personalization of content and device delivery.

To highlight the importance of the non-technical success factors of technology firms, we decomposed (deconstructed/separated) customer experience design into two variables: *average*

switching costs and *perceived incremental benefit of new technology*. The customer is experiencing a new technology product by evaluating the incremental benefit of the new technology. Her perception of the new product is a function of her degree of loss aversion towards the incumbent solution and by her degree of enthusiasm towards the promise of the new technology. The user is also considering a set of non-technical criteria when considering the adoption of new technology product. This set of criteria is captured by the average switching costs.

Information technology firms often underestimate the impact on business outcomes of inimitable customer experience even though it is an essential part of successful entry. New products that are based on incremental or radical technological changes require an understanding of customer experience and a scientific experimentation process for discovery and continuous learning of the customer journey (Ries 2011). Does the customer perceive the new technology product as beneficial considering the disruption of a new installation and re-training? On the other hand, "*when companies are faced with radical technological changes decision-making cannot be based on existing understandings of customer needs, values, and expectations*" (Weil 2009). Winning in technology markets assumes that the firm has the skills to design and manage a new category of positive user experiences.

3.3. Switching costs

> *"You just cannot compete effectively in the information economy unless you know how to identify, measure, and understand switching costs and map strategy accordingly." (Shapiro and Varian 1998)*

We refer to switching costs as the costs incurred by the customer to switch to the new information technology product. There are three types of switching costs: transaction costs, learning costs, and artificial or contractual costs. (Farrell and Klemperer 2007). These costs are explicit.

> *"Transaction costs are costs that occur to start a new relationship with a provider and sometimes also include the costs necessary to terminate an existing relationship. Learning costs represent the effort required by the customer to reach the same level of comfort or facility with a new product as they had for an old product." (Chen and Hitt 2002)*

There are implicit switching costs that pertain to the customer's degree of loss aversion and willingness to be an early technology adopter. Implicit switching costs include cultural biases towards acceptable attributes of information technology products such as data privacy.

> *"Despite the critical role of switching costs in ecommerce strategy, there is surprisingly little empirical evidence about the presence, magnitude, or impact of switching costs on customer behavior." (Chen and Hitt 2002)*

Switching costs are assumed heterogeneous. There is a normal distribution of switching costs for customers. The system dynamics model described in this study attempts to link the role of switching costs to the customer's willingness to adopt a new technology product. The model captures the heterogeneous behavior of customers.

4. Description of system dynamics model

> *"People discover that their own policies inevitably generate their troubles. That's a very treacherous situation because if you believe these policies solve the problem, and you do not see that they are causing the problem, you keep repeating more of the very policies that create the problem in the first place. This can produce a downward spiral toward failure." Jay Forrester (Fischer 2005)*

4.1. Choice of system dynamics as a methodology

Business decision makers rely on simple mental models, which have significant limitations. They become increasingly deficient as business problems grow more complex, as the competitive environments evolve more rapidly, and as the number of decision makers increases. The "*amplification and tipping dynamics typical of highly coupled systems, for example, bandwagon and network effects*" that are defined in chapter 3, are not anticipated. "*Behavioral factors play critical roles in the evolution of markets*" (Weil 2009). This study illustrates the benefits of system dynamics modeling to aid decision-making in a complex, rapidly changing business environment.

An original system dynamics model was designed and built using the software Vensim DSS. The purpose of the model is to explore the dynamic behavior of a firm's product development activity and of the role of customer experience in the adoption of new technology products. Our motivation was to build a model of the firm and its relationship with its customers in order to identify the high leverage points for effective intervention and investment. The model was built to capture the learning from the classical frameworks in section 2. It was also informed by market research and interviews with senior executives in two studied technology firms. In this section, we describe the important elements of the system dynamics model.

The model took into account the learning and important dynamics of a system dynamics model of innovative industries(Weil and Utterback 2005). An interesting and novel feature of the model is the incorporation of the 9x effect framework (Gourville 2006). Overestimation of the new technology product by the firm and overestimation of the incumbent product by the customers are modeled.

Finally and critically, the model also takes into account the importance organization learning and learning from customers. This capability is one of the three capabilities we identified by applying the dynamic capabilities framework described in section 2.1. We modeled three categories of capabilities.

- **Technological**: Technological assets and opportunities. Technological assets matter when they are difficult to imitate.
- **Ability to reduce switching costs**: This category includes "reputational assets", ability to understand the customer's unmet needs and relationship to the product to be displaced. We are particularly interested in ways to reduce the non-financial switching costs (emotional, psychological, reputational). The model includes a normal distribution of switching costs.
- **Organization learning**: The ability for the organization to experiment with business models, product design, pricing strategies, customer experience and proposition options,

to learn from customers and from other divisions, and to disseminate information effectively inside the organization. Organizational learning is particularly challenging in global firms because of scale and geographic limitations. Furthermore, counter intuitive policies prevent effective collaboration and information exchange. Large organizations often operate in division silos. Learning from customers does not organically spread through global locations and strategic business units. The firm needs to proactively and continuously manage the diffusion, use and reuse of the learning from the customer and from within the organization. "*Competing on intangibles requires quite different capabilities from competing on product or service price and performance*" (Weil 2007).

4.2. System dynamics model assumptions

It must be noted that in order to properly define the model within the scope of this study and calibrate it to available data, a series of assumptions were made:

- The model time horizon covers the development and release of one product as opposed to a series of releases that may be part of a product line.
- Switching costs are assumed heterogeneous. There is a normal distribution of switching costs for customers.
- Word of mouth is an aggregate of network and bandwagon effect as described in section 3.1.
- The target customer perception for the firm's marketing campaign is constant throughout the life cycle of the product.
- Price is an exogenous variable.
- The process by which the technology firm learns from its customers, being coupled to the product adoption rate, does not begin until product launch. However, the firm may choose a limited and exclusive product launch. The firm would choose to start with A/B testing business experiments in order to improve its product strategy such as key product features, complementary offering, pricing model, user experience design and service level agreements.

4.3. Important dynamics

The dynamics of new technology adoption and customer experience are interrelated. In this section, we describe the important dynamics and their linkages. The important dynamics are composed of reinforcing and balancing loops. A reinforcing loop produces an exponential growth or decay. A balancing loop produces a curve that tends towards a goal, meaning that the curve reaches a plateau.

4.3.1. Technology investments and understanding the customer

This feedback loop captures the customer's perception of the new technology and the resulting product adoption. Technology firms invest in research and development (R&D) to increase the benefit of the new technology. Their focus is on gaining a technological advantage, which would be achieved by investments in R&D. However, there are diminishing returns in investments in R&D for a given product. As the benefit of a new technology increases, the productivity of R&D expenditures decreases. This dynamic can be illustrated by the photographic film industry or the microprocessor technology. At some level, the investments in

making a better film or a better microprocessor provides less value both to the firm and to the customer. The diminishing returns of investments in R&D loop assumes that the firm is producing incremental innovations in the absence of the second and important dynamic of learning shown in red on Figure 6.

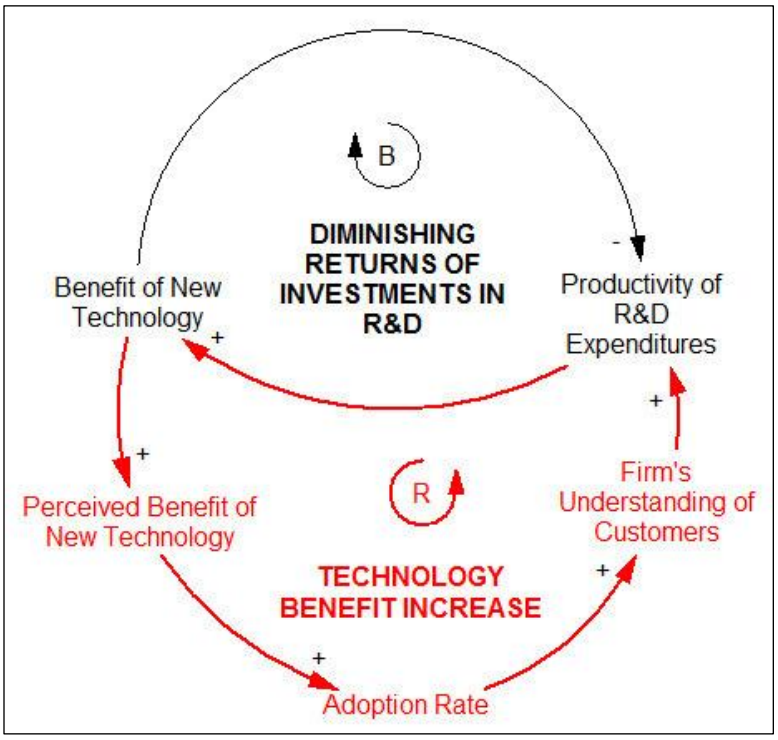

Figure 6 – Technology investments and benefit - Causal loop diagram

The loop labeled “diminishing returns of investments in R&D” is a balancing loop, while the technology benefit increase is a reinforcing loop. As the benefit of the new technology increases, the customer's perception of new technology increases. The rate of improvement of customer perception may be slow as described by the "long haul" scenario in the Gourville framework in section 2.3. We assume that the customer’s perception of the new technology cannot deteriorate as the benefit of the new technology increases. As the perceived benefit of the new technology increases, the adoption rate increases. With more adopters, the firm learns from its customers and increases its understanding of the customers. Better understanding of the customers' needs increases the productivity of R&D expenditures, which in turn increases the benefit of the new technology.

This reinforcing loop illustrates the importance of learning and understanding customers. Using the system dynamics model and scenario analysis, we will illustrate in section 6.2.1 the implications of the technology benefit increase loop. A firm that takes the initiative to learn from its customers with each sale will improve its understanding of the objective and emotional factors that can increase the customer's willingness to adopt the new product. The customers' willingness to adopt depends on both objective and emotional factors (Weil and Utterback 2005).

4.3.2. Marketing investments and word of mouth

We define marketing as the activities of the firm to improve the customer's perception of the new technology as the product is launched. This term includes branding activities and traditional product and the firm marketing. Investment in marketing increases the effectiveness of marketing. Effective marketing improves the customer's perception of the new technology product and helps kick start the word of mouth effect, which eventually becomes the primary marketing effect. This loop captures the firm's marketing strategy in developing customer perception and its execution as a transition from firm-focused outbound push marketing into customer-driven word of mouth. The role of marketing is to reach and influence customers when there are not enough adopters to benefit from positive word of mouth. As the effect of word of mouth increases, incremental investments in marketing efforts become less impactful. The loop labeled "diminishing returns of investments in marketing" is a balancing loop and is shown in Figure 7.

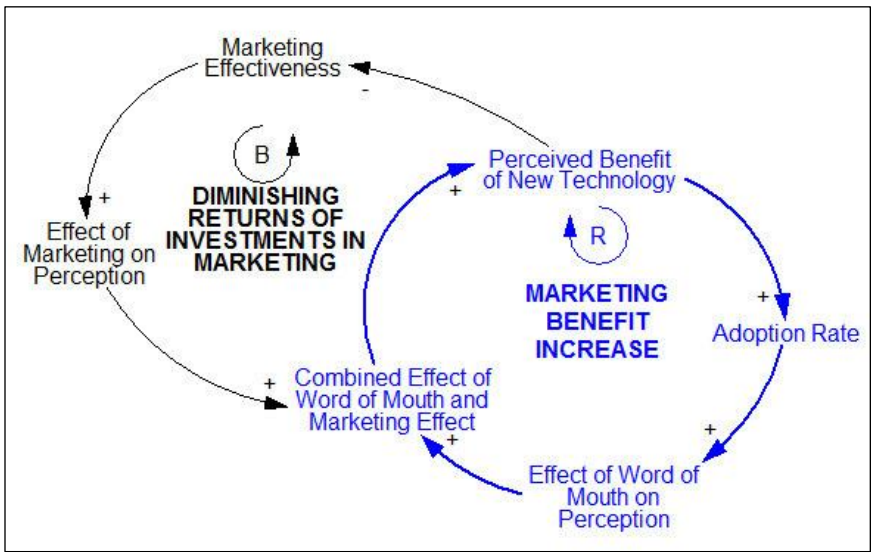

Figure 7 - Marketing investments and effectiveness - Causal loop diagram

Word of mouth has the same role as marketing but it is significantly less costly or free to the firm. As more adopters discover the advantage of the new product, word of mouth improves customer's perception. The combined effect of marketing and word of mouth improves customers' perceptions that in turns increases the adoption rate. The loop labeled "marketing benefit increase" is a reinforcing loop.

4.3.3. Integration of technology and marketing loops

In this section, we show how technology and marketing are interrelated and influence the customer's perception of the new technology and the adoption rate.

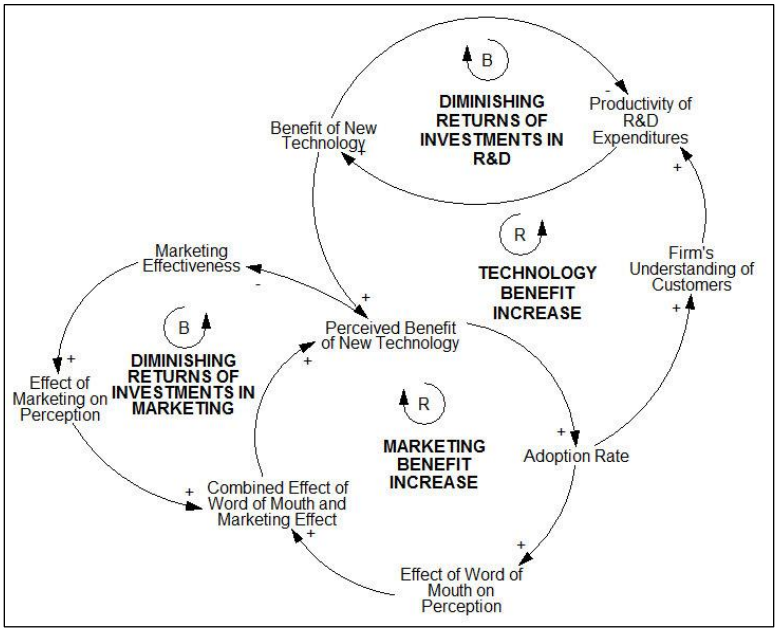

Figure 8 - Technology and marketing - Causal loop diagram

We are able to observe that technology and marketing activity both increase product adoption in two distinct ways. Technology is focused on the capability to deliver a benefit to the customer through a product. Marketing is focused on shaping the expectations of the market to align to the benefits delivered by the product incorporating the technology. Both activities serve to increase product adoption rate by increasing the customer's perception of the benefit of new technology.

Unmanaged, the perceived benefits of a product shaped by marketing often do not align well with the capabilities delivered by a new technology, leading to a lack of product adoption. A pro-active focus on understanding the needs of customers is a crucial means to ensure the continued alignment between technology and marketing. It allows R&D groups to focus on technologies that deliver the benefits that marketing is promising to customers. It must be noted that marketing and word of mouth are focused on the perception of the technology and do not impact the customer's switching costs. Also, R&D investments and technology benefits are focused on technical capability and its value to the customer, and not on switching costs of adoption.

4.3.4. Switching costs reduction

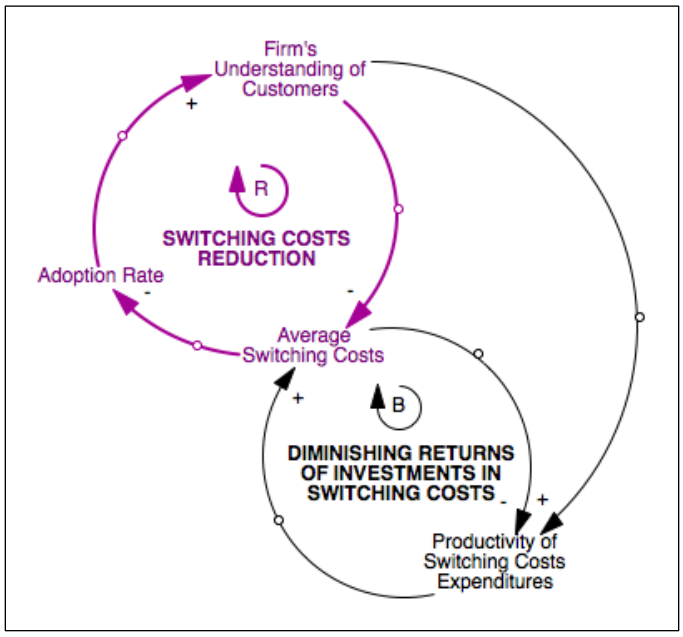

Figure 9 - Switching costs - Causal loop diagram

Switching costs were defined in section 3.3. The causal loop diagram shown in Figure 9 allows for the introduction of a heterogeneous profile of customers in respect to switching costs. In the full system dynamics model, we included statistical functions to capture the assumption of a normal distribution of switching costs. The variable labeled average switching costs represents the switching costs for the entire target market. The loop labeled "switching costs reduction" illustrates that customers are more likely to adopt when their switching costs are reduced. As switching costs for product adoption are decreased, the barriers to entry for new customers are lowered. This lowered barrier to entry incentivizes mainstream majority customers to adopt, creating the opportunity for the new technology product to become dominant in the market.

The firm's ability to understand its customer drives its ability to reduce average switching costs, which in turn increases the adoption rate. As described in section 4.3.1, the increased number of adopters enables the firm to improve its understanding of its customers by learning from them. Figure 9 also illustrates that there are diminishing returns on investments aimed at reducing switching costs. At some point, investments in reducing switching costs results in lower productivity of switching costs expenditures. The firm can increase the productivity of switching costs expenditures by improving its ability to learn and understand its customers.

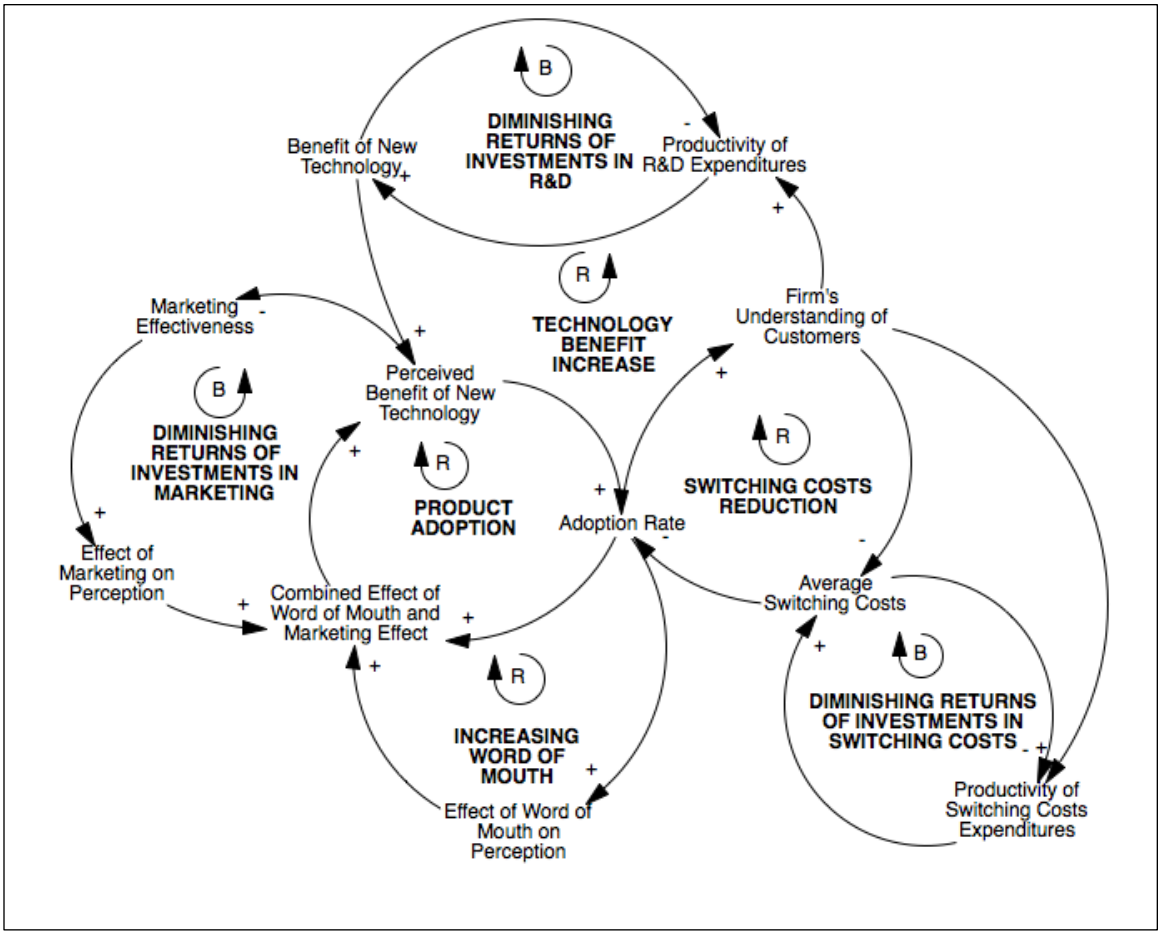

Figure 10 - Firm's investment levers and ability to understand customers

A firm has limited resources and must constantly rethink where it makes the most sense to invest its next dollar. Our model (Figure 10) shows that the answer to this question changes over time based on previous investment decisions and that focusing exclusively on any one area leaves significant value on the table. Our model suggests that a firm can optimize its returns on investment by taking a balanced approach across all three major investment areas. The primary way to achieve balanced investments is through learning from customers and effective dissemination of customer understanding within the organization. Balancing the investment requires measuring the results and hence relying on data to make decisions about investment allocation.

4.3.5. Product adoption dynamics

From our previous observations, we can conclude that there is a central sequence of events related to customer adoption of a technology product, shown in Figure 11.

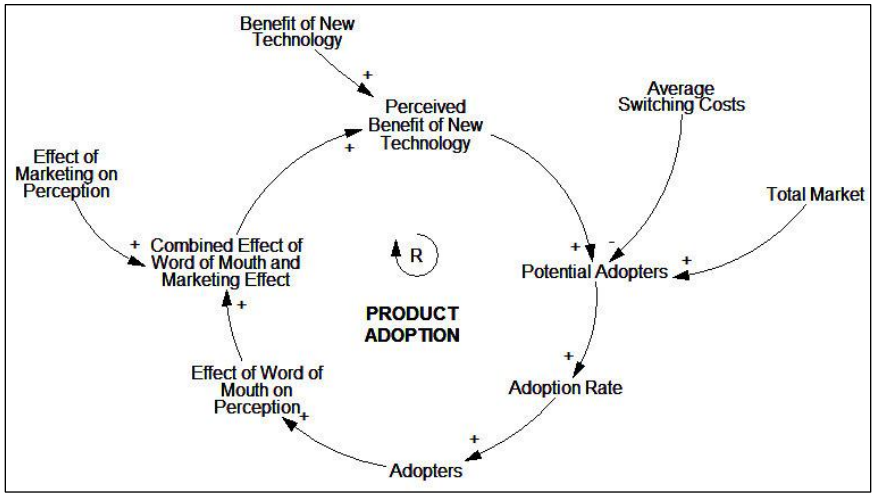

Figure 11 - Product adoption dynamics

This central product adoption behavior is the customer-focused nexus at which the other activities meet:

- Increased marketing to influence and shape the customer perception of the product
- Technology R&D increasing the benefit of new technologies to the customer
- Understanding of customer's leads to increasing technology value delivery
- Understanding of customer's leads to lowering average switching costs

When properly managed, these relationships are capable of increasing product adoption. However, as presented in Figure 12, there is a limit to product adoption -- and that is when the market becomes saturated. The good news is that the point at which a firm's market becomes saturated depends not only on the total size of the market but also on the firm's ability to learn from its customers and to incorporate this learning into designing a better product and addressing its customers' switching costs.

Although beyond the scope of this research, it is not beyond reason to put forth a hypothesis that firms committed to learning from and understanding their customers are well positioned to not only capture a large portion of the total market as it may be defined initially, but to also understand how they might even broaden the total market by identifying new customer needs that its product may address.

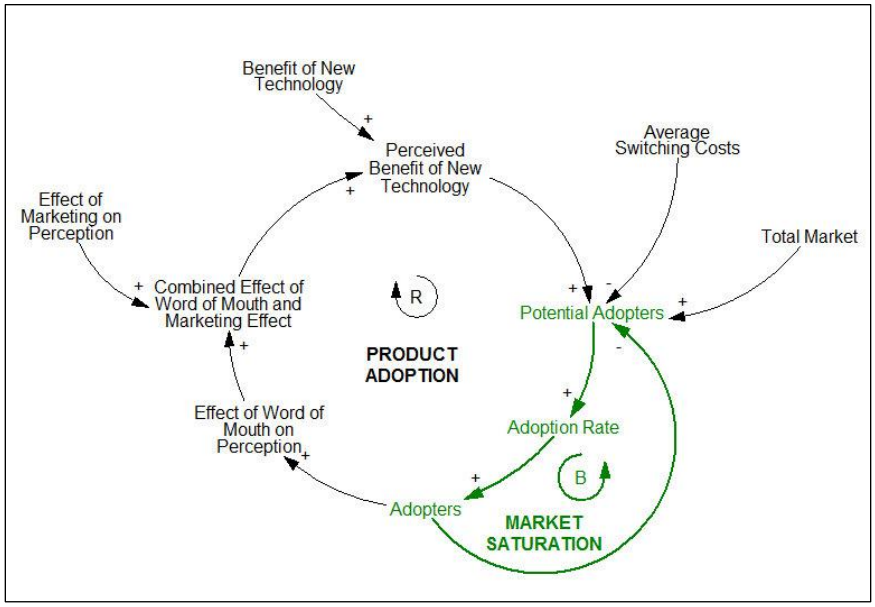

Figure 12 - Product adoption and market saturation

There are always limits to growth, and every product progresses through a natural lifecycle from early adoption to late adoption. Our model captures this dynamic not only for the diminishing returns on investment across the three major investment areas but also for the overall growth of a firm's customer base.

5. Model validation using business data

This study included the business case of an information technology firm that delivers an online search service to a specific class of knowledge workers. The research process included the exclusive access to proprietary data obtained and interviews with executives at the abovementioned firm. Normalized new product adoption data and interview insights were used to validate a system dynamics model of technology adoption a posteriori at the firm level. We were given adoption data about two products called product A and product B that were introduced around the same time. Both products are embedded features on the online research platform. We also interviewed executives in charge of product research and development in order to understand the important adoption factors for both products. Interviews revealed attributes of Product A and B that aided the calibration of the system dynamics model.

5.1. Product A – familiar technology and familiar market

Product A is built on a technology that is well understood by the firm. Product A is an external facing version of an internal development tool that was in extensive use by the R&D team. The purpose of Product A is to improve the content provided on the online search platform. The strategy behind the launch of product A was to take an internal solution and deliver it to the user of the online research platform. Product A consists of a recommendation engine for additional content and expert opinion. Interviews with the executive in charge of new product development helped apply both the familiarity matrix and the Gourville's framework. Product A is familiar. The underlying new technology had been extensively used internally to improve the performance of the parent online search platform. The market is also familiar: product A's value proposition is the same as the parent online search platform.

5.2. Product B – new, familiar technology and new, familiar market

Product B relied on technology that is less familiar to the firm. The assumption was that the user would greatly benefit from the ability to perform search on her internal documents in the same fashion that users search for content on the online research platform. As with Product A, an interview with the lead executive in charge of product development provided the products position on both the familiarity index and the Gourville framework. Product B is new but familiar technology. Its functionality is different from the parent search platform therefore the market is new but familiar. Although product B is targeted at the same customer base, it delivers a functionality that is new and different. Product B was developed internally. The familiarity matrix in section 2.2 suggests that a better go-to-market strategy would be to consider an internal venture approach, an acquisition or a licensing deal. Berry and Roberts describe that internal ventures, the ability "to harness and nurture an entrepreneurial behavior within the corporation" yield mixed results (Roberts and Berry 1985). Product B developers assumed that its value proposition was complementary to the one of the parent online search platform.

5.3. Description of adoption data

The adoption data consisted of monthly-adjusted revenue numbers as well as instances of usage in the case of product A. For Product A, the delivery model was changed mid-stream. The product management team received feedback from users that the ancillary model of pay-per-use was a cause of concern. The variable and unpredictable cost of usage of product A was unattractive to firm A's customers. Consequently, the business switched the delivery model of Product A to a subscription model that provided predictable yearly expenses for its customers. After adjusting for price increases, we verified with senior executives that revenue numbers were an adequate proxy for adoption of product A. We obtained a smaller range of data for product B. Interviews with senior executives confirmed that the missing data was in trend with the data received. In other words product B experienced a very low and flat adoption rate.

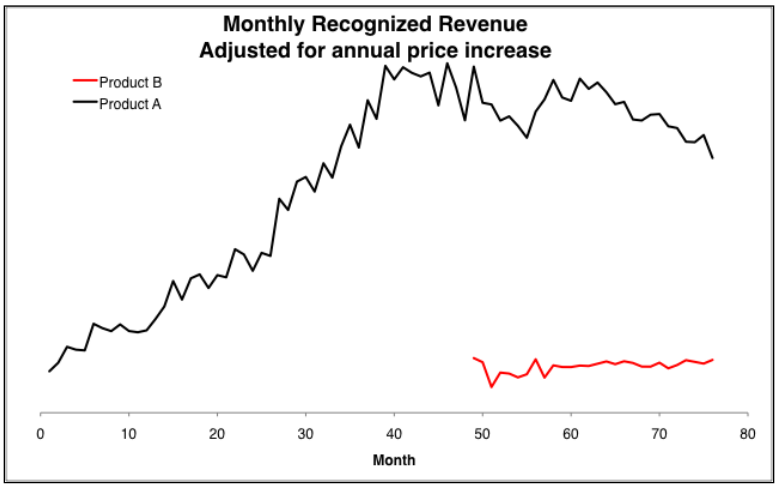

Figure 13 - Validation data: Adoption of products A and B in firm A

During our interview, we asked the senior executive in charge of product development to locate Product A and B on the Gourville framework shown on Figure 4. Product A was classified as an "Easy Sell" and product B as a "Long Haul". Product A fits well in the customer experience of the customer as it is performing its primary task of vertical search: there is very little

behavior change required of the customer. The underlying technology was proven and used internally by the firm. In contrast, Product B required a significant change of behavior from the customer as it attempted to replace an incumbent solution that exists outside of the Firm A's product suite. In addition, the underlying technology was not familiar to the firm. The Gourville framework described in the literature survey would have been sufficient to predict the relative success of Product A and lack of success of Product B.

6. Scenario analysis

> *"There can be a very powerful synergy between scenario development and system dynamics modeling. Scenarios consider multiple futures and force unconventional thinking. (...) Scenario building requires managers to have a coherent view of their business. System dynamics models can help managers to acquire this view". (Weil 2007)*

6.1. Base scenario – model validation

Product B did not get adopted and is a failure as measured by the stagnant sales and small revenue generated. Product A was a success. We note that there is a decline of revenue that coincides with the "Great Recession" starting in December 2007 (Rampell 2009). The recession affected all products and is exogenous to our model. We also can make the assumption that competition can be kept outside the boundaries of the model. For the period studied, the product was embedded on a platform that maintained consistent and dominant market share. In 2010 and onward, after the studied period, new entrants from other industries and small players are threatening the dominant position of the platform today. However, understanding the success factors of Product A and the drivers behind the failure of Product B continue to be important as competition increases.

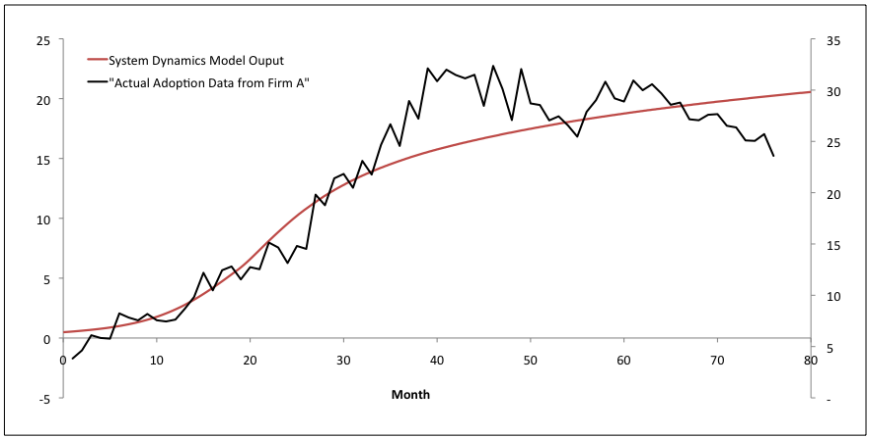

Figure 14 - Calibration of system dynamics model using Actual Adoption Data from Product A

Product B did not take into account the switching costs and therefore resulted in very low adoption. The model predicts low to no adoption for a given product if *Average Learning Per Sale* or the *Switching Cost Expenditures* are null.

6.2. Alternate scenarios

In this section, we run different scenarios from the baseline for Product A to understand what factors contribute to adoption. For each scenario, we looked at the rate of adoption by plotting

the stock *Adopters* and the financial outcome, *Accumulated Discounted Profits* at the end of the simulation period of 140 Months. The goal of the scenarios is to witness the behavior of the model.

6.2.1. Scenario: Learning more from customers

The first scenario is one where we double the *Average Learning Per Sale*.

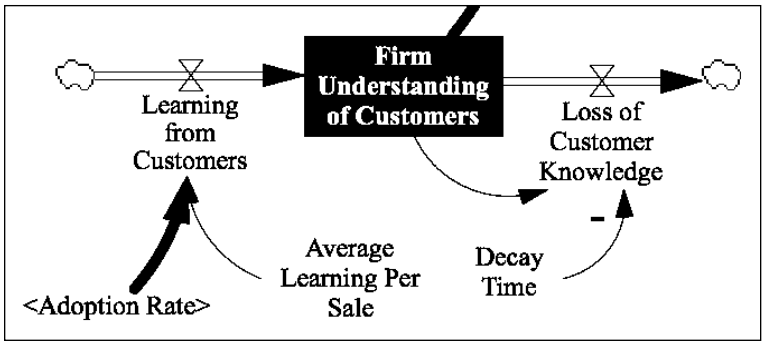

Figure 15 - Model structure pertaining to customer understanding

Increasing *Average Learning Per Sale* by a factor of 2 results in a 12% increase in *Accumulated Discounted Profits*. It also increases the rate of adoption and drives adoption sooner as shown in Figure 16. This scenario illustrates the benefits of investing in the firm's ability to learn from customer and to disseminate the information efficiently and rapidly inside the organization. The learning is achieved through experimentation and as a mean to thrive "in a world that values agility and speed over anything else" (Bosch 2012).

Our interview with the firm's management revealed that there was a change of delivery model based on information collected from customers and feedback on why a pay-per use model was less favorable than a subscription based model. This scenario describes a case where additional insights might have been collected about the usage of Product A to increase the firm's ability to learn with each sale. Better business analytics enabled by richer customer data offers new ways to achieve increased learning from each sale. The ability to rapidly learn from customers and share the insights inside the firm is mandated by the leadership and enabled by information technology (IT).

> *"IT is setting off a revolution in innovation on four dimensions simultaneously: measurement, experimentation, sharing and replication. Each of these is important alone, but, more profoundly, they reinforce each other. They magnify the impact of each other" (Brynjolfsson 2010).*

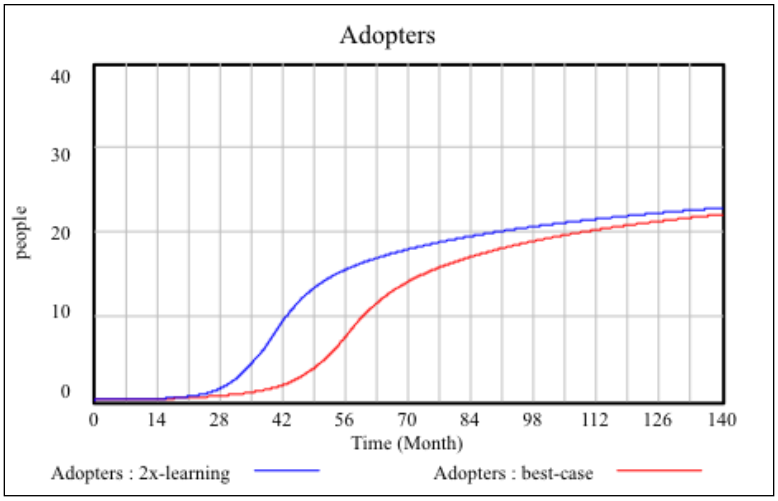

Figure 16 - Impact of better rate of organization learning on product adoption

Learning from customers must be seen as integral and essential to the go-to-market strategy for information technology products. The learning must be sustained and continuous with a pervasive culture of business experimentation to deliver the benefits illustrated by this section.

6.2.2. Scenario: Decreasing switching costs

In this scenario, we allocate an additional 0.5 million in *Switching Cost Expenditures* and reduced *Prelaunch Product Development Expenditure Rate* by the same amount. In this scenario, the firm focuses on the factors that contribute to customer experience that are not driven by technology or by the perception of technology that can be addressed by marketing or word of mouth.

Reducing the switching costs has a significant positive effect on product adoption, as measured by a 27% increase in *Accumulated Discounted Profits*. Investments towards reducing switching costs aim at meeting and anticipating the needs of the customer over time. “Switching costs shift competition away from what we normally think of as the default (a single consumer’s needs in a single period) to something broader – a single consumer’s needs over time” (Farrell and Klemperer 2007). Attributes such as usability, simplicity of customer journey, carefully designed and reliable customer service provide the assurance to the customer that the new product is worth incurring switching costs. The impact of re-allocating 0.5 million from research and development to the reduction of switching costs is positive because the product is adopted faster by a broader set of customers.

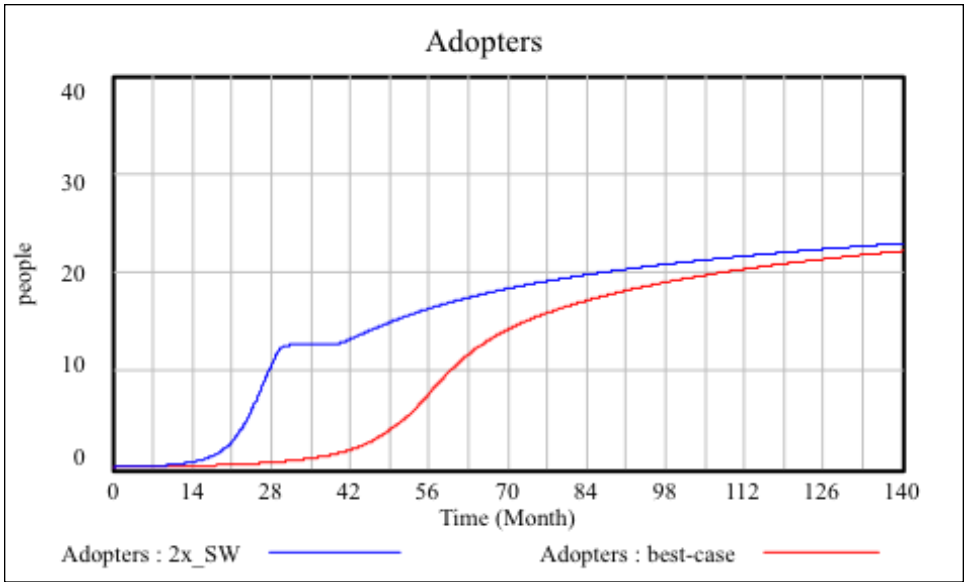

Figure 17 - product adoption with an increased focus on switching costs reduction

Technology firms tend to underestimate these switching costs. Instead of product design and development lifecycle process, technology firms should adopt a customer experience design approach. A tacit requirement for the adoption of new technology is reducing switching costs that are neither financial nor solely addressed by technological improvement.

7. Recommendations

> *"Competitive advantage is no longer about the economics of applications, software or hardware. In the modern era, it is the economics of data and networks of trust that determine winners and losers." (Newman 2011)*

7.1. Limitations of classic frameworks

In chapter 2, we described the selected academic papers that shaped the design of the system dynamics model in this study. We identified non-technical factors in the adoption of technology products. Several strategy frameworks were incorporated into a system dynamic model. Classic frameworks such as Porter's five forces are static (Porter 1996). They do not address the effects of "bounded rationality, imperfect information, and fragmentation of decision making" (Weil 2009). We describe here some of the limitations of the classic frameworks.

The digital economy represents an acceleration of the pace of competition and a static and linear view of competitive advantage and is therefore limiting and inadequate for survival. Other frameworks identify the rise of competition from adjacent or radically different industries(Munir and Phillips 2002), Teece and Pisano (1994). By developing a dynamic firm-level model, we walked away from an industry level view of competition and focused on the relationship of the firm with its customer and on the strategic capability of effective rate of organizational learning.

Gourville focuses on the firm and its customers. His framework captures perceptions biases of new products by customers and the firm. Gourville's framework does not address market heterogeneity as captured by the normal distribution of switching costs in our model, nor the positive effect on profits of effectively learning from customers over time as product adoption

increases. Learning from customers is an important and effective mechanism for closing the perception gaps identified by Gourvillle. Building dynamic capabilities to conduct business experiments, continuously acquiring and refining better customer understanding, and disseminating learning across the organization increases the firm's chance to overcome the "9x effect".

While each framework is described in chapter 2 provides insight, separately they only partially address the important decisions of whether to launch and how to launch. We combined critical aspects of each of these frameworks into a more inclusive, cohesive and dynamic model.

7.2. Conclusions and next steps recommendations

In chapter 3, we defined customer experience as the customer's perception of the benefit of the new technology and her average switching costs. Investments towards reducing switching costs aim at meeting and anticipating the needs of the customer over time. Such investments imply building new capabilities to reduce switching costs: new type of work force, new model of customer engagement and adaptive business models that leverage past business experiments.

A system dynamics model was described in chapter 4 and provided the basis for scenario building to understand high leverage points when introducing a new information technology product to market. Technology firms have a strong bias towards over-estimating their market familiarity and towards over-estimating the benefit of the new technology.

Our system dynamics modeling results suggest that two high leverage points around reduction of switching costs and organization learning need to be considered in addition to the delivery of an adequate technological solution. Technologists tend to underestimate the implications of customers' switching costs and perception of the benefit of a new technology.

We identified that investing in continuously improving customer experience is necessary to succeed for technology firms. Understanding and addressing the customers' switching costs is essential to transition from a product company to a customer experience company. An important insight from our study is the importance of learning from customers and of the rate of organization learning at large.

The model would benefit from further development to capture, compare and contrast a software product versus a software platform strategy. We would incorporate the effect of on-boarding third party developers and describe the dynamics of building a business ecosystem. As more technology businesses are starting up in an effort to realize the benefits of a platform business model, an updated system dynamics model shall explore the dynamics of technology adoption in the context of platform strategy (Bosch).

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