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The effectual process of business model innovation for seizing opportunities in frontier markets

Masoud Karami, William W. Baber, Arto Ojala

Abstract

Business model innovation is crucial for small digital service providers when they move into frontier markets. This study applies effectuation theory to explain how these firms innovate their business models as a cognitive description of the structure and activities. We conducted 24 interviews over five years with key decision-makers from eight small digital service providers in Japan and Canada. Our findings reveal that effectual logic of control enables decision-makers to utilize their internal means and innovate their business models in the face of rapid changes to shape and seize new opportunities at the frontier market. Focusing on the opportunity side of changes, taking action, learning from the results of each action, and collaboration with important stakeholders are the most important factors in successful entry into a frontier market. Also, technology and human capital play an important part in taking control of the frontier market entry process. We contribute to business model innovation research by theorizing the managerial cognition as a microlevel factor in BMI research. We also contribute to practitioners' understanding of their cognitive models and BMI.

Keywords: Business model innovation, Effectuation, opportunity creation, Uncertainty

1. Introduction

In the current digital business environment, changes in technologies, regulations, and customers' requirements develop so quickly that constant preparation and adjustment of business models¹ are needed to stay ahead in business. This is why Lewis Carroll's (1872) story of the Red Queen's world in which one must run as fast as possible just to stay in the same place has become a widely used parable for modern business. Because changes come rapidly, and often unexpectedly, it is thought that firms that are able to adjust or innovate their business models

¹We define business models as "cognitive structures providing a theory of how to set boundaries to the firm, of how to create value, and how to organize its internal structure and governance." (Doz and Kosonen, 2010, p. 371)

(Aspara et al., 2010; Casadesus-Masanell and Zhu, 2013; Demil and Lecocq, 2010; Futterer, Schmidt, and Heidenreich, 2018; McGrath, 2010) are more likely to succeed or have the conditions needed for success (Marquardt, 2011; Saebi, Lien, & Foss, 2017; Yeo, 2003).

Business model innovation (BMI)² enables such firms to proactively improve in increments or by leapfrogging the industry to change market conditions (Doz and Konsonen, 2010; Tongur and Engwall, 2014; Velu, 2015; Voelpel, et al., 2004) and reach a frontier³ position. The frontier in this context means a constantly unfolding uncharted territory of innovations and technology for businesses (Levy and Kuo, 1991). As there is constant development of new technologies, systems, platforms, infrastructures, regulations, and needs, it is challenging for firms to reach frontier position in their market. This requires ongoing innovation of new business models. However, the process is risky as it includes many uncertainties so that only a limited number of firms can achieve position at the business frontier.

To attain better understanding of frontier position, we integrate literature from business model studies with effectuation literature. We conceptualize business models as a mental description of the structure and activities of an organization (Baden-Fuller and Morgan, 2010; Osterwalder et al., 2005; Teece, 2010). Entrepreneurial cognition becomes critically important in small firms as the business models reflect entrepreneurs' hypotheses about customers' needs and wants, and how the firm can create, capture, and deliver that value (Teece, 2010). As such, business models and BMI are closely intertwined with entrepreneurs' imagination, judgement, and learning (Foss and Saebi, 2017; McGrath, 2010). Literature on effectuation theory (Sarasvathy, 2001) provides a useful framework in explaining how entrepreneurs co-create new opportunities to deliver and capture value (Tidhar and Eisenhardt, 2019) out of the uncertainty of an unknown future. This is the case especially at frontier markets where entrepreneurs' cognitive models and heuristics (including their BMs) have developed over years (Maine, Soh, and Dos Santos, 2015; Read et al., 2016).

The extant BMI research has been heavily engaged with the reactive approach of businesses to changes in the environment (Demil and Lecocq, 2010), discovery of new BMs (Markides, 2006), business model replacements (Mitchell and Coles, 2004), adopting novel approaches to

² In line with Foss and Saebi (2017, p. 201) we define BMI as “designed, novel, nontrivial changes to the key elements of a firm’s business model and/or the architecture linking these elements.”

³ We consider a business to be at the frontier if it involves very new features or configurations, especially those that are largely absent in the industry. We further consider firms to be at the frontier if they are investigating or taking on projects, technologies, and ideas that are novel or barely known in the industry or the world in general (Hinings, et al., 2018).

commercializing (Gambardella and McGahan, 2010), among other reactive approaches. As such, the opportunity side of the rapid changes, internal motivations, and the uncertainty of such context has received only meager attention (Foss and Saebi, 2016). Effectuation theory provides a useful lens to look at BMI as a cognitive process in pursuit of new opportunities, and further develop our understanding of proactive approaches to BMI. Specifically, effectuation helps us to gather better understanding why some firms can innovate their business models to reach the frontier position in the market whereas some firms fail to do so. In addressing this gap, we set the following research question: *how do small digital service providers innovate their business models to attain or fail to attain a position at the business frontier in the face of uncertainty caused by rapid changes?*

To contribute to our understanding of the topic, we apply qualitative case-study methodology. Our empirical data base on 24 interviews from eight case firms collected over a five-year period. The case firms include small and medium firms developing software services and products. The focus on small firms makes it easier to control for the moderating impact of micro level factors, as entrepreneurs are a major portion of the firm, not merely a segment at the top (Foss and Saebi, 2017; Hambrick and Mason, 1984). We study the phenomena by using effectuation theory (Sarasvathy, 2001) to better understand BMI for gaining a successful presence at the frontier (Alvarez et al., 2016; Takata et al., 2020). The theory provides a useful framework to unpack uncertainty and better understand how entrepreneurs co-create new opportunities out of the uncertainty of an unknown future (Tidhar and Eisenhardt, 2019).

Our goal is to contribute to BMI research in multiple ways. First, we theorize BMI process as a less studied aspect of business model research (Foss and Saebi, 2017) through which firms resolve uncertainty and digitally transform. We focus on the internal means accessible for these firms as well as their entrepreneurs' effectual logic of control in taking proactive approaches in innovating their business models to gain a successful presence at the frontier. Second, we take the opportunity view to explain BMI as a process to create new opportunities, rather than only as a reaction to changes imposed by the external environment of the firms (e.g. Takata et al., 2020). As such, we explain how effectual logic enables entrepreneurs to take actions and change a business model to sense, shape and seize new opportunities (Foss and Saebi, 2017; Karami, Ojala, and Saarenketo, 2020). Third, we place certain boundary conditions for our suggested effectual mechanism of BMI by investigating BMI in the context of small entrepreneurial firms (Zott and Amit, 2008) which are experiencing the frontier. Lastly, the findings provide several practical

contributions indicating how uncertainty brings new opportunities, how intangible resources, partnerships, and learning play key roles to reach frontier position in the market.

In order to address the gap and answer our research question, we first review the literature on entrepreneurial opportunity and effectuation theory as well as BMI. Then we introduce and justify our methodology. Section four presents our findings and elaborations in response to our research question. In section five, we discuss our findings in terms of theoretical and practical implications followed by the limitations of our research and some directions for future research.

2. Theoretical background

2.1. Uncertainties and opportunities of being at a frontier

Frontier as a constantly unfolding uncharted territory which is unforeseeable for businesses provides a clear example of Knightian uncertainty (1921), wherein “a future whose distribution is not only unknown, but unknowable” (Sarasvathy and Kutha, 2001, p. 5). Described as pre-emerging markets (Wiprächtiger, et al. 2019), or “emerging emerging markets” (Marshal, et al., 2015), frontier markets present true uncertainty of situation wherein there are no established institutions and activities. For instance, some geographic markets are called frontier markets (Berger, et al., 2011; Marshal et al., 2015; Speidell, 2009), certain scholars have talked about frontier industries (Levy and Kuo, 1991), or frontier market segments (Prahalad and Ramaswamy, 2003), and finally others focus on economics of frontier technologies (Kneller and Stevens, 2016). The lack of institutions along with unreliable information as well as no clear definition of success and failure make decision-making difficult in such markets (Gaur et al., 2007; Parmigiani and Rivera-Santos, 2015). The stakes are high, as succinctly summarized by Figueres and Rivett-Cranc (2020, p. 125) in their inspiring book “The Future We Choose” under such conditions “if [managers/founders] shift their companies too far and too fast, they destabilize their business model, and investors will punish them. If they delay the shift too long, the value of their company may crumble.” Like any truly uncertain conditions, the frontier market’s uncertainty comprises undefined and as yet unknown opportunities for shaping the frontier.

Frontier can have different meanings; nonetheless, it always can be linked to the concept of new opportunities. Frontier, in digital industries involves new features or configurations which are nearly or totally unknown in the industry (Hinings et al., 2018). As such, there are “unexplored opportunities, untapped potentials” which offer the chance to unpack the unknown and create new opportunities (Futterer et al., 2018; Wiprächtiger et al., 2019). Frontier markets therefore offer

plentiful opportunities for shaping and developing a new future. Under such conditions of novelty and radical change in processes or technology, entrepreneurs sense and create new opportunities and invent novel business models to exploit the new opportunities (Ojala, 2016).

Somewhat ironically, in conditions when a market does not yet exist, or when technology is constantly changing, those entrepreneurs who can imagine future directions and utilize and activate their resources, will be able to create the new direction of the technology, and therefore, the new market (Huang et al., 2012; Ojala, 2016; Ojala and Lyytinen, 2022). Prahalad and Ramaswamy (2003) discuss the role of technology in creating opportunities for transforming the established markets and creating new frontier markets. More specifically, they argue for the importance of developing a platform which enables co-creation of value by providers and customers in new frontiers. In their own words: “Increasingly, companies are seeking to leverage their investments in R&D, as well as in their logistics system, so more time is spent on creating a platform that develops products with multiple application possibilities for new segments of opportunity.” (Prahalad and Ramaswamy, 2003, p.16).

There is a growing body of empirical research on frontier markets which brings uncertainty to the forefront of the research in such markets. Andries et al. (2013) have observed the challenges that firms have in defining a sustainable value proposition under uncertainty conditions. They argue that these firms focus on opportunities under such conditions and facilitate their survival and growth in the long run by simultaneous experimentation. Speidell (2009), investigated behavioral finance as a coping strategy in frontier markets and compared these behaviors in terms of trust, loss aversion, risk preference, and familiarity bias across different countries. Caputo et al. (2021) reviewed 198 articles on the association between digitalization and business models. They observed three major thematic clusters: digital transformation, technological innovation, and strategic management, making an inevitable link between the digitalization and BMI. Prem (2015) investigated changes in business models induced by industry 4.0. Frank et al. (2019) proposed a conceptual framework to connect industry 4.0 and servitization from a BMI perspective. They found that revising business models to match proper levels of servitization with levels of Industry 4.0 can help with successful servitization. Joseph (2018) investigated transformation of traditional bricks and mortar value chains in the content industry. He observed that BMI results in attraction of new customers and more consumption by existing customers. The focus on emergence of new opportunity out of rapid changes and uncertainty is the concept that puts all these empirical studies

in the same line. We consult with business model and BMI literature to further develop the opportunity view in the next section.

2.2. BMI for new opportunity creation

Business models have been studied by scholars from different points of view (Foss and Saebi, 2017; Saebi et al., 2017). We adopt Foss and Saebi's (2017, p. 201) definition, and conceptualize BMI as "designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements." In this sense, BMI is characterized by transformation and radical moves, in terms of new business logic (Bouwman et al., 2018), novel value (Aspara et al., 2013), and fundamental changes (Markides, 2006), organizational structures (Hinings, 2018), business model elements (Rachinger et al., 2019), and summarized as being planned or process based (Wirtz, 2019). We join the process view of BMI. Effectuation theory with its co-creative approach helps theorizing the process of BMI (Achtenhagen et al., 2013; Berglund and Sandström, 2013; Khanaga et al., 2014) and addressing the stream's shortfall as it "is usually retrospective, case based, and inductive rather than predictive and theoretical" depending on the situation (Foss and Saebi, 2017, p. 212).

We focus on the cognitive aspect of BMI by conceptualizing business models as a "cognitive structure" guiding the value creation process (Doz and Kosonen, 2010, p. 371), and conceptualize BMI as decisions to transform the existing business models to create and exploit new opportunities (Foss and Saebi, 2017). We argue that change in BM requires managerial cognition and sensemaking of the situation. We then argue that managers/founders' decision-making logic and their capabilities to keep up with the changes play as the driving force of the process of BMI.

Effectuation theory also enables us to conceptualize business models as an important means in commercializing new ideas (Chesbrough, 2010; Teece, 2010). Changes in the environment at macro, meso, and micro levels require businesses to revise their business models to survive and grow in the long run (Chesbrough, 2010; Lindgardt et al., 2009; Zhu et al., 2019). We look at BMI as a vehicle for employing means for sensing, shaping and seizing new opportunities (Saebi and Foss, 2015) at the frontier. More specifically, the effectuation lens enables us to look into the internal motivations for developing new opportunities through innovating the existing business models (Foss and Saebi, 2017; Schneider and Spieth, 2013).

We distinguish between identification and creation of new opportunities (Alvarez and Barney, 2007), and argue that in the specific context of digital frontier, opportunities are created by entrepreneurs (as there is no mountain to be discovered and exploited). We argue that looking at BMI at frontiers from the opportunity creation point of view is a useful view, as frontier means unshaped, and emerging space wherein nobody can predict the rules of the game (Wiprächtiger et al., 2019). As such, those entrepreneurs who can imagine and shape a future collectively (Kerr and Coviello, 2020; Read et al., 2015), can set the boundaries for the new markets (Sarasvathy and Dew, 2005). As such, BMI can be explained as a process of new opportunity creation through imagining of new value propositions and changes in the “key elements of a firm’s business model and/or the architecture linking these elements” (Foss and Saebi, 2017, p. 201). With this view, entrepreneurs think of BMI in terms of how new business models can enable them to revisit the established value propositions and to exploit new opportunities for putting forth and deliver new value propositions (Zott and Amit, 2007).

In the next section we elaborate on how effectuation provides a theoretical ground for explaining the BMI process through microlevel cognitions and actions. There is an established literature on how entrepreneurs develop new opportunities and transform their ideas into new businesses. However, there is a gap in integrating opportunity research into BMI to explain how entrepreneurs evolve their business models in the process of new opportunity creation (Ojala, 2016). Effectuation theory provides one such bridge between the two literatures.

2.3. Effectuation and BMI

Sarasvathy’s (2001) seminal work and the continued research on effectuation theory (e.g. Read et al., 2016, Sarasvathy and Dew, 2005; Wiltbank et al., 2006; Karami et al., 2020) has provided a strong theoretical basis for understanding of decision-makers’ cognitions and actions in the face of environmental uncertainty (Read et al., 2016; Sarasvathy, 2001). From the effectuation point of view, unpredictability of the future implies that there are new opportunities to be imagined and developed for creating an alternative reality (Sarasvathy, 2001). Effectuation theory argues that under such conditions, the preferred way that decision-makers can move forward is by relying on their existing means, rather than prediction of the future (Sarasvathy, 2001). This is the case because the existing means are the only things under control of the decision-makers, which provides them with a basis to gradually expand their control over the situation by

extending their existing social network and accessing new/complementary resources. As such, effectuation is about how to “make do with doable” (Sarasvathy, 2001). The next step in the effectual process is partnership with like-minded stakeholders for co-creation of new opportunities (Karami and Read, 2021; Kerr and Coviello, 2020). Using the existing means to take initiative signals self-efficacy to other stakeholders and encourages them to partner with the focal entrepreneur. Partnership is a key mechanism in effectuation process as self-selected stakeholders collectively make sense of the uncertain situation and put forth their available means to actualize their commitments (Karami and Read, 2021).

Under such conditions of an ever-changing environment of the frontier markets, the important question standing before decision-makers is *how they should create new opportunities to revisit the established value propositions in the market and move forward*. The effectual opportunity creation view enables them to replace this amorphous question with a more workable question of how “firms [should] do more with the resources and capabilities, they have” (Amit and Zott, 2010:2). This key question also enables research to concentrate on an internal view on BMI, wherein there are significant gaps in our understanding of the drivers of BMI (Foss and Saebi, 2017). As Chesbrough (2010) argued, effectuation enables entrepreneurs to create new businesses and required business models by using the existing means and taking actions that reveal and utilize latent possibilities in the market.

Under uncertainty conditions, effectuators are inclined towards action over analysis, so that, instead of market analysis, they take actions and wait and observe the reactions of the market (Read et al., 2016). More specifically, decision-makers experiment with new business models to activate their imagined opportunities and by welcoming the unexpected as a new source of opportunity, they leverage contingencies and learn from their failure within the threshold of their affordable loss (Futterer et al., 2018; Sarasvathy, 2001). The effectual actions result in new knowledge which in turn enables more calibrated actions. Through these iterations of action and cognition among stakeholders, decision-makers develop new business models and gradually shape a new market (Baber et al., 2019b). Effectuation theory enables us to focus on the opportunity side of uncertainty in frontier markets through looking at “the readiness to take action ... by sensing, shaping, and seizing opportunities” (Foss and Saebi, 2017, p. 2018).

Effectuation theory provides a useful lens to look at the business model as both means (Teece, 2010) and a cognitive structure; and BMI as an entrepreneurial process of new opportunity

sensing, shaping and seizing (Foss and Saebi, 2017) in transforming the established markets to new markets (Dew and Sarasvathy, 2005). In other words, effectuation theory provides a framework to look at the cognitive process of imagination of new opportunities to unpack true uncertainty (Sarasvathy, 2001) of frontier markets, and use their existing business model as their initial means to shape a new future by relying on the logic of control and partnership (Sarasvathy, 2001).

There is an emerging body of research on effectuation and BMI. Xu and Koivumäki (2019) integrated effectuation theory with the lean start-up method in explaining antecedents of BMI. Futterer et al. (2018) investigated the effectiveness of effectuation and causation in BMI and the resultant firm's performance. They found effectuation to be more effective under high industry growth conditions. Further, Baber et al. (2019a) observed that business models can evolve both causally and effectually, depending on the situation. Reymen et al. (2017) investigated technology-based ventures' business model development as an effectual process. And finally, Brenk et al. (2019) applied effectuation theory to trace the process of decision-making in an established firm in shifting from a product-based into smart service business model. They found that effectual logic reduces the uncertainty of shifting to new business models.

Overall, the extant literature on BMI has been more focused on BMI as a reaction to changes in the environment whereas the opportunity side of BMI which requires investigation of the internal motivations and processes has received meager attention. We synthesize BMI research with effectuation theory to problematize the field and argue that BMI at the frontier markets needs further theorizing to capture the entrepreneurial cognition and actions that drives the changes through BMI, and effectuation theory provides a useful lens for such purpose.

3. Methodology

We chose multiple, exploratory case study methodology to look into complex phenomena around BMI and how companies face the unknown frontier territory of their industry. Multiple case studies allow not only evaluation of rich data, but also greater opportunity for theoretical generalizations (Yin, 2013). Further, the exploratory approach provides flexibility that is needed to focus on dynamic processes (Swanborn, 2010) such as how small digital service providers innovate their business models and create new opportunities to be at the frontier. This approach enabled also the gathering of detailed and rich data related to this phenomenon as it has received

only meagre attention in previous studies (Dyer and Wilkins, 1991; Edmondson and McManus, 2007; Yin, 2013).

We selected eight digital service providers for this study. All of them are primarily involved in development of various digital-based services like video games and customized software as their major activity. The case firms were chosen by using purposeful, theoretical sampling as recommended by Eisenhardt and Graebner (2007). That is, the case firms were selected so that the nature of the companies in size, industry activity, and technology context were similar. Table 1 below shows the firms and their main business activities in the order in which they were first interviewed.

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The selected eight firms fell into two groups of four firms each. One group included firms with frontier positioning that has led to innovated business models. The other group included firms without frontier positioning and thus no business model which explored the frontier. The four firms without presence at the frontier market provide polar examples (Eisenhardt and Graebner, 2007) and can thus reveal insights regarding their failure to drive into the frontier. That is, we included “polar types” of research examples. Based on the recommendations by several scholars, this kind of sampling is necessary if a study includes rather a small number of case firms (Eisenhardt, 1989; Pettigrew, 1990). In addition, we selected case firms based on our knowledge of the industry and the firms which helped us to recognize and select case firms with and without frontier positioning (see Stake, 1995). The personal relationships with some of the firms significantly increased their willingness to participate and share information related to their market activities and business models.

The interviews included 24 in-depth interviews that were collected between 2017 and 2020 (see Table 2), with leading members of the firms and with more than one person except for firms A, E, and F. Regarding firm H, one of the authors had numerous discussions with the top managers from 2012 to 2020. All the interviewees had an in-depth knowledge about their firm’s activities and a key role in business model development over the years. That is, we selected interviewees based on their knowledge and involvement on BMIs. During the interviews, we followed an open-ended protocol to provide flexibility that enabled collection of in-depth data, e.g., making further questions based on interviewees’ answers (Benbasat et al., 1987). When possible, we tailored the

interview questions to the interviewees' roles and their involvement in BMI. Follow up interviews with all but firm F allowed confirmation and clarification of previous interviews and specific issues as needed. The interview transcripts, notes, and other source materials (see Table 2) collected from each case firm were reviewed to evaluate whether the technologies under development or newly in use could be described as pushing the frontier or merely as up-to-date. We must accept an inexact definition of frontier technology, that it is identifiable by experts, but hard to communicate (Hsu, Tzeng, & Shyu, 2003). In this study, we conceptualize frontier technology to mean technological systems and products that are new to the industry and at the limit of established abilities. As we followed a qualitative, exploratory approach, the interviewees were not informed about our interest in the concept of "frontier" before or during the interviews.

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The data analysis methodology included several steps. First, we condensed the data (Miles, Huberman, and Saldaña, 2018) using a variety of approaches from timelines to wire diagrams. Collateral materials such as brochures and websites were used to confirm timelines and macro-processes of the case firms. In this way, we saw how the case firms' characteristics and actions explained the research question. Thereafter, the excerpts were sorted by topic. In the next step, using open coding, we selected key phrases from transcripts and collateral materials such as business model, helicopter view, roadmap, outsource, tool creation, and so on. We organized these codes into several concepts and then applied our own increasing expertise to gather the concepts into abstract axial categories (Corbin & Strauss, 2014). The axial categories arose from the transcripts with themes becoming salient due to frequent mention by interviewees or connection to literature on frontier concepts and effectuation. These axial concepts led to the final codes selected for this research. Codes and axial categories are shown in Table 3 along with the related final selected codes. Interviewees less often mentioned intentions, such as explicit aims to create leading technologies, however it is appropriate to draw codes based on presence in the literature. Strategic intent in organizational change and strategy appears in management science literature from the 1980s through recent discussions on digital transformation (Hamel and Prahalad, 1989; Chanas and Hess, 2016; O'Shannassy, 2016). Accordingly, the topics were further specified to identify: 1) Technology at frontier, i.e. technologies new to that industry, 2) Personnel at frontier,

i.e. those able to make new frontier technologies, and 3) Explicit aim, i.e. stated organizational goals of frontier business and technology innovations. For instance, if the interviewee said: "...we wanna take AI and bring it right now into our core technology products and we have to figure out how to do that", this was coded as the firm having an explicit aim to achieve the frontier whereas the statement "We outsource the key development to China and India" was coded regarding personnel and the frontier. Table 3 shows the progression, left to right, from examples in the data to open coding to axial codes to final codes.

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Construction of tables made it possible to visually identify differences among the characteristics, processes, and outcomes of the firms. Further steps were taken to understand the businesses, for example, wire diagrams were developed showing the business models of the firms and confirmed with interviewees. The authors discussed patterns identified among the case firms and possible causation in order to draw conclusions. Further, all possible inconsistencies between interview data and collateral materials were discussed with interviewees. The stylized versions of the tables, based on coded data, are used in the findings section of this study.

4. Findings

Based on the empirical findings from the eight cases, firms D, F, G, and H have attained their frontier positions regarding both technology and personnel. We found that these firms broadly follow BMI as an effectuation process in their efforts to attain the frontier market. This especially means that they heavily relied on their effectual logic of control, and utilized their internal means while considering their existing business model as a means. The case firms that reached the frontier (D, F, G, and H) did not wait and attempt to see to adapt the best strategy, rather they took action to gain new knowledge and unpack the uncertainty caused by rapid changes. Furthermore, they took collective approach and relied on co-creation of new reality while leveraging strategic contingencies. Within these broad requirements, the frontier achieving firms further 1) took control over their own advanced technologies rather than merely assembling or repackaging bought-in technologies; 2) utilized their human resources with the required cognitive abilities to co-create those technologies; and 3) sensed when and how to apply their resources. Additionally, firms D, G, and H, though not F, expressed their general aspiration to reach the frontier.

Firms D, F, G, and H innovated their business models to pursue new opportunities at the frontier, whereas the other four firms were not able to develop business models for such purpose. Table 4 helps to identify aspects that the presence or absence of which impact the ability to achieve the frontier. As mentioned above, the firms were naïve to the frontier concept, therefore the authors collected evidence from interviews and collateral material, that indicated frontier efforts, successes, and failures.

Having an explicit aim appears in all four of the frontier-achieving firms. Firm A also has explicit aims to regain a position on the frontier, but “we are not there yet,” they said regarding their hope for technology advance. Firm B informed us that their slogan is “to go beyond” but that this refers to game experiences and offerings, not technology or goals that could be considered frontier. Firm C made it clear that their staff is to learn and create technologies as needed by the customers, but that technological prowess is not their goal; rather it is merely to serve the customer appropriately. Firm E explained that they had given up seeking frontier technologies, defunded those projects, and made the related IP open source.

On the other hand, having frontier quality technology, specifically technology in the hands of those capable of creating and using it at the frontier, appears in each of the four firms, (D, F, G, and H), that are on the frontier. Firm D mentioned they always like to “push the technology” while F made it clear that owning top technology was vital to their competitive advantage. Firm G, in cryptocurrency, created world leading transaction clearance technology and states that they, “take a strategically progressive approach to embrace technology and innovation.” Meanwhile Firm H eschews technology for its own sake, but has the goal of attaining a position “where we can operate both sides of the market via a platform” which they must build themselves. For this firm, “technology helps you achieve a goal,” but technology is not a goal.

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We examined which elements of business models have received impact from the firms’ moves into the frontier. The business model elements considered include technologies (new implementation of technologies), value co-creation (inclusion or exclusion of partners and even customers in creation of value), structure (new or changed structures within the firm), and financial

aspects (cost and revenue). This analysis relies on the characterization of “transformational” (Matt, et al. 2015) as “radical” (Hinings et al., 2018) change and substantial change. Conversely, “non-transformational” is change that does not change radically. We further define a middle degree of change as “Partially Transformational” if the transformation effort changes a dimension but cannot substantially reshape it (Matt et al., 2015).

The categorization of the data relied on the apparent level of change revealed to us by interviewees. For example: Firm G described their new clearing technology created the “beating heart” of the business model and Firm H revealed that transition to a platform business model would result in profit margins two to three times greater than at present through a wholly different business model. Firm D, however, mentioned “...we experiment by bits and pieces” indicating that technologies are incremental, partial, and not transformative though they are “always exploring”. This reveals that the application of effectual heuristics results in a spectrum of transformation in the market. Additionally, we support the characterization of the three categories with evidence from case interviews and documents. Table 5 displays the results whereas Table 6 gives examples how the business model changed within each case firm.

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4.1. BMI as a process of effectual cognition and action

Firms D, F, G, and H have been able to create new or revitalized business models by improving their personnel and technology. These business models pass a fundamental test of business validity: profitability. This achievement confirms diffusion, and thus, successful innovation. It also reveals the focus of these firms on the opportunity side of all radical changes, so that, instead of being threatened by the environmental changes, they make sense of the emerging opportunities and develop new opportunities out of the uncertainty of the environment to shape a new future for the market.

All four of these firms, according to their statements gathered for this study, have expended limited amounts of their resources to develop the skills of their staff so that they could rely on their own human capital (who we are and what we know) in further development of the core technology and engineering to address the radical changes in the market. Firms D and H have a culture of constantly learning, a capability that enabled them to look at the radical changes in the market as

a serendipity and a source of new emerging opportunities. As a senior producer at Firm D put it, “[We are] always exploring” and in the words of the CEO at Firm H, “We accept the challenging jobs and reject uninteresting ones...” Firms D, G, and H maintain an explicit vision of leading their industries through entrepreneurial aspirations and envisioning of new futures for their industries. Firm D and G include technology in that vision while firm H insists that technology is a tool, not a focus, and that the focus is on nurturing the staff. Firm G’s view is summarized in their published materials “Develop our own path. Competition is great, but ... [our] way has always been to push the boundaries and lead the charge.” Firm G also hinted that finance and technology are in their DNA “He [founder] is a legacy broker, dealer, trading platform developer. So, he became a technology leader” and another founder was described as “legacy venture capital.” The three older firms in this study, D, F, and H, have innovated new business models while maintaining an existing one. Their relatively conservative approach, however, was not a sign of causal thinking. Instead, they had great reliance on their managers/founders’ effectual heuristics and perception of the frontier and while making timely moves toward creation of new opportunities. All four are closely connected to platform technologies, with G and H relying on their own platform.

The other firms, A, B, C, and E, are at their frontiers regarding only one of the two key aspects and have not arrived fully. Their failure to change their business models in order to fully pursue new opportunities at the frontier makes them useful as contrasting cases. Only firm A professes an explicit desire to lead its industry in technology and services, the firm is unable to realize the aspiration due to weak technical skill and has outsourced key development tasks for some years out of necessity. Similarly, firms B and C do not have staff advanced enough to stay ahead. Meanwhile firm E recruits and maintains non-fulltime, top quality staff worldwide, but gave up the effort to stay ahead, instead reacting as needed because the constant investment required to stay ahead of unpredictable hacking techniques did not bring suitable returns.

Looking for the commonalities based on the data gathered for this study from these non-frontier firms reveals some interesting non-effectual cognition and actions. Having no aspiration for being and thriving at the frontier market was the most important aspect. Effectuation logic begins with the general aspiration of forming a new and different future. Those firms who do not think aspirationally may not activate their existing means in that direction. As a result, they concentrated on the conservation of what they have and did not look for emerging opportunities.

The conservative approach also holds some firms back from learning. Learning through doing is an important mechanism in effectual process which empowers the human capital of the firms which in turn enables them to make sense of the emerging opportunities. As with Firms A, B, and C, they did not take such a proactive approach to their business and their perception of the frontier at the same time. Firm A sought frontier technologies, but not by investing in staff skills. Firm B sought new business models in the past, but is now content to intensify their existing markets. Firm C promotes ongoing learning by staff, but specified that they develop just what the customer needs, not more. This shows cognition that prefers not to take on excessive challenges. For its part, Firm E abandoned an advanced technology project because it no longer appeared remunerative. The approach resulted in not entering at the frontier market and taking a reactive approach to their business and market.

4.2. Effectual co-creation, resources, affordable loss

Firm D achieved successes at various points in their history, first by providing advanced graphics for a Nintendo console when the firm was founded. An important innovation to the information flow into the firm came with their joint creation of an industry event that brought together players and developers. Development of the event relied on relationships with trusted local partners such as members of similar firms, government officials, and leading members of the local industry who could bring various skills and resources to the project.

Firm D successfully exploited and improved its business network to gain access to a major Google project to co-create a new value proposition. Paraphrasing firm D's webpage, they are committed to beating any technical limits to advance visual quality and gameplay. Having such general aspirations regardless of what environmental uncertainty brings them guides their way ahead. A combination of different types of skills as the main means in hand enables the firm to move forward and shape a new future for the market. Firm D's management thinking has been consistently to "push the technology forward" to serve their other cognitive cornerstone "it must be fun". This requirement must be met for each game in order for it to pass through gateways in the development project. This mantra serves their general aspiration to continually learn in order to create without knowing what future products they may create. Commitment to this mantra has brought all actors around this core idea of "fun" and provided them with a framework which enables them to make sense of the future that they wish to create in their industry. This mantra acts

as a shared aspiration which absorbs different types of means such as knowledge, experience, skills etc. and a platform for ongoing interactions and also prioritize alternatives. All these effectual actions form new artifacts such as new software and markets for it.

Firm F also followed a co-creation strategy when they coopted a leading publisher to help realize a corporate goal – publishing their own game. They could not gain direct contact to that firm, so they successfully used their Tokyo network to reach it indirectly over some months. They explained that they would not accept funding or give up a share of the game but jointly found a creative solution by entering into an unusual Intellectual Property sharing agreement that allowed both sides to manage risk and achieve their goals. As game publishers, firms F and D saw their partnerships in terms of sharing their understanding of the changes and implications for the industry, as well as a way to pool intangible resources such as market insights to move forward in uncertain conditions. Their effectual thinking and actions helped them with every game product because the market for a game can never be confirmed in advance – it is only after release that a game is accepted, rejected, or ignored by the market. Interviewees from firm F did not explicitly say the engineers were of such high skill, however a review of their products, technology approach with high commitment to improving the tools provided by publishers, and third-party reviews suggest they are indeed among the leaders of the industry. Further, their public information refers to the “quest for technologies”. Firm F was also able to smoothly switch between marketing modes, taking risks in the market and acting to make the firm stable, depending on available resources. Firm F also held aspirations for entering and thriving at the frontier market. In contrast, firm E had an explicit aim to reach top levels of technology early after its founding, but discovered that frontier technology was not so necessary in its business niche and thus dropped the explicit aim. This realization was an important point in firm’s development as they could restructure based on their learning about the technology and the market to put their limited means to other strategic uses.

Firm G, a cryptocurrency exchange, relies on the constant development of their own technologies to remain at the forefront of crypto exchanges in Japan and southeast Asia. The firm follows its published “roadmap” as it utilizes its technology as a means to systematically bring new products to market based on its in-house core technology. The roadmap is influenced by customer preferences, the offerings of competitors, and the regulatory environment. With this thinking, they created their own source of funding through a blockchain token release. The firm

leverages contingencies to react to regulatory changes successfully and at the same time cooperates with regulators to co-create their world, as indicated in interviews. Regarding regulators and other actors, they clarified how their BMI is co-created:

“I think that's what's unique about what we do in this financial services space. And not only do we challenge ourselves, to figure out how we are going to change the way we provide our services and products, or how we position ourselves within the context of the sector, but also, obviously, the regulators, as well, customers. Everybody in this whole ecosystem is, you know, being challenged to think differently, and to embrace technology and to create together the future of finance”

On the other hand, there are regulatory changes that Firm G can only lightly influence. Their thinking has been to seek best regulatory practices while delivering additional services to customers. Further, firm G takes an affordable loss approach, spending its resources to build up sufficient services to compete with larger exchanges. The roadmap created by embodies its attempt to craft its future, rather than merely react to the current environment.

Meanwhile, firm H is developing not only the technology of its main prototyping business but is simultaneously developing a new platform business model that brings firms with design and manufacturing needs into contact with designers and mass producers. Effective collaboration with these actors has become an advantage for firm H which enables them to continuously co-create new services and form new sectors in the market. This new platform model is based on decades of data they have collected, which has become a strategic resource for the company. It enables them to identify and provide a service that the market has matured to accept in recent years. The new business model allows firm H to provide a variety of different ideas and solutions for the newly emerging needs. Most of all, their development has been propelled by their thinking to “nurture the human” and thereby avoid routine and unpleasant work. This basic idea of “nurture the human” has been acting as a core around which employees and the external network actors agree and commit resources. As in the case of firm D, a shared understanding developed at firm H that enables the collaborating actors to imagine future products and markets regardless of the unpredictability of the future. Indeed, their cognition of the situation did not rely on any certain future, rather it relied on their core philosophy to “nurture the human” which let them imagine and actualize a new future. As the current head of the business put it, the goal must be to increase the

profit margin so dramatically as to allow the aging workforce to become more expensive without harming the overall organization.

4.3. Seizing opportunity rather than just reacting to the market changes

The four case firms (firms D, F, G, and H) able to arrive at their respective frontiers showed the ability to seize opportunities in advance of change in the environment, as opposed to waiting for change and reacting post hoc. Firm D took the opportunity of a serendipitous meeting at a US-based conference to expand its value network by engaging with a leading platform business to work on a risky product that was still in development. The risk paid off first by gaining development work for Firm D and second by publishing, in 2021, one of the first VR games to appear on the platform. Intangible gains included appearing on stage at a global industry event to announce their role in 2019. Firm D was able in several instances to expand its value network and revenue structure by releasing successful games. These were important effectual actions because popular success of a game is essentially impossible to predict. Firm D jointly created a specialized trade conference without being able to forecast the long-term success it ultimately attained. The conference was intended primarily to create a flow of information between developers and players. It became an unexpectedly popular venue for video game professionals to exchange ideas and also for games and smaller studios to gain exposure through media visits by industry leading firms. Indeed, a proactive move by the leaders of firm D in forming the conference as a platform for gathering some actors, serendipitously attracted others who became active members of the community and shared their critical means with firm D. Thus, the new event became a place for sharing ideas, unplanned insights, networking, and gaining market information that helped the participants navigate uncertain times.

Firm F altered their business model from only outsourcing to game development by husbanding their resources of staff and money. Through successful partnerships, they expanded their network of trusted partners so that they could work even for competing major firms. These partners provided word of mouth references within Tokyo allowing access to new customers. The same firm took the radical step of creating a library of proprietary tools that they could use with greater confidence than the Software Development Kits used throughout the industry. Due to “many, many bugs” they “don’t use anything from outside. ... develop by themselves.” In other words, their own kits were better in technology and reliability and this allowed creation of better

products, despite the challenge of creating the library while handling high pressure work. This effort, built on the skills and self-improvement of their own staff, gave the firm another powerful technical resource all their own. The new experience significantly increased their knowledge of the industry and market which added to their perceived capability. Although the library was expensive to make, the firm recognized that it could generate opportunities later.

Firm G moved beyond its funding limitations by releasing a crypto token in advance of market confirmation. The release freed them from the uncertainties and restrictions of conventional funding by providing cash flow from customers and simultaneously making those customers into interested shareholders. The financial success of this move was clarified at the time in industry news about the firm and their website. Communicating intentions helps excite the existing customers and attract new ones, as their materials point out: “Perhaps it’s unorthodox, but we would like to take this opportunity to relay some of our thoughts so you can understand the plans for our company...” And, similarly, “We know that our community is eager to hear what there is on the horizon ... we are going to seize this opportunity to give you a look into ... the next year.” Also, Firm G attends to a variety of sources as they explained:

“Then at the same time, we also evaluate the industry, as well as looking at data metrics of how our platform is being used. And through that we decide on, you know, what things we should be investing our time and money into, for building out new features.”

Additionally, this firm has developed core engineering solutions in-house, such as their native blockchain and peer to peer products, which are advanced technological capacities that help them keep abreast or ahead of market expectations. Firm G announces these in advance and upon achieving them posts blogs about the new services; this keeps the firm in close communication with expectant customers who might otherwise defect to competitors. Firm G thus engages customers in the process of development as active participants who share the tacit knowledge of the product. Their expectations and perceptions of the new products become critically important resources for the firm in further development of the products.

Meanwhile, firm H is developing a platform business that will connect parts designers with engineering and manufacturing firms, a development new to the specialty machining industry which allows them to fill a market gap for connecting design to distributed production. This initiative has put firm H in an advantageous position between these two critically important actors

in the chain of value creation. By connecting these actors manually at first, firm H was able to make much clearer sense of the frontier market and imagine new services to be developed and presented to the market. The collaboration that enabled creation of the novel idea first involved experienced individuals in the network outside of the firm who helped guide thinking about needs in the market. Driving that effort to discuss and create was the cognition of and desire to get ahead of inevitable problems such as cost of labor, thus, translating their words from Japanese, they sought “to systematically reduce engineering cost through AI.” Current collaborators include a few organizations poised to become strategic partners, but many more such partners are targeted. Sharing perception of the market, its future, market and business information, and other tangible resources was the key for these critical, creative collaborations. The firm’s platform is an example of spending limited resources carefully in order to take control of their future. The above examples all connect effectual heuristics and sense making of the uncertain environment and the entrepreneurial action that followed from which enabled them to co-create new opportunities to attain the frontier spaces of their industries. These examples instantiate and partially depict how the opportunity view leads the BMI.

Financial aspects of seizing new opportunities, such as profitability, as well as how financial resources are received, handled, and distributed, transformed in three of the firms. Firm H noted that it expected the profit margin to double as its new business model comes into play. Firm A told that their efforts to arrive at the frontier would help them maintain their incumbent position as a leading provider to academia. Firm E ceased efforts to be at frontier, finding it was just as effective, but more cost efficient, to react rather than to act in advance of customer needs.

5. Discussion and Conclusions

We set out on this study to address the important question of how small digital service providers at the frontier innovate their business models in the face of uncertainty and rapid changes to co-create new opportunities and digitally transform. In addressing this question, we applied effectuation theory as a cognitive entrepreneurship theory to analyze the process through which small digital service providers successfully innovate their existing business models in the face of uncertainty. As such, our study develops BMI literature.

According to our results, all four frontier firms are using effectual logic in their cognition and actions regarding goals, aims, and strategic moves. These insights help us understand how small digital service providers innovate their business models in the face of rapid changes as they

arrive at their business frontiers. They pursue the mechanism that concentrates on technology while driven by internal policies and philosophies with the targeted outcome of reaching frontiers, thus they actively take steps to transform their internal processes and business model elements. A combination of frontier technology and people with the cognitive ability to use the new technology to co-create the new frontier was the key for firms on the frontier. A challenge that these decision-makers were able to successfully make sense of and transform into new opportunities was the radical and transformational change in the market, which makes causal prediction and planning for a safe future almost impossible. Value creation processes transformed among all the frontier firms as new partners, knowledge, and inputs arrived.

Our findings put forward earlier works by Andries et al. (2013) and McGrath (2010) in terms of emphasizing the opportunity aspect of uncertainty in frontier markets. However, unlike McGrath (2010), our findings emphasize the co-creation of opportunities rather than discovery. This is an important contribution due to the collective nature of BMI process as a reflection of the critical importance of interactions among different stakeholders in BMI. We also put forward Futterer et al.'s. (2018) findings by theorizing BMI as a mechanism to enter frontier markets in the context of small firms. We also add to Speidell's (2009) work in emphasizing the critical importance of partnership, trust, and risk preference in the process of effectual new opportunity co-creation through BMI. Also, in line with Brenk et al. (2019) we found that effectuation enables small firms to unpack and manage the uncertainty of frontier markets. We add to their findings by theorizing the process of transformation to a frontier market through innovating the existing business model in a gradual process which enable the small firms to establish changes in their business model in an organic way with no conflict with the existing business model. As we observed, active learning plays an important role in their successful BMI (Andries et al. 2013; Berends et al. 2016; McGrath, 2010). Our results show that leaders of small firms enact their existing means and take action to unpack the uncertainty step by step mainly through engaging other stakeholders. This matches well with what Takata et al. (2022) observed on the behavioral patterns of technology transfer professionals. Finally, our findings elaborate both theoretically and empirically on the observation that in small firms, BMI is closely intertwined with managers/founders' imagination and judgement (Foss and Saebi, 2016), which is enacted by effectual logic of decision-making.

5.1. Theoretical implications

Our study contributes to BMI literature in several ways. First, we offer a novel theoretical perspective that accounts for managerial cognition as a critical microlevel factor in BMI (Foss and Saebi, 2017). We adopted Doz and Kosonen's (2010) definition of business model as a "cognitive structure" of value creation process, and used effectuation theory to investigate changes in business models from a cognitive change's perspective. We argued that BMI in constantly changing environments cannot be a planned process (Wirtz, 2019), as the environment rapidly changes and no one can predict what comes next, so that planning and adaptive approaches become insufficient (Wiltbank et al., 2006). In explaining BMI as cognitive changes, we used effectuation theory to focus on the internal means activated by the decision-makers' effectual logic of control rather than reaction to external changes. Conceptualizing business model as means (Teece, 2010) and BMI as a cognitive process, enabled us to utilize the effectual cognitive models of decision-makers to explain the active role of decision-makers in sensemaking of the ongoing changes in the environment. Applying effectual logic under uncertainty of the frontier markets enables decision-makers to focus on much simple question of "what our firm should do next" rather than being occupied by the assumption that "what can be predicted can be controlled" (Wiltbank et al., 2006, p. 981). Effectual logic enables decision-makers to take initiatives rather than wait and react. This is an important insight that effectuation theory provides in investigating BMI. Action in effectuation theory plays a central role in terms of being proactive in addressing uncertainty. Indeed, decision-makers take action to gain new information, learn and unpack the environmental uncertainty little by little so that each action informs the next decision and enables the decision-makers to transform the environment into their favorable conditions (Sarasvathy, 2001; Wiltbank et al. 2006). With effectual logic, frontier firms of our study took transformative approaches driven by their philosophies and aspirations as well as by environmental changes and expanded their control over the situation and the outcomes of their actions (Sarasvathy, 2001; Wiltbank et al., 2006). Effectual logic of these decision-makers enabled them to work with their existing means and allow the goals to gradually emerge (Read et al., 2016).

Second, our theoretical lens also enables us to take a constructivist view (Hunt, 2005) and explain how small digital service providers seize new opportunities in uncertainty conditions rather than being focused on the threats of uncertainty and taking a reactive stance (Read et al., 2016; Sarasvathy, 2001). Frontier markets as constantly unfolding territory make prediction of changes

and planning an appropriate strategy almost impossible. In such markets the lack of institutions along with no clear definition of success and failure, adaptive decision-making becomes very difficult if not impossible (Gaur et al., 2007; Parmigiani and Rivera-Santos, 2015). In other words, in a frontier with no established standards of success, firms need to be highly creative in setting new standards. As such, adaptive strategies become useless, and each firm needs to design its own strategy (Rindova and Courtney, 2020; Wiltbank et al. 2006).

By applying the opportunity creation view, we unpacked BMI as a new entrepreneurial opportunity creation process as an underdeveloped aspect of BMI research (Saebi and Foss, 2015; Foss and Saebi, 2017; McGrath, 2010). Effectuation theory provides a pragmatist view to look at the uncertainties of rapid changes on frontiers. The seizing of innovation includes, for example, leveraging of partnerships, embarking on new product development, and even relocation of headquarters (Sarasvathy, 2008). While the extant BMI research has been heavily engaged with the reactive approach of businesses to changes in the environment, and theorized it in terms of resources, structure and competition (e.g. Afuah and Tucci, 2001; Amit and Zott, 2012; Lindgardt et al., 2009), our study took entrepreneurial perspective and addressed the opportunity side of the rapid changes and the internal motivations and processes of new opportunity co-creation through BMI as a less studied aspect of BMI.

Effectuation theory with its pragmatist approach to handling uncertainty with focus on decision-makers' cognitive patterns and realistic definition of resources as personal means provides a useful framework for understanding of the changes and transformation in frontier markets. Our findings reveal that some small digital service providers cannot afford to wait passively for the changes in the environment to happen. Rather, they take a proactive effectual approach to the novelty of the environment by imagining and actualizing a new future wherein they can play an active role in shaping and utilizing from such new futures. Effectuation theory helped us explain how these firms make sense of the changes in the environment by using their managers' cognitive models and heuristics and activating their social and business ties to realize the imagined opportunity. This finding adds to our understanding of BMI as a shaping strategy rather than adapting strategy (Rindova and Courtney, 2020), opening a new avenue for investigating BMI.

Finally, our focus on small digital service providers was theory driven. Effectuation theory originally is about individual decision-makers and acknowledges its application at the level of the firm for further development of the theory (Sarasvathy, 2001). We focused on small firms because

in such firms, founders/managers represent a major portion of the firm, and not merely a small segment at the top (Foss and Saebi, 2017). As such, we could use our findings of managerial cognitions and actions in our arguments for small digital service providers (Hambrick and Mason, 1984).

5.2. Practical implications

Our findings have several practical implications for managers and founders of small high-tech businesses. First, they need to recognize the importance of focusing on the opportunity side of uncertainty of changes in the marketplace, rather than trying to wait and see in order to adopt new BMs in their sectors. This is a shift in mindset from a reactionary mindset to a proactive entrepreneurial mindset. With an entrepreneurial mindset, decision-makers of these firms can use several mechanisms to successfully enter frontiers as follows: A) small businesses need to take a proactive approach to collaboration with other actors in the market to gain access to new knowledge and other resources and facilitate their entry. B) They need to take action, rather than wait and see. Each action regardless of its failure or success will produce some new knowledge, which in turn enable the firms to unpack some more pieces of the uncertainty. Furthermore, those who take timely actions will be able to set the standards for the late movers. C) Effectuation logic enables this kind of proactive approach to changes in the environment. Adopting effectual logic, decision-makers of small high-tech firms can see that each change brings new opportunities for forming a new reality in the market. D) small business should consider their existing BM as an internal means that needs to be transformed in a way that facilitates extensive interactions with important actors in the market and enables co-creation of new conditions in the market. With this view BMI becomes an opportunity for changing the established rules of the game. By thinking effectually, small businesses can apply their existing means creatively to change their business models in order to redefine the structure of their market and take control of the situation.

Second, due to the rapidity of changes in such industries, small firms need to appreciate that they cannot drive the future independently. Partnership is the key and learning plays a critical role in this process. Without ongoing learning, firms will have to hire appropriate staff which may be cost prohibitive for small organizations. Outsourcing of these activities is an alternative. However, this approach leaves the firm without complete control over the development and upgrading of its

technologies, and sometimes act as a barrier to achieving frontier goals. Looking at outsourcing as partnership and co-creation strategy makes it more controllable.

Third, affordable loss logic is a fruitful approach when managing an uncertain future as it allows firms to avoid debt and overspending. However, decision-makers should notice that resources are not just limited to financial resources. Intangible resources such as social and business ties, trust, reputation etc. are also important resources that need to be utilized and managed properly in the process of BMI.

5.3. Limitations

Like any empirical studies, this study has its own limitations that facilitate some directions for further research. First, we applied effectuation theory to investigate the cognition and actions of founders/managers in innovating their business models. However, effectuation theory concentrates on well-developed heuristics and cognitive models of expert entrepreneurs which facilitate their decision-making and guide their actions (Read et al., 2016; Sarasvathy, 2001). Second, effectuation theory focuses only on the co-creation of BMI, and it does not account for discovery opportunities. Third, our case firms were all from high-tech service industries. However, we did not consult with service literature in our study. Fourth, our study was a qualitative case study design, which limits the generalizability of our findings. case studies and qualitative research are merely reporting about the current state of specific organizations and may not be generalizable to other organizations or industry segments. Finally, our research was a cross-sectional study. While we spoke in detail with senior management and heads of these firms, we were not able to review financial records nor to benchmark their technologies against industry standards.

5.4. Future research

Cognition is an important microlevel factor in BMI research (Doz and Kosonen, 2010), however, it is unclear whether firms modulate the impact themselves, and if so, whether they do it with intent or not. An analysis of metacognition among management or at the organizational level could help understand this. Future research can also dig deeper in the decision-makers' cognition and heuristics by applying Kahneman's (2017) framing theory to investigate both useful and harmful heuristics. One interesting research direction is also applying a less-is-more heuristics model

(Gigerenzer and Gaissmaier, 2011) to investigate how decision-makers make sense of the ecology around BMI and the firm and make use of less information to unpack uncertainty and make the most ecologically rational decisions. Considering the importance of the *opportunity* aspect of BMI, as emphasized in this study, future research can apply discovery opportunity theory (Alvarez and Barney, 2007) to investigate if BMI can be the result of external opportunities. Considering a juxtaposition of both creation and discovery opportunities may provide a more realistic picture of BMI at the frontier. Chetty et al.'s (2018) paper on duality of creation and discovery opportunities may provide some useful insights. It would be also interesting to utilize March's ambidexterity concept to investigate how small businesses divide their resources into exploitation of certainties in their existing markets, and exploration of new opportunities at the frontier (March, 1991). Future research can employ a service lens to dig deeper on the BMI from the service literature point of view. Tidhar and Eisenhardt's (2019) work provides an interesting framework for such study. They have argued for the critical importance of the fit between value creation and value capture in successful business models. Service dominant logic (Lusch and Vargo, 2004), and service logic (Grönroos, 2011) can provide clear directions for such research. Studies can also go further and look at cognition in an ecosystem of institutional setting, wherein cognitive institutions as micro level institutions are shaped by regulative and normative institutions (Scott, 2008). Vargo and Lusch's (2016) article on institutions and extension of service dominant logic may provide clear directions. Finally, future research can apply effectuation logic to investigate formation of hybrid business models for fulfilling their both economic and social commitments. Vrontis et al.'s (2021) study provides a good starting point for such research.

References

- Achtenhagen, L., Melin, L., Naldi, L. 2013. Dynamics of business models - strategizing, critical capabilities and activities for sustained value creation. *Long Range Planning*, 46(6), 427–442. <https://doi.org/10.1016/j.lrp.2013.04.002>.
- Afuah, A. and Tucci, C.L. 2001. *Internet Business Models: A Strategic Management Approach*. New York: Irwin/McGraw-Hill.
- Alvarez, S. A., & Barney, J. B. (2007). Discovery and creation: Alternative theories of entrepreneurial action. *Strategic Entrepreneurship Journal*, 1(1-2), 11-26.
- Alvarez, S. A., Audretsch, D., & Link, A. N. (2016). Advancing our understanding of theory in entrepreneurship. *Strategic Entrepreneurship Journal*, 10(1), 3–4.
- Amit, R., Zott, C. 2012. Creating value through business model innovation. *MIT Sloan Management Review*, 2012, 36-44.
- Andries, P., Debackere, K., Van Looy, B. 2013. Simultaneous experimentation as a learning strategy: Business model development under uncertainty. *Strategic entrepreneurship journal*, 7(4), 288-310.
- Aspara, J., Lamberg, J. A., Laukia, A., Tikkanen, H. 2013. Corporate business model transformation and inter-organizational cognition: The case of Nokia. *Long Range Planning*, 46(6), 459–474. <https://doi.org/10.1016/j.lrp.2011.06.001>
- Baber, W. W., Ojala, A., Martinez, R. 2019a. Effectuation logic in digital business model transformation Insights from Japanese high-tech innovators. *Journal of Small Business and Enterprise Development*, 26(6/7), 811–830. <https://doi.org/10.1108/JSBED-04-2019-0139>
- Baber, W. W., Ojala, A., Martinez, R. 2019b. Transition to Digital Distribution Platforms and Business Model Evolution. In *Proceedings of the 52nd Hawaii International Conference on System Sciences* (Vol. 6, pp. 4997–5006). Maui.
- Baden-Fuller, C., Morgan, M. S. 2010. Business models as models. *Long Range Planning*, 43(2–3), 156–171. <https://doi.org/10.1016/j.lrp.2010.02.005>
- Benbasat, I., Goldstein, D. K., Mead, M. 1987. The case research strategy in studies of information systems. *MIS quarterly*, 369-386.
- Berends, H., Smits, A., Reymen, I., & Podoynitsyna, K. (2016). Learning while (re) configuring: Business model innovation processes in established firms. *Strategic Organization*, 14(3), 181–219.
- Berger, D., Pukthuanthong, K., Yang, J. J. 2011. International diversification with frontier markets. *Journal of Financial Economics*, 101(1), 227-242.
- Berglund, H., Sandström, C. 2013. Business model innovation from an open systems perspective: structural challenges and managerial solutions. *International Journal of Product Development*, 18(3-4), 274-285.
- Bloching, B., Remane, G., Leutinger, P., Quick, P., Oltmanns, T., Rossbach, C., Shafranyuk, O. 2015. *The Digital Transformation of Industry*. Muenchen. <https://doi.org/10.4324/9780429203572-6>
- Bouwman, H., Heikkilä, J., Heikkilä, M., Leopold, C., Haaker, T. 2018. Achieving agility using business model stress testing. *Electronic Markets*, 28(2), 149–162. <https://doi.org/10.1007/s12525-016-0243-0>
- Brenk, S., Lüttgens, D., Diener, K., & Piller, F. (2019). Learning from failures in business model innovation: solving decision-making logic conflicts through intrapreneurial effectuation. *Journal of Business Economics*, 89(8-9), 1097-1147. Springer Berlin Heidelberg. <https://doi.org/10.1007/s11573-019-00954-1>

- Brennen, J. S., Kreiss, D. 2016. Digitalization. In *The international encyclopedia of communication theory and philosophy* (pp. 1–11). John Wiley & Sons.
- Burgelman, R. a. 2015. *Built to Become: Corporate Longevity and Strategic Leadership* (Working Paper Series No. 3115). Stanford, CA.
- Burns, J., Nielsen, K. 2006. How do embedded agents engage in institutional change? *Journal of Economic Issues*, XL (2), 449–457. Retrieved from <http://www.jstor.org/stable/4228267>
- Caputo, A., Pizzi, S., Pellegrini, M. M., Dabić, M. 2021. Digitalization and business models: Where are we going? A science map of the field. *Journal of business research*, 123, 489-501.
- Carroll, L. 1872. *Through the looking-glass, and what Alice found there*. London: MacMillan.
- Casadesus-Masanell, R., Zhu, F. 2013. Business model innovation and competitive imitation: The case of sponsor-based business models. *Strategic management journal*, 34(4), 464-482.
- Chanias, S., & Hess, T. 2016. Understanding digital transformation strategy formation: Insights from Europe's automotive industry. In *Pacific Asia Conference on Information Systems, PACIS 2016 - Proceedings*.
- Chesbrough, H. 2010. Business model innovation: Opportunities and barriers. *Long Range Planning*, 43(2–3), 354–363. <https://doi.org/10.1016/j.lrp.2009.07.010>.
- Chetty, S., Karami, M., & Martín, O. M. 2018. Opportunity discovery and creation as a duality: Evidence from small firms' foreign market entries. *Journal of International Marketing*, 26(3), 70-93.
- Corbin, J., & Strauss, A. 2014. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (4th ed.). Thousand Oaks, CA: SAGE Publications.
- Demil, B., Lecocq, X. 2010. Business model evolution: In search of dynamic consistency. *Long Range Planning*, 43(2–3), 227–246. <https://doi.org/10.1016/j.lrp.2010.02.004>
- Doz, Y. L., Kosonen, M. 2010. Embedding strategic agility: A leadership agenda for accelerating business model renewal. *Long Range Planning*, 43(2–3), 370–382. <https://doi.org/10.1016/j.lrp.2009.07.006>
- Dyer, W.G., and Wilkins, A.L. 1991. Better Stories, Not Better Constructs, to Generate Better Theory: A Rejoinder to Eisenhardt, *Academy of Management Review* (16:3), pp. 613-619.
- Edmondson, A.C., and McManus, S.E. 2007. Methodological fit in management field research, *Academy of Management Review* (32:4), pp. 1155-1179.
- Eisenhardt, 1989. Building theories from case study research. *Academy of Management Review*, 14(4), 532–550.
- Eisenhardt, K. M., Graebner, M. E. 2007. Theory Building from Cases: Opportunities and Challenges. *Academy of Management Journal*, 50(1), 25–32. <https://doi.org/10.5465/AMJ.2007.24160888>
- Figueres, C., Rivett-Carnac, T. 2020. *The future we choose: Surviving the climate crisis*. Vintage.
- Foss, N. J., Saebi, T. 2017. Fifteen Years of Research on Business Model Innovation: How Far Have We Come, and Where Should We Go? *Journal of Management*, 43(1), 200–227. <https://doi.org/10.1177/0149206316675927>.
- Frank, A. G., Mendes, G. H., Ayala, N. F., & Ghezzi, A. (2019). Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective. *Technological Forecasting and Social Change*, 141, 341-351.
- Futterer, F., Schmidt, J., Heidenreich, S. 2018. Effectuation or causation as the key to corporate venture success? Investigating effects of entrepreneurial behaviors on business model innovation and venture performance. *Long Range Planning*, 51(1), 64-81.

- Gambardella, A., & McGahan, A. M. 2010. Business-model innovation: General purpose technologies and their implications for industry structure. *Long Range Planning*, 43, 262-271.
- Gaur, A. S., Delios, A., & Singh, K. (2007). Institutional environments, staffing strategies, and subsidiary performance. *Journal of Management*, 33(4), 611-636.
- Gigerenzer, G., & Gaissmaier, W. 2011. Heuristic decision making. *Annual review of psychology*, 62, 451-482.
- Grönroos, C. 2011. Value co-creation in service logic: A critical analysis. *Marketing theory*, 11(3), 279-301.
- Hambrick, D. C., Mason, P. A. 1984. Upper echelons: The organization as a reflection of its top managers. *Academy of management review*, 9(2), 193-206.
- Hamel, G., Prahalad, C. K. 1989. Strategic Intent. *Harvard Business Review*, 67(July-August), 63–78. <https://doi.org/10.1113/jphysiol.2003.043182>
- Heikkilä, M., Bouwman, H., Heikkilä, J. 2018. From strategic goals to business model innovation paths: an exploratory study. *Journal of Small Business and Enterprise Development*, 25(1), 107–128. <https://doi.org/10.1108/JSBED-03-2017-0097>
- Hinings, C. 2018. Why should we bother? What are configurations for? *Strategic Organization*, 16(4), 499–509. <https://doi.org/10.1177/1476127018804796>
- Hinings, C., Gegenhuber, T., Greenwood, R. 2018. Digital innovation and transformation: An institutional perspective. *Information and Organization*, 28(1), 52–61. <https://doi.org/10.1016/j.infoandorg.2018.02.004>
- Hsu, Y. G., Tzeng, G. H., & Shyu, J. Z. (2003). Fuzzy multiple criteria selection of government-sponsored frontier technology R&D projects. *R and D Management*, 33(5), 539–551. <https://doi.org/10.1111/1467-9310.00315>
- Huang, H. C., Lai, M. C., Lo, K. W. 2012. Do founders' own resources matter? The influence of business networks on start-up innovation and performance. *Technovation*, 32(5), 316-327.
- Hunt, S. D. (2005). For truth and realism in management research. *Journal of Management Inquiry*, 14(2), 127-138.
- Joseph, R. P. (2018). Digital Transformation Business Model Innovation and Efficiency in Content Industries. *A Review The International Technology Management Review*, 7(1), 59-70.
- Kahneman, D., 2017. *Thinking Fast and Slow*, Penguin Books, New Yourk.
- Karami, M., Read, S. 2021. Co-creative entrepreneurship. *Journal of Business Venturing*, 36(4), 106125.
- Karami, M., Ojala, A., Saarenketo, S. 2020. Entrepreneurial orientation and international opportunity development by SMEs: The mediating role of decision-making logic. *Journal of Small Business Management*. 1-29.
- Kerr, J., Coviello, N. 2020. Weaving network theory into effectuation: A multi-level reconceptualization of effectual dynamics. *Journal of Business Venturing*, 35(2), 105937. <https://doi.org/10.1016/j.jbusvent.2019.05.001>
- Khanagha, S., Volberda, H., Oshri, I. 2014. Business model renewal and ambidexterity: structural alteration and strategy formation process during transition to a C loud business model. *R&D Management*, 44(3), 322-340.
- Kneller, R., Stevens, P. 2006. Frontier technology and absorptive capacity: Evidence from OECD manufacturing industries. *Oxford Bulletin of Economics and Statistics*, 68(1), 1-21.

- Levy, B., Kuo, W. J. 1991. The strategic orientations of firms and the performance of Korea and Taiwan in frontier industries: lessons from comparative case studies of keyboard and personal computer assembly. *World development*, 19(4), 363-374.
- Lindgardt, Z., Reeves, M., Stalk, G., & Deimler, M. S. (2009). Business model innovation. *When the Game Gets Tough, Change the Game, The Boston Consulting Group, Boston, MA, 118*.
- Lusch, R. F., Vargo, S. L. 2006. Service-dominant logic as a foundation for a general theory. In R. F. Lusch, S. L. Vargo (Eds.), *The service-dominant logic of marketing: Dialog, debate, and directions* (pp. 381–420). Armonk: ME Sharpe
- Maine, E., Soh, P. H., Dos Santos, N. 2015. The role of entrepreneurial decision-making in opportunity creation and recognition. *Technovation*, 39, 53-72.
- March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1), 71-87.
- Markides, C. 2006. Disruptive Innovation: In Need of Better Theory. *The Journal of Product Innovation Management*, 23(1), 19–25.
- Markides, C. 2013. Business model innovation: What can the ambidexterity literature teach us? *Academy of Management Perspectives*, 27(4), 313–323. <https://doi.org/10.5465/amp.2012.0172>
- Marquardt, M. J. 2011. *Building the Learning Organization: Achieving Strategic Advantage through a Commitment to Learning*. London: Quercus.
- Marshall, B. R., Nguyen, N. H., Visaltanachoti, N. 2015. ETF liquidity. Work. Pap., Massey Univ.
- Matt, C., Hess, T., Benlian, A. 2015. Digital Transformation Strategies. *Business and Information Systems Engineering*, 57(5), 339–343. <https://doi.org/10.1007/s12599-015-0401-5>
- McDonald, R. M., & Eisenhardt, K. M. 2020. Parallel play: Startups, nascent markets, and effective business-model design. *Administrative Science Quarterly*, 65(2), 483-523.
- McGrath, R. G. 2010. Business models: A discovery driven approach. *Long Range Planning*, 43(2–3), 247–261. <https://doi.org/10.1016/j.lrp.2009.07.005>
- Miles, M. B., Huberman, A. M., Saldaña, J. 2018. *Qualitative Data Analysis: A Methods Sourcebook* (4th ed.). Thousand Oaks, CA: Sage Publications.
- Mitchell, D. W., & Coles, C. B. 2004a. Business model innovation breakthrough moves. *Journal of Business Strategy*, 25, 16-26.
- Ojala, A. 2016. Business models and opportunity creation: How IT entrepreneurs create and develop business models under uncertainty. *Information Systems Journal*, 26(5), 451–476. <https://doi.org/10.1111/isj.12078>
- Ojala, A., Lyytinen, K. 2022. How do entrepreneurs create indirect network effects on digital platforms? A study on a multi-sided gaming platform. *Technology Analysis & Strategic Management*, 1-16.
- O’Shannassy, T. F. 2016. Strategic intent: The literature, the construct and its role in predicting organization performance. *Journal of Management and Organization*, 22(5), 583–598. <https://doi.org/10.1017/jmo.2015.46>
- Osterwalder, A., Pigneur, Y., Tucci, C. L. 2005. Clarifying business models: origins, present, and future of the concept. *Communications of the Association for Information Systems*, 15(1), 1–43. <https://doi.org/10.1.1.83.7452>.
- Parmigiani, A., & Rivera-Santos, M. 2015. Sourcing for the base of the pyramid: Constructing supply chains to address voids in subsistence markets. *Journal of Operations Management*, 33, 60-70.

- Prahalad, C. K., & Ramaswamy, V. (2003). The new frontier of experience innovation. *MIT Sloan Management Review*, 44(4), 12.
- Prem, E. (2015, December). A digital transformation business model for innovation. In *ISPIM Innovation Symposium* (p. 1). The International Society for Professional Innovation Management (ISPIM).
- Rachinger, M., Rauter, R., Müller, C., Vorraber, W., Schirgi, E. 2019. Digitalization and its influence on business model innovation. *Journal of Manufacturing Technology Management*, 30(8), 1143–1160. <https://doi.org/10.1108/JMTM-01-2018-0020>.
- Read, S., Sarasvathy, S. D., Dew, N., & Wiltbank, R. 2016. Response to Arend, Sarooghi, and Burkemper (2015): Cocreating effectual entrepreneurship research. *Academy of Management Review*, 41(3), 528-536.
- Reymen, I., Berends, H., Oudehand, R., & Stultiëns, R. (2017). Decision making for business model development: a process study of effectuation and causation in new technology-based ventures. *R&D Management*, 47(4), 595-606.
- Rindova, V., Courtney, H. 2020. To shape or adapt: Knowledge problems, epistemologies, and strategic postures under Knightian uncertainty. *Academy of Management Review*, 45(4), 787-807.
- Saebi, T., Lien, L., Foss, N. J. 2017. What Drives Business Model Adaptation? The Impact of Opportunities, Threats and Strategic Orientation. *Long Range Planning*, 50(5), 567–581. <https://doi.org/10.1016/j.lrp.2016.06.006>
- Sarasvathy, S. D. 2008. *Effectuation: Elements of Entrepreneurial Expertise*. Cheltenham, UK: Edward Elgar.
- Sarasvathy, S. D., Dew, N. (2005). New market creation through transformation. *Journal of Evolutionary Economics*, 15(5), 533-565.
- Sarasvathy, S., Kotha, S. (2001). Effectuation in the management of Knightian Uncertainty: Evidence from the Real Networks Case. *Research on Management and Entrepreneurship*, 1, 1-49.
- Schneider, S., Spieth, P. 2013. Business Model Innovation: Towards an Integrated Future Research Agenda. *International Journal of Innovation Management*, 17(01), 1340001. <https://doi.org/10.1142/s136391961340001x>
- Schumpeter, J. A. 2017. *Theory of Economic Development*. New York, NY: Taylor Francis. Retrieved from <https://books.google.co.jp/books?id=UD4rDwAAQBAJ>
- Scott, W. R. 2008. *Institutions and organizations: Ideas and interests*. Los Angeles: Sage.
- Speidell, L. S. 2009. Investing in the unknown and the unknowable—Behavioral finance in frontier markets. *The Journal of Behavioral Finance*, 10(1), 1-8.
- Stake, R. E. 1995. *The art of case study research*. Thousand Oaks, CA: Sage Publications.
- Swanborn, P., 2010. *Case study research: What, why and how?* Sage Publications.
- Takata, M., Nakagawa, K., Yoshida, M., Matsuyuki, T., Matsuhashi, T., Kato, K., Stevens, A. J. 2020. Nurturing entrepreneurs: How do technology transfer professionals bridge the Valley of Death in Japan? *Technovation*, 102161.
- Teece, D. J. 2010. Business models, business strategy and innovation. *Long Range Planning*, 43(2–3), 172–194. <https://doi.org/10.1016/j.lrp.2009.07.003>
- Tidhar, R., & Eisenhardt, K. M. 2020. Get rich or die trying... finding revenue model fit using machine learning and multiple cases. *Strategic Management Journal*, 41(7), 1245-1273.
- Tongur, S., Engwall, M. 2014. The business model dilemma of technology shifts. *Technovation*, 34(9), 525-535.

- Vargo, S. L., Lusch, R. F. 2016. Institutions and axioms: an extension and update of service-dominant logic. *Journal of the Academy of marketing Science*, 44(1), 5-23.
- Velu, C. 2015. Business model innovation and third-party alliance on the survival of new firms. *Technovation*, 35, 1-11.
- Voelpel, S. C., Leibold, M., Tekie, E. B. 2004. The wheel of business model reinvention: How to reshape your business model to leapfrog competitors. *Journal of Change Management*, 4(3), 259–276. <https://doi.org/10.1080/1469701042000212669>
- Vrontis, D., Morea, D., Basile, G., Bonacci, I., & Mazzitelli, A. 2021. Consequences of technology and social innovation on traditional business model. *Technological Forecasting and Social Change*, 170, 120877.
- Wiltbank, R., Dew, N., Read, S., Sarasvathy, S. D. 2006. What to do next? The case for non-predictive strategy. *Strategic Management Journal*, 27(10), 981-998.
- Wiprächtiger, D., Narayanamurthy, G., Moser, R., & Sengupta, T. (2019). Access-based business model innovation in frontier markets: Case study of shared mobility in Timor-Leste. *Technological Forecasting and Social Change*, 143, 224-238.
- Wirtz, B. W. 2019. *Digital Business Models*. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-13005-3_9.
- Xu, Y., & Koivumäki, T. (2019). Digital business model effectuation: An agile approach. *Computers in Human Behavior*, 95, 307-314.
- Yeo, R. K. 2003. Linking organisational learning to organisational performance and success: Singapore case studies. *Leadership Organization Development Journal*, 24(2), 70–83. <https://doi.org/10.1108/01437730310463260>
- Yin, R. K. 2013. *Case Study Research: Design and Methods* (5th ed.). Thousand Oaks, CA: SAGE Publications.
- Yoo, Y., Henfridsson, O., Lyytinen, K. 2010. The new organizing logic of digital innovation: An agenda for information systems research. *Information Systems Research*, 21(4), 724–735. <https://doi.org/10.1287/isre.1100.0322>
- Zhu, X., Xiao, Z., Dong, M. C., Gu, J. 2019. The fit between firms’ open innovation and business model for new product development speed: A contingent perspective. *Technovation*, 86, 75-85.
- Zott, C., Amit, R., Massa, L. 2011. The business model: Recent developments and future research. *Journal of Management*, 37(4), 1019–1042. <https://doi.org/10.1177/0149206311406265>

Table 1

Case firms

Firm	Year of establishment	Employees	Main activity	Headquarters Location
A	1984	8	Customized software development	Kyoto
B	1990	130	Videogame development	Kyoto
C	1984	132	Customized software development	Tokyo
D	2001	42	Videogame development	Kyoto
E	2013	50	Cybersecurity development	Toronto
F	2006	130	Videogame development	Tokyo
G	2014	300	Cryptocurrency exchange and services	Tokyo
H	1961	130	Digital engineering services and prototyping	Kyoto

Table 2

Interviews and written sources

Firm	Date	Length	Representative	Other source materials
A	May 29, 2017	1.5 hours	President	-Firm's web page -3 rd party reseller websites -App stores -Leaflets
	October 10, 2017	1.5 hours	President	
	March 27, 2020	45 min	President	
B	June 16, 2017	2 hours	CFO Publishing producer	-Firm's web page -Advertising materials
	September 16, 2017	1 hour	Publishing producer	
	April 12, 2019	45 min	CFO Publishing producer	
C	August 4, 2017	1 hour	Chairman (former CEO)	-Firm's web page -Book written by CEO -News articles from past 25 years
	September 13, 2017	1 hour	Chairman (former CEO)	
	July 19, 2018	1 hour	Chairman (former CEO)	
	September 10, 2018	1 hour	Chairman (former CEO) Senior Department Head	

D	August 9, 2017	2 hours	Senior Producer Creative Producer	-Firm's web page -3 rd party news releases -Conference video -News media
	September 19, 2017	2 hours	Senior Producers	
	April 15, 2019	1 hour	Senior Producers	
E	August, 2017	1.5 hours	President	-Firm's web page -News media -Leaflets
	October 11, 2017	45 min	President	
	April 1, 2020	1 hour	Head of Business	
F	November 6, 2017	2.25 hours	President (Founder)	-Firm's web page -News media
G	July, 2019	1.5 hours	CFO Senior Product Leader Senior Business Developer	-Firm's web page -News media
	April, 2020	30 min	Senior Business Developer	
H	March 3, 2019	30 min	Head of USA subsidiary	-Firm's web page -Book written by CEO -News articles from past 25 years
	March 14, 2019	1 hour	Head of USA subsidiary	
	April 11, 2019	30 min	Head of Business	
	June 12, 2020	45 min	Head of Business (retired)	
	April 14, 2021	30 min	Head of Business (retired)	

Table 3. Selected quotations and examples underlying open coding, axial coding and final codes

Quotes and Examples	Open Coding	Axial Coding	Final Selected Codes
<p>A: “must be very strategic ...and you can have helicopter view”; “We definitely knew about the field, what was coming.” B: “the CEO....at that time he had his ear like he was just listening closely for new opportunities” C, D, and H: constant learning expectation for staff</p>	<p>Overview, Extensive reading and learning</p>	<p>Worldview</p>	<p>Effectuation cognition</p>
<p>D: Created an event to gain insight into trends. “not only user feedback but also feedback from fellow developers in [the] city”</p>	<p>events for insight</p>		
<p>B: “check out the user's activity and our sales interest every day” C: “when we go [to] our customer we can understand what they’re doing, how they’re doing, how we can use this IT for them.” D: “Communication is much faster than message boards, twitter is much faster, Facebook is much faster in getting feedback.” G: “because that initiative casts such a wide net ...we kind of need all the characters from that wide net” H: intensive communication with customer’s engineers leads to insight and trust</p>	<p>Understanding customers</p>	<p>Sensing the environment</p>	
<p>A: “must be very strategic ...and you can have helicopter view”; “We definitely knew about the field, what was coming.” B: “the CEO... he was just listening closely for new opportunities” C, D, and H: constant learning expectation for staff</p>	<p>Overview, Extensive reading and learning</p>		
<p>A: “We definitely knew about the field, what was coming.” B: “we are trying to find that new things, we are searching what platform or what kind of games is going to be preferred by the users, so we are just searching”</p>	<p>Market information</p>		

<p>D: “When we were able to gather these people together, and organize an event, that's what basically became the first Bitsummit.”</p> <p>F: “advantage ...being in touch with market”</p>			
<p>C: “they gave some order ...then we designed ourself”</p> <p>D: “we go through iterations of games, verify these iterations to see if they're actually entertaining...”</p> <p>F: “separate in two team. One team is for develop the library for the PC. Another one for mobile”</p> <p>H: Developing all technical aspects of new business model in house.</p>	<p>Prototyping, Product development</p>	<p>Innovation Development</p>	<p>Technology at frontier Personnel at frontier</p>
<p>B: left products as technology changed;</p> <p>D: “they stopped and thought if the game was fun or not. Then if it's not, they don't really go into it”</p> <p>F: Support of some games has ended due to lack of popularity.</p> <p>G: “our CTO, or Chief Product officer, ...the main assigned person as to which endeavors we'd like ...he is the one who either says yes or no to that idea”</p>	<p>Abandon products</p>		
<p>A: “We outsource the key development to China and India”</p> <p>B: “It’s as much in-house as we can possibly do.”</p> <p>F: “...short recruitment from outside ...about 300 and 400 people”</p> <p>G: “The majority ...is done in house We do have one contract team that we utilize”</p>	<p>Outsourcing</p>		
<p>A: “No one was doing that, and we could do that. We could engineer that.”</p> <p>D: “push the technology”; “As far as the core development is concerned, everything is done here”</p> <p>F: “the traditional way is to develop in the company.”</p> <p>G: “take a strategically progressive approach to embrace technology and innovation.”</p> <p>H: All development is in-house.</p>	<p>Technology development</p>	<p>Technology Control of technology</p>	<p>Technology at frontier Personnel at frontier</p>

<p>F: “staff ...can create a library for the platform after research the function of the hardware.”</p> <p>G: “we do have a separate team, our operations technology team, that helps satisfy any technical requirements”</p> <p>H: Developed their own middleware tools as needed.</p>	Tool creation		
<p>A: “try and figure out the backend to all these products. ... What is the next thing with fonts that will make fonts smart?”</p> <p>G: The firm publishes and updates their long-term roadmap online.</p>	Roadmap	Self-understanding of progress Strategic intent	Explicit aims
<p>A: “to have helicopter view and then having it translated by a team into product”</p> <p>D: “It's a small team. Those members will make various decisions for the company.”</p> <p>F: “quality ... the enjoyment for the player ... new game design, it will increase the value of the company.”</p> <p>G: “take a strategically progressive approach to embrace technology, innovation”</p> <p>H: “operate both sides of the market via a platform”</p>	Strategy		
<p>B: “Our strategy is always about finding the new chance.”</p> <p>D: “to be in the history of the gaming.”</p> <p>F: “create an original new game.”</p> <p>G: “financial inclusion and providing financial services to all”</p> <p>H: Control the market of their industry.</p>	Goals and Aspirations		
Detailed histories were provided by each case firm.	Company history		
<p>A: “you don't need somebody in between anymore so that's changed for us.”</p> <p>B: “, instead of the retail shops, it's being distributed by the telecom carriers”</p> <p>G: Controls own distribution platform (crypto exchange)</p>	Distribution	BMI as a cognitive change process	Manager cognition
Detailed business models were developed with each case firm.	Business model		
<p>A: “That's changed in ten years you don't need Daigakusei as the middleman in that business model”</p>	Revenue structure		

<p>B: "Instead we provided that ... In-App purchase." D: "Oh, we don't have to go through the middle man anymore. We can do it ourselves."</p>			
<p>D: "When we were able to gather these people together, and organize an event, that's what basically became the first Bitsummit." F: "They cannot have some direct network to the final company, the one to get relationship, so they have to establish this relationship through another person." H: Established new network while expanding in California.</p>	Networking	Crazy quilt co-creation	Effectuation co-creation of value
<p>A: "they [Google] have a beer garden on Friday every month and I have been to it a couple times" B: "BitSummit" D: "When we were able to gather these people together, and organize an event, that's what basically became the first Bitsummit." H: Participated in JETRO and local events while expanding in California</p>	Trade events	Crazy quilt co-creation	
<p>C: "to build up the local businesses and industries for survivability." G: Moved to Japan in order to gain better regulators and input from them.</p>	Relocate to gain network	Crazy quilt co-creation	
<p>B: "We closed two studios and ours ended up be is creates, one more studios." F: "All of the capital for a new game would be created by themselves inside the company." G: "this more modular approach to development is something that's become more popular for startups because of its adaptability"</p>	Restructuring, One project pays for another, Self-funding	Affordable loss	Effectuation resources

<p>B: “the smart phone era ... the technology allows you to do so much more you need specialized talent... So, there’s more investment in human resources”</p> <p>C: “we’ll do that ourselves we don’t mind to study, if we think our technology alone is not enough to satisfy the customer.”</p> <p>H: Develop staff to do programing and engineering</p>	<p>Understanding resources</p>	<p>Means</p>	
<p>C: “in Japan get big recession, I did mind that was big chance for me to open new market, new customer”</p>	<p>Took advantage of market downturn</p>	<p>Leverage contingencies</p>	<p>Effectuation action/seizing opportunity</p>
<p>D: “It was a pretty big change in the industry that people basically saw it very clearly that it really meant that you didn’t have to be a mega, behemoth publisher that had a lot of money to be able to sell your product.”</p> <p>H: Reliable high-volume Internet allows transfer of data overseas.</p>	<p>Took advantage of technology shift</p>	<p>Leverage contingencies</p>	

Table 4

Overview of the case firms’ positioning at the frontier

Firm	Technology at frontier	Personnel at frontier	Explicit aim
A	<p>No</p> <p>-The firm was not able to achieve the new technology</p>	<p>No</p> <p>-The staff was not up to date and they outsourced key tasks</p>	<p>Yes</p> <p>-The firm aimed to update their products with top technologies</p>
B	<p>No</p> <p>-The firm was satisfied with their current status</p>	<p>No</p> <p>-The focus was on existing users’ experience and culture</p>	<p>No</p> <p>-Their explicit aims were not related to technology or BMI</p>
C	<p>No</p> <p>-The focus was not on technology or business model development</p>	<p>No</p> <p>-Staff constantly learned in order to serve existing customers but they limit their activities on that</p>	<p>No</p> <p>-Explicit aims were only about the existing customer</p>
D	<p>Yes</p> <p>-The firm has made significant contributions to its</p>	<p>Yes</p> <p>-Founder and other engineers were able to</p>	<p>Yes</p> <p>-The firm constantly sought to push the technology forward</p>

	industry since establishment	make advanced technology	- Be part of gaming history
E	No -The firm attempted to develop new technologies but they were not successful	No -The team was not able to create the technology needed	Yes -The firm aimed to create novel, leading technology
F	Yes -The firm successfully created superior development tools in their industry	Yes -They completed projects internally	No -Goal was to be strong in technology, but not to be a leader in technology
G	Yes -The firm developed core block chain technology	Yes -Projects were completed internally	Yes -The firm stated top technology as their goal
H	Yes -The firm created totally new platform for the industry	Yes -The platform project completed internally	Yes -The new manager stated that they would create new business functions in the industry

Table 5

Transformational outcome or not

Firms	Technologies	Changes in Value Co-creation	Structural Changes	Financial Aspects
D	Partially	Transformational	Non-transformational	Non-transformational
F	Partially	Transformational	Transformational	Transformational
G	Transformational	Transformational	Transformational	Transformational
H	Transformational	Transformational	Partially	Transformational

Table 6

Examples of changes in case firms' BMs

Firm	Change(s) in business model elements	Examples how the business model evolved
A	-Technologies -Changes in Value Co-creation -Structural Changes	Firm A added new AI technologies to their software. They also networked with an advanced technology partner in order to do so. However, these BMIs remain only partially completed and have not materially impacted the business model. Firm A outsourced development of a technology that is intended to become a key differentiator.
B	-Technologies -Changes in Value Co-creation -Financial Aspects	Firm B initiated a partnership with an IP provider to make new offerings. They also moved to new mobile gaming platforms as they appeared and, in that way, gained access to new users. These BMIs have improved profitability but have not moved the company into the frontier of technology or business structures.
C	-Technologies	Firm C improved their offerings. The new business model is closely integrated with the customers from whom the staff draw the ideas for improved offerings. While the technology keeps up-to-date, change is incremental and does not impact the other elements of the BM.
D	-Technologies -Changes in Value Co-creation	Firm D improved their offerings and reached major new customers. This based on provisioning advanced technology for a new global B2B customer. The incrementally changed business model that enables the firm to reach more direct and indirect end users through the new partner.
E	-Technologies	Firm E developed new technologies (offensive cyber forensics) and capabilities (e.g. strike back at hackers). They developed technologies mainly reactively despite the technology being highly advanced. The firm intentionally does not attempt to get ahead of its customer demands due to its ability to react quickly to meet unique project demands.
F	-Technologies -Changes in Value Co-creation	Firm F developed new technologies (e.g. tools superior to vendor development kits) and capabilities (e.g. game logic tools) to acquire new B2B customers. This firm emphasized in-house technology development to put it

		ahead of its suppliers and thus create competitive advantages which allowed it to gain new customers.
G	-Technologies -Changes in Value Co-creation	Firm G developed new technologies (e.g. a clearing algorithm, peer to peer lending system) and related capabilities (e.g. microtransactions and interest accrual) to reach new end users. The firm relies on its own engineering capacity and the ability of the founders to steer it toward the frontier. They must react to aggressive competitors in a fast-moving industry by staying at the frontier.
H	-Technologies -Changes in Value Co-creation	Firm F developed platform technologies to reach new platform technology as well as new partners and customers. This firm is developing its own engineers to create its own technology behind a platformization strategy. The technology and related services are new to the industry.