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Agility in responding to disruptive digital innovation: Case study of an SME

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Abstract

Disruptive digital innovation (DDI) often creates hypercompetitive market environment that forces firms to be agile to survive and remain competitive. Whereas most studies have focused on larger firms' effort to be agile, few have looked at how small- and medium-sized enterprises (SMEs) respond to DDI. The study attempts to answer the research question of how SMEs achieve agility to respond to DDI. Drawing on a case study of an innovative SME, our study develops a framework on agility based on the processes of mitigating organizational rigidity, developing innovative capabilities, and balancing the tension of organizational ambidexterity. Specifically, our findings show that for SMEs, mitigating organizational rigidity is enabled by the mechanism of achieving boundary openness while developing innovative capability is enabled by the mechanism of achieving organizational adaptability. At the same time, given the inherent challenges of resource constraints, SMEs also need to balance the tension of organizational ambidexterity.

KEYWORDS

agility, capability, case study, disruptive digital innovation, rigidity, small- and medium-sized enterprises

Introduction

Corporate leaders across various industry sectors are disturbed by the stream of disruptive digital innovation (DDI) that has stricken businesses around the world. In a survey of corporate board members, 32% indicated that their company's revenue is under threat from DDI, and 60% felt that significantly more time should be dedicated to addressing this issue (Weill & Woerner, 2015a). Such intense concern is understandable because DDI not only affects businesses operations but can also transform business models (Weill & Woerner, 2015b).

Disruptive digital innovation is understood in the literature as a scientific discovery that enables significant breakthrough in capabilities (Bower & Christensen, 1995) to the extent that traditional competencies are rendered irrelevant or trivial (Schumpeter, 1934) and existing rules of competition are disturbed (Lyytinen & Rose, 2003). Firms that fail to respond appropriately to DDI risk losing market opportunities and becoming obsolete or even extinct. Two infamous examples are Kodak and Nokia, both of whom failed to respond rapidly to the emergence of DDI. For Kodak, the disruption came from digital photography technology, while Nokia failed to respond to the DDI of smartphone technology (Lucas & Goh, 2009).

Faced with rapid and often unanticipated changes brought about by DDI, agility has emerged as a key business imperative for organizations in staying competitive and innovative (Teece, Peteraf, & Leih, 2016). Agility refers to the ability to sense and respond nimbly to business opportunities and unexpected changes in the market (Brown & Bessant, 2003). Firms that are agile in taking advantage of DDI can create a niche and expand their foothold in a hypercompetitive economy (Kane, Palmer, Phillips, & Kiron, 2015; Lyytinen & Rose, 2004; Sambamurthy, Bharadwaj, & Grover, 2003). For example, Airbnb is a resource-constrained start-up using an online platform to offer its service, disrupting and restructuring the traditional hotel industries (Alton, 2016). With the business environment becoming increasingly hypercompetitive and dynamic (Wheeler, 2002), it is important for firms to discover how they can achieve agility in adapting to DDI (Lyytinen & Rose, 2003).

Less established businesses such as small- and medium-sized enterprises (SMEs) are typically more agile and able to innovate more rapidly than large and well-established corporations (Dibrell, Davis, & Craig, 2008). Small- and medium-sized enterprises are also more likely to be successful in benefiting from digital innovation than large and well-established corporations, which are often reluctant to adopt emerging DDI for fear of losing the foundation of their existing competitive advantages (Christensen, 1997). However, SMEs are also often hindered by resource limitations (Street, Gallupe, & Baker, 2017) and are thus more vulnerable in a hypercompetitive business environment in which disruptive changes abound (Arendt, 2008; Levy & Powell, 1998; Meister, 2017). In the literature, there is a lack in understanding how SMEs achieve the agility to respond to DDI.

To address this knowledge gap, this paper presents a case study of an SME that has been agile and thrived for decades amidst DDI. The study attempts to answer the research question of how SMEs achieve agility in response to DDI and develops a framework on agility based on the dual process of mitigating organizational rigidity and developing innovative capabilities.

Disruptive Digital Innovation (DDI)

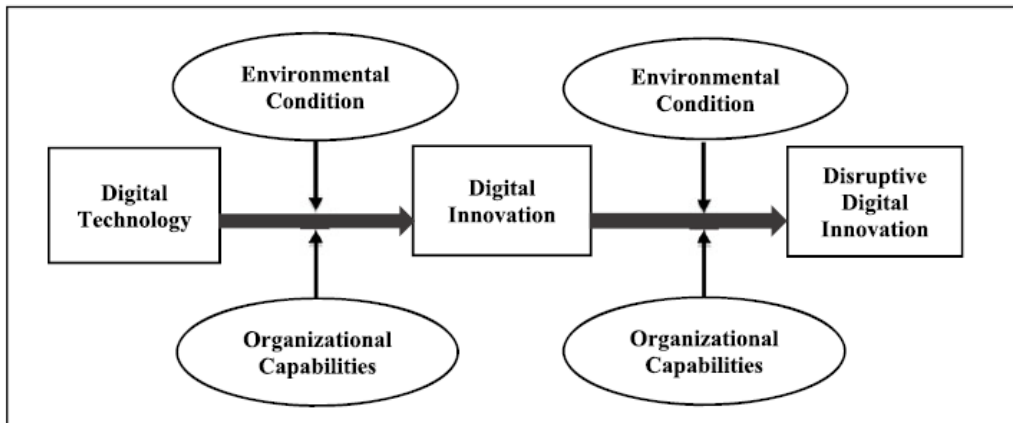
All DDI can trace their origins to some form of digital technology. New digital technologies are constantly developed from scientific research and discoveries. Some of these digital technologies may be combined and developed into digital innovation (Christensen & Rosenbloom, 1995). For example, the smartphone is a digital innovation that incorporated various digital technologies such as touch-screen technology, mobile telephony technology, and internet technology. A digital innovation can be the product of research and development (R&D) efforts by research institutions or business organizations. In either case, while the environmental condition (e.g., the maturity of supporting technological infrastructure and the sophistication of consumer demand; Porter, 1990) affects the development of digital technology into digital innovation, the literature indicates that organizational capability has a more significant effect on the transformation of digital technology into digital innovation (Fichman & Melville, 2014). A recent study (Kane et al., 2015) suggests that some of these key organizational capabilities include the ability to conceptualize how the new digital technology will affect current business processes or models and the ability to experiment and take risk. These organizational capabilities are enabled through resources such as a conducive organizational culture and having digitally savvy talent in the organization. This emphasis on organizational capability over environmental condition in the transformation of digital technology into digital innovation may also explain why digital technology organizations operating under similar environmental conditions can yield drastically different outcomes.

Even as organizations manage to transform digital technology into digital innovation, not all digital innovation will eventually be transformed into DDI. The transition from digital innovation to a DDI is contingent on a myriad of organizational capabilities and environmental conditions (Christensen, 1997; Lyytinen & Rose, 2004). Results from initial studies on transformation of digital innovation into DDI note the importance of organizational leadership and coercive pressure from the institutional environment such as industry trends and consumer preferences (Lui, Ngai, & Lo, 2015). For example, widespread investment into novel DDI may be resisted by shareholders because such innovation is considered risky and presents uncertain benefits. Many organizations, particularly large and well-established organizations often become rigid and reluctant to adopt new disruptive technologies, preferring to stick with proven technologies and innovations (Kassicieh et al., 2002). In fact, Christensen (1997) states that well-established firms are usually poorly positioned to introduce

DDI into markets; instead, it is the new high-technology firms that outperform the larger, more established and resource-rich organizations (Walsh, Kirchhoff, & Newbert, 2002).

This process of transforming digital technology into digital innovation and consequently into DDI is depicted graphically in Figure 1.

FIGURE 1 Transformation from digital technology to disruptive digital innovation



AGILITY

Numerous definition of agility exists among organization scholars. Some have defined it as the capacity to continuously adjust and adapt strategic direction in a core business to create value for a company (Doz & Kosonen, 2008). Others defined it as the ability to remain flexible in the face of new developments (Weber & Tarba, 2014). There are also others who defined it as the capability to make timely, effective, sustained organizational change. Leading scholars have also defined agility as “the capacity of an organization to efficiently and effectively redeploy/redirect its resources to value creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant” (Teece et al., 2016, p. 17). Most scholars would agree that agility is the ability of an organization to sense and respond with a relative degree of speed to environmental changes and to take advantage of new opportunities (Overby, Bharadwaj, & Sambamurthy, 2006; Ravichandran, 2018; Roberts & Grover, 2012; Sambamurthy et al., 2003; Sanchez, 1995; Tallon & Pinsonneault, 2011).

The impact of agility on organizational outcomes is directly related to the environmental conditions surrounding the organization. Organizations with agility can quickly enact intentional strategic changes to their structures, processes, and outputs to adapt, survive, and even gain competitive advantage in such conditions (Roberts & Grover, 2012; Tallon & Pinsonneault, 2011). As such, agility is critical to organizations in a DDI-dominated environment. On the one hand, DDI usually introduces rapid and radical changes to products, services, and current business models. For example, the introduction of new platform services such as Airbnb and Uber services radically changed some of the dynamics of hospitality and hired transportation industries. In the midst of such rapid and radical changes, organizations need agility to sense and gain insights to these changes and be able to develop effective responses, such as new products and services, to address new customer preferences and needs. On the other hand, as part of their response, organizations may choose to develop and/or adopt DDIs to leverage the changes brought about by these DDIs. However, organizations may face resistance from internal stakeholders given the high degree of uncertainty with the adoption of a disruptive innovation as part of its internal processes. Such uncertainty stems from both the risk of using the innovation in its current processes and the organization's ability to conceptualize how the innovation may change its products and services. Yahoo's struggles in its attempt to absorb paid search advertising technologies as part of its portfolio of services through the acquisition of Overture is an exemplary example of such a risk (Rindova, Yeow, Martins, & Faraj, 2012). In such cases, agility will enable organizations to successfully navigate the uncertainty and unpredictability within a DDI-dominated environment.

Agility Among Small-And-Medium-Sized Enterprises (SMEs)

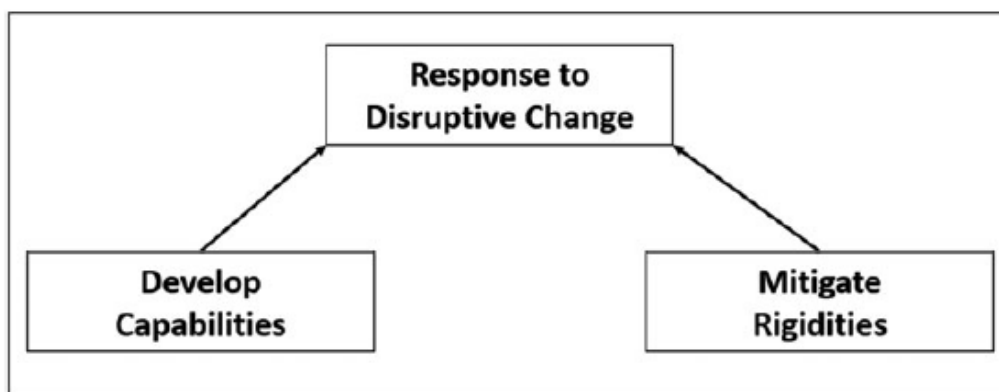
Compared with large organizations, SMEs are typically less formal, lean, and flatter in terms of their organizational structure. Given their inherent size limitation, they tend to operate at a smaller scale using focused and specialized resources, capabilities, and processes catering to their niche/specific markets, customers, and industry domain (Levy & Powell, 1998; Meister, 2017). As such, their resources, capabilities, and business processes are highly idiosyncratic. Because of their limited scale and focused operations, most of them do not have a significant amount of slack resources (e.g., financial and human resources) or the appropriate capabilities to develop the routines and processes to be agile (Neirotti & Raguseo, 2017).

Despite these inherent challenges for SMEs, there are studies that point to some advantages that SMEs have in relation to achieving agility, especially in a DDI-dominated environment (Levy & Powell, 1998, 2000; Levy, Powell, & Yetton, 2001). First, Neirotti and Raguseo (2017) found that SMEs that managed to achieve agility were also able to achieve higher profit margins compared with larger organizations. They explained that SMEs would have lower cost of reconfiguring their operational model with leaner structures and lesser institutionalized routines and processes to be changed.

Second, Levy and Powell (1998, 2000) found that much of SMEs' agility and IT adoption issues are related to owner-manager's mindset. They argue that when owner-managers are able to articulate their strategies and broaden their views, they are more open to innovations and changes to their internal and external processes. In turn, SMEs that are able to adopt such innovative mindset and align their internal processes with new innovations are found to perform better than those that do not (Cragg, King, & Hussin, 2002).

Third, research on entrepreneurial firms also provides some insights in dealing with the limitation of "smallness" that SMEs face inherently. Studies have suggested SMEs could leverage on external relationship networks to overcome its liability of smallness and gain access to necessary resources and capabilities not available internally (Hite, 2005; Hite & Hesterly, 2001; Rehm & Goel, 2017; Rindova et al., 2012). For example, studies of entrepreneurial firms found that external links help provide critical opportunities and financial resource (Larson & Star, 1993) needed to innovate and change product and service offerings (Rindova et al., 2012; Sampson, 2007). Specifically, these external network relationships can help SMEs identify opportunities or link them to external entities regarding new opportunities (Powell & Smith-Doerr, 1994). They can also enhance their access to critical human and technical resources from external parties (Nahapiet & Ghoshal, 1998; Yeow, Soh, & Hansen, 2018).

FIGURE 2 Framework for responding to disruptive change



Agility in Responding to Disruptive Digital Innovation (DDI)

A framework based on Lucas and Goh (2009) provides a conceptual basis to understand how firms achieve agility in response to DDI. The framework is rooted in the disruptive innovation theory of Christensen (1997; Christensen & Raynor, 2003) and illustrates how firms may respond to disruptive changes such as DDI. As shown in Figure 2, response to disruptive innovation is enabled by development of capabilities and mitigation of rigidities.

In responding to disruptive changes such as DDI, organizations often need to develop capabilities in face of new situations brought about by the changes. For instance, the use of technology can develop superior technology capabilities that can in turn support greater agility for organizations to respond to disruptive changes (Lu & Ramamurthy, 2011). Such capabilities may include the ability to tap on and integrate external competencies to address changing environments (Teece, Pisano, & Shuen, 1997), or enacting specific strategic or organizational processes such as alliance, product innovation, and development, that create value for the organization in responding to dynamic changes (Eisenhardt & Martin, 2000; Helfat et al., 2007; Teece, 2007).

Besides developing capabilities, organizations also concurrently need to mitigate against rigidities to reconfigure itself in responding to disruptive changes. As organizations mature, their systems, structures, cultures, processes, routines, and even capabilities may become so institutionalized and rigid that its ability to respond to disruptive changes becomes inhibited (Leonard-Barton, 1992; O'Reilly & Tushman, 2016). Capabilities that have been useful under previous situation may not only become useless but actually become harmful as new situation emerges. For example, an organization may gain efficiency through having an enterprise resource planning system to standardize the entire organization's operations and processes. However, the enterprise resource planning may also inhibit the organization's responsiveness to disruptive changes as it will be hard to adapt their operations and processes to new realities.

RESEARCH DESIGN

A case study approach is adopted for this research as it allows for an in-depth examination of contemporary phenomena (Pan & Tan, 2011). The case study approach is also known to be appropriate for examining research questions that address the “how” aspect of phenomena (Walsham, 1995). It is therefore appropriate for answering the research question: “how SMEs achieve agility in response to Disruptive Digital Innovation?”

Elixir Technology is chosen for this case study as it exemplified an innovative SME that achieved agility in responding to DDI and continued to thrive over the years. As observable from the Case Background description, some of the key DDIs that Elixir Technology has responded successfully include disruption in programming method (i.e., from having to write every single line of code to leveraging on open-source code), disruption in software application distribution model (i.e., from offering software engineering/programming services to off-the-shelf software packages and now to cloud-based software-as-a-service), and disruption in technology solution (i.e., from mere business reporting tool to business analytics tool and now to integrated internet-of-things end-to-end solutions with data and video analytics capability).

Data collection

The interviews done are the primary sources of our data, totaling 22 of them. Each session of the interview is between forty-five minutes to not more than one-and-a-half hours. These 22 interviews were conducted with different individuals from a cross section of job functions at Elixir Technologies who were involved in various DDI projects. Among the 22 interviews, two were follow-up interviews held with individuals in the Top Management Team to seek further data and verification of insights shared by other interviewees. Table 1 shows a summary of the interviewees' profile. An interview protocol (see Appendix A) was developed as a guide for the interviews, which were conducted in a semistructured manner. This allowed flexibility in adapting the questions and deviating from the protocol so that new insights and interesting revelation could be explored in further depth to inform the overall research question of “how SMEs achieve agility in response to Disruptive Digital Innovation.” All interviews were audio-recorded with interviewees' permission and transcribed for analysis.

Besides the interviews, secondary sources of data were also collected to complement primary interview data. This facilitated the researchers in forming a comprehensive understanding of the phenomenon under investigation, achieving data triangulation, and maintaining a reliable chain of evidence that can be cross-referenced for verification. Secondary sources of data collected include internal documents from Elixir Technologies such as project reports, presentations, marketing collaterals, and media releases, as well as external documents such as media reports.

TABLE 1 Summary of interviewees' profile

Interviewees	Interviews	Follow-up Interviews	Total
Top Management Team	2	2	4
Business Development Manager	1	...	1
Product Consultants	5	...	5
Technical Specialist	4	...	4
IT Staff	3	...	3
Business Partners	5	...	5
Total	20	2	22

Data analysis

Data analysis was performed in an iterative manner (Pan & Tan, 2011), with the researchers alternating between the interview data and relevant literature on agility, capability development, rigidity mitigation, and DDI. The transcribed interviews were first subjected to open coding by the researchers independently, where the interview data were coded into themes found in the relevant literature. This ensures a cumulative tradition in developing the corpus of knowledge as established concepts and terminologies are adopted rather than reinvented. Table 2 shows examples of open coding.

TABLE 2 Examples of open coding

Themes	Quotations
Sensing	The CEO is good at staying with his association, keeping in touch with his networks and industry developments.
Adaptation/innovation	We are very dynamic in adopting and adapting new ideas or technologies, we are open to new ideas. That's the reason why I stayed in this company as I enjoyed the continual changes. It isn't too boring.
Leadership/innovation	Our CEO is rather visionary and whenever he has new idea or comes back from a conference, he will brainstorm it with our CTO.
Service innovation	From there we introduce new products by pushing out from plain reporting, which was initially started from the ETL (Enterprise Transform and Loading) Tool and moved on to Ambient, a web-based interface.

Abbreviations: CEO, Chief Executive Officer; CTO, Chief Technology Officer.

The researchers met to share their respective analysis and extended the theory of agility as the dual process of capability development and organizational rigidity mitigation. During this stage, differences in the open coding among the different researchers were discussed to arrive at a common consensual understanding, hence enabling the attainment of intercoder reliability. Through numerous iterations in fine tuning the analytical framework and revisiting the data to seek confirmation and validation, the researchers ultimately derived a cohesive framework to explain “how SMEs achieve agility in response to Disruptive Digital Innovation.” Selective coding was used to identify further data that corroborated with the resultant framework, affording confidence in its validity. The framework and corresponding findings were presented to the Chief Executive Officer (CEO) of Elixir Technology for further validation to ensure that it corresponded with actual development.

CASE STUDY

Case background: agility amidst DDI at Elixir Technology

Elixir Technology is founded in 1993 by Lau Shih Hor, the CEO, and Jonathan Priddey, the Chief Technology Officer. The company started off as a training and consulting outfit targeting programmers. However, the founders subsequently realized that it was difficult to be commercially viable as programmers were often independent and self-reliant and companies were not ready to pay for their services. An interviewee shared:

It's a journey of discovery. It took us a while to discover. At that time there was not many people that we can approach to tap onto their wisdom. So if I were to start all over again, I wouldn't do what we did before as we learned the hardest possible way. We banged our heads long enough to learn this would not work. Yes, I loved what we did and what we were good at. But if nobody was going to pay you for it, then it couldn't go on.

Elixir Technology thus switched to creating and commercializing a computer-aided software engineering (CASE) tool, which was at its peak of popularity at that time. The CASE tool was used by programmers to design and build large, complex systems in a manner that promotes high-quality, defect-free, and maintainable software. Hoping to tap on the emergence and popularity of Java programming language, Elixir Technology launched a Java-based CASE tool in 1997. An interviewee mentioned:

Our target audience was the world of Java developers. We tracked the trends to address the market We were able to sell, we even had interesting customers like Citi Bank in the US (But) it was met with limited success.

However, their foray into CASE tools was overshadowed by the emergence of the open-source software (OSS) movement, which started to gain momentum in the 1990s. With OSS, programme source codes and even CASE tools became freely available. This presented a head-on challenge to Elixir Technology and affected its business. In response, Elixir Technology was adept in sensing the emergence of user-based programming, where part of the responsibility of “programming” the functionality of a software application could be determined by the end-user rather than “hard coded” by the developer into the software application. This led them to develop and roll out Elixir Report in 1999. It was an enterprise-class software application that allowed end-user to query and extract data from databases and data warehouses and was presented in various graphical, tabular, or textual formats as desired. One of the interviewee recalled how this innovative idea was mooted:

We realized there was a gap in the market. Back then, there was no Java Reporting Tool. Things were still very basic then. Although there was Crystal Report, it was only available on Visual Basics So we asked ourselves if we could do up a Java Reporting Tool.

The market adopted Elixir Report with a great deal of enthusiasm. The release of Elixir Report coincided with the period when internet began to gain mass appeal. This in turn fuelled corporate end-users' demand for easy and quick access to information. Mindful of these changes and in response to demands from its clients, Elixir Report was retrofitted into an enterprise-class reporting tool and launched in 2001.

By 2003, Elixir Report was crowned as one of the top three reporting tools in the market, winning a number of awards such as Best Java Reporting Tool and Best XML Tool by the Java Developer's Journal in 2003. Elixir's client base spread across almost 60 different countries and included world famous company such as Walt Disney.

Furthermore, responding to rising use of personal mobile devices such as mobile telephones and personal digital assistants, Elixir Report was further enhanced to enable use via these devices, which allowed information generated to be accessible on-demand, anytime and anywhere. Elixir Technology's agile responses catapulted the success of Elixir Report to become a market leader among enterprise business reporting tools, increasing the product revenue by 11-fold between 2001 and 2003.

To maintain its leadership position, it was clear to Elixir Technology that constant innovation is needed to stay ahead even as the market evolves. One interviewee commented:

People talked about S curve. Every 3 years or 5 years, something new will happen. By then, you have better jumped to the next curve By then, the (business reporting tool) market had become the BI (business intelligence) market. We also started developing our own BI products.

This business intelligence (BI) product became known as Elixir Repertoire and was launched in late 2005. Business intelligence products are essentially technological tools that transform data into insightful information that create useful values to businesses, especially in terms of better decision-making. Unlike reporting tools that basically extract and aggregate data and present them in various formats, BI products afforded greater analytical and data visualization capabilities. Hence, moving from Elixir Report to Elixir Repertoire, the company needed new knowledge and capabilities that an interviewee narrated how these were developed:

It entailed lots of learning on-the-job ... based on researching and applying previous experience working in (such) a dynamic environment. Having a dynamic team that is flexible and open to new ideas also contributed to the company's direction and ability to (undergo) transition.

In 2007, Elixir Repertoire was recognized to be among the most innovative products, emerging among the top three winners in the Reporting Tool category at the German Middle Market Innovation Award. This award was to be given to outstanding innovative IT and consulting solutions, and Elixir Repertoire was selected by the jury from 1200 entries of submissions.

That same year, Elixir Technology was also honoured in two other awards for its business performance as well as its technical prowess. It was named among Deloitte's Technology Fast 500 Asia Pacific 2007, a ranking of the 500 fastest growing technology companies across Australia, China, Japan, India, South Korea, and other countries in the Asia Pacific region. Between 2005 and 2007, Elixir Technology achieved an impressive 163.86% in revenue growth. Elixir Repertoire also emerged top in the Applications and Infrastructure Tools category in the Singapore League of the Asia Pacific Alliance Award, where entry products were evaluated on criteria that include uniqueness, market potential, functionalities and features, quality, application of technology, and presentation.

By this time, the culture of being agile and innovative was already well entrenched in the company. Instead of basking in the glory, Elixir Technology started to anticipate yet another digital innovation in the form of cloud computing. An interviewee elaborated:

In 2007, we started to look at this market of selling tools and (thought) it was not going to last long So we started looking at selling platforms. That means platforms that could scale. We started this concept even before the cloud (computing) concept became popular.

In 2010, Elixir Ambience was launched and touted as “Business Analytics on the Cloud.” Explained one interviewee:

With Ambience, we were putting business analytics onto the cloud platform. We were taking the technology to the cloud to achieve the goals of scalability and multi-tenancy.

However, it achieved little success as business analytics capability was often only part of a complete solution. With the emergence of Big Data, which focus on insights that could be harnessed from analysing voluminous and complex data sets, it became clear to Elixir Technology that BI tool such as Elixir Ambience must be coupled with Big Data to generate insights that could then be consumed by other systems for further processing and operation. An interviewee noted:

At that time, I was like “Oh, it didn't quite worked (out)” Rather than Ambience as the (standalone BI) Tool and bringing in your data (separately), which was much harder to do it this way, I thought we needed to have real-time, end-to-end solutions so that people would be more willing to use it.

Partnering with two other technology firms with complementary capabilities, Elixir Technology subsequently developed an end-to-end smart urban transport solution that involved the use of internet-of-things video sensors. Video sensors were installed at taxi stands to monitor the real-time length and flow of taxi queues. Alerts could then be sent to despatch vacant taxis to the location. At the same time, potential waiting time could also be fed to commuters who could then make informed decisions on their travel options. The three partnering firms each contributed their respective specialization in developing this solution. One partner was a

firm specializing in mobile close circuit television solutions with capability in wireless networking and image processing. The other partner was specializing in producing high-quality video sensors, while Elixir Technologies specialization was in business analytics solutions. This solution was subsequently showcased at the launch of Singapore's Smart Nation Master Plan in 2014.

However, the taxi despatching smart urban transport solution was not implemented on a large scale as it was eclipsed by the growing popularity of Uber car sharing services. With Uber, most commuters no longer passively waited at taxis stands but used the Uber app to hail for rides. By 2017, Elixir Technology was yet again innovating with its partners to adapt the taxi despatching smart urban transport solution for use at bus stops.

Another attempt at developing real-time, end-to-end solutions led Elixir Technology to acquire access to the company registry and reporting database held by the Accounting and Corporate Regulatory Authority of Singapore in 2014. The database contained data of all companies ever registered in Singapore, including their annual corporate returns and filings. With this access, Elixir Technology set up a wholly owned subsidiary known as BizInsights. Corporations and individuals could purchase access to the database overlaid with Elixir Ambience to carry out their own analysis of the data to assess credit risks, monitor competitors, or identify prospects. Alternatively, they could also buy services from BizInsights to perform such tasks or other BI analysis.

At the end of 2017, Elixir Technology had a customer base of over 600 across 50 countries. Its largest markets were Singapore, the United States, Japan, and the Middle East region. Reflecting on the journey the company had taken since its inception in 1993, an interviewee commented:

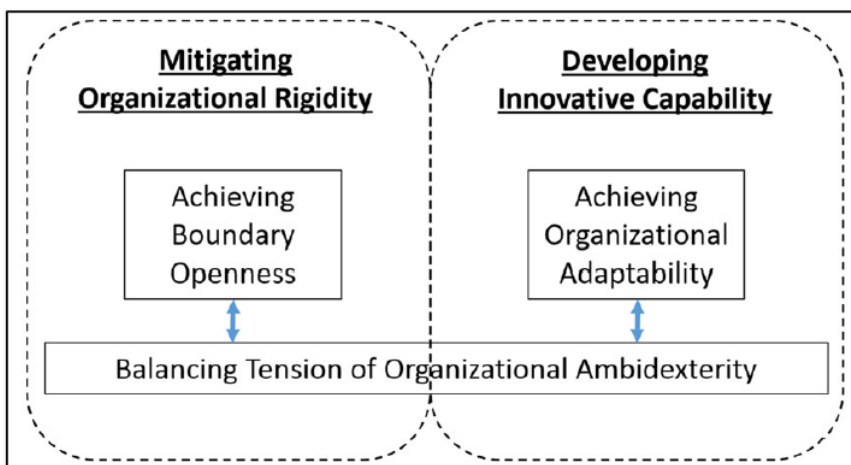
Whenever there is a new technology introduced, we (always) have the capability to adapt to it.

CASE ANALYSIS AND FINDINGS

In addressing the research question of “how SMEs achieve agility in response to Disruptive Digital Innovation,” analysis of the case study showed that Elixir Technology achieved agility in responding to DDI by concurrently mitigating organizational rigidity and developing innovative capability. This corresponds with the concept that agility comes from the concurrent mitigation of rigidity and development of capability (Leonard-Barton, 1992; Lucas & Goh, 2009).

Depicted graphically in Figure 3, the analysis found three underlying mechanisms that enabled the achievement of such agility in SMEs. On one hand, the mitigation of organizational rigidity is enabled by the mechanism of achieving boundary openness. On the other hand, the development of innovative capability is enabled by the mechanism of achieving organizational adaptability. The analysis also showed that the mechanism of balancing the tension of organizational ambidexterity is key to agility amidst DDI as both mitigating organizational rigidity and developing innovative capability are enabled by it.

FIGURE 3 Small- and medium-sized enterprises agility in responding to disruptive digital innovation



Mitigating organizational rigidity

Throughout its history, Elixir Technology has shown its capability to mitigate against organizational rigidity that can impede a firm's agility in response to DDI. Typically, as firms become established, legacy or institutionalized practices and processes set in and lock down the organizations with rigidity. Past successes, organizational norms, structures and culture, established practices, and even growth in size hamper an organization's agility. Small, young, start-up firms may also become rigid and inert to DDI not so much because of legacy or institutionalization, but owing to its inherent need to build focused and specialized resources and capabilities as well as a lack of slack resources. However, this did not happen in Elixir Technology. Despite being in business for over 20 years, Elixir Technology has largely retained its agility in response to successive waves of DDI. In particular, it is observed that despite experiencing resource constraints, Elixir Technology did not become rigid. Instead, it mitigated the organizational rigidity brought forth by resource constraints through achieving boundary openness.

Achieving boundary openness

The case analysis revealed one of the mechanisms that enabled Elixir Technology in mitigating organizational rigidity is in achieving boundary openness. Openness in its organizational boundary enabled Elixir Technology to stay up-to-date with the latest industry trends and developments, which ensured that it does not become disconnected with industry developments and market trends and does not fall victim to organizational inertia. One of Elixir Technology's Top Management Team related how his involvement in the IT Federation of Singapore enabled him to be exposed to developments and trends in the industry:

There was a moment of change in my mindset when I started to be involved in the IT Federation in Singapore. I realized that many Singapore companies do not innovate. They do the same things for 10/20 years. How can you expect the world to wait for you especially when you are in IT? So, I thought to add in something, at least some analytics. That opened me up to people, gave me that desire to want to innovate not just for myself but also for the entire industry.

This observation was affirmed by another interviewee who attributed the success of Elixir Technology at least in part to the sensitization of Top Management Team to industry developments and trends:

Our bosses are very knowledgeable. They foresee many things that can happen in the next few years. This is one of the key factors of success [The CEO] knows market trends and it helps him to be creative.

Another illustration of Elixir Technology's boundary openness is its ability to tap on external resources that are outside of the organization's boundary. For example, given Elixir Technology's forte in business analytics, it has often partnered firms with complementary expertise and skills to develop new products and solutions in response to new business opportunities. One interviewee elaborated on this point:

Our company works with industry partners on [some] projects, where we work with a consortium of partners to develop [a] new platform or showcase using such technologies aimed at specific industries. Our [area] is in analytics software, what comes in has to be collected from the sensor [which is provided by our partner]. That is how we work with the partners. The customer sees a camera-analysis solution, ours is just a front-end dashboard. We typically work together to do a project and provide solutions with others' hardware and software to the customer

Developing innovative capability

Elixir Technology has consistently demonstrated its innovative capability by being agile to develop new products and services in response to the onslaught of various DDIs. For example, its initial foray into CASE tools in the 1990s was eclipsed by the emergence of DDI in the form of OSS where source codes and CASE tools became freely available. This propelled Elixir to innovate and as a result, launched the award-winning Elixir Report in 2001. When personal mobile devices became popular in the early 2000s, it again innovated to develop a version of Elixir Report that could be accessed via mobile devices.

With the emergence of BI, the company yet again leveraged on its innovative capability to build-in BI functions into Elixir Report and launched it as Elixir Repertoire in late 2005. In 2007, even as cloud computing was still emerging, Elixir Technology was already innovating to create a cloud computing version of Elixir Repertoire, which it launched as Elixir Ambience in 2010.

With the arrival of yet another DDI in the form of Big Data, Elixir Technology was again innovating with real-time end-to-end solutions with the setting up of BizInsights in 2014 and experimenting with smart urban transport solution in the 2010s.

Hence, the development of innovative capability is identified to be key to its agility amidst DDI.

Achieving organizational adaptability

The analysis showed that one of the underlying mechanisms in the development of innovative capability is achieving organizational adaptability. In response to DDI, Elixir Technology continuously adapted the organization and its products to remain relevant amidst a volatile and changing environment. As one of the interviewees related:

To be a successful SME, we ran on a very lean structure and everyone got their hands dirty ... our team has to be dynamic, flexible and open to new ideas so that we have the ability to adapt

For instance, in dealing with the emergence of OSS, which challenged its CASE tools back in the 1990s, the innovation effort of Elixir Technology was meant to adapt to the rise of user-based programming. Hence, instead of innovating more tools for programmers, they redirected their innovation effort to creating tools for end-users.

Similarly, the innovation of Elixir Report into Elixir Repertoire in the early 2000s was to adapt to the emergence of BI. Again, in the late 2000s, the innovation of Elixir Repertoire into Elixir Ambience was to adapt to the emergence of cloud computing. This focus in achieving organizational adaptability continued to be observed into the 2010s as Elixir Technology developed its innovative capability in creating BizInsights and smart urban transport solution as adaptation to DDI brought about by Big Data and internet-of-things.

Balancing tension of organizational ambidexterity

The case analysis also revealed that the mechanism of balancing tension of organizational ambidexterity is involved in both developing innovative capability and mitigating organizational rigidity.

In terms of developing innovative capability, Elixir Technology had to balance the tension of organizational ambidexterity in having to achieve both exploitative innovation and explorative innovation concurrently. This is in addition to achieving organizational adaptability as described earlier. Furthermore, such tension is often exacerbated for SMEs like Elixir Technology, which often experiences greater resource constrain as compared with larger firms. A member of Elixir Technology's Top Management Team highlighted the following:

The exploiting part, I think ... we do not have enough focus on this area. Exploring, you will never know what comes out of it, or at this early stage, the pilot project is not making money. This is a tension aspect that I have to frequently manage. Even if we hire more people, [the] question [is] whether it is necessary to hire so many people and explore so many things. On the other hand, with every new project, because we have this link to the current system, it does drive more adoption of the current system as well. Unless there is no link, then there would be competition. Now, it is still complementary, just that the effort for exploring out of ten, one succeeds. But when it's exploiting, maybe for every ten, we can get three. We must strike a good balance as to how much energy we spend on each.

Moreover, the case of Elixir Technology demonstrated how both exploitative innovation and explorative innovation occurred in conjunction with the achievement of organizational adaptability. For example, when personal mobile devices emerged as a DDI in the early 2000s, the exploitative innovation to extend the award-winning Elixir Report to be accessible via mobile devices is in effect an attempt by Elixir Technology in

adapting to this emerging DDI. Similarly, the explorative innovation of Elixir Technology in developing BizInsights in 2014 and experimenting with smart urban transport solution in the 2010s also demonstrated its adaptability to emerging DDI in the form of Big Data and internet-of-things Smart Solutions, respectively.

In addition, it is also observed that balancing tension of organizational ambidexterity occurred in conjunction with achieving boundary openness in mitigating organizational rigidity. Elixir Technology overcame the organizational rigidity of resource constrain that SMEs typically face by having boundary openness to tap on resources external to the organization to realize organizational ambidexterity. For example, instead of redirecting in-house human resources, which are already dedicated to exploitative innovation, to work on explorative innovation, Elixir Technology brought in interns and assigned them to explorative innovation projects. These interns often brought with them fresh perspectives on existing trends and technology, helping Elixir Technology to explore new technology and product opportunities. An interviewee made the following observation:

We are getting interns to restore visibility [of latest trends] and [the] technicality for exploration of new innovative solutions ... [I] think it is fine using interns ... because we still need to focus on cash flow. Funding is usually needed for R&D ... interns can be very skillful if they are well managed ... My boss has many ideas but needs help to execute [these ideas]. Sometimes [ideas are] not realized. We hope we can realize some of them [through interns].

Another example was when Elixir Technology partnered two external technology firms with complementary capabilities to develop taxi dispatching smart urban solution. Hence, to mitigate organizational rigidity brought about by resource constrain, Elixir Technology balanced the tension of organizational ambidexterity by maintaining its traditional exploitative innovation in improving the data analytics capability of its solution, while also achieving boundary openness to work with external partners in explorative innovation to develop the solution.

DISCUSSION

One of the key challenges experienced by contemporary businesses across various industry sectors is the rapid proliferation of DDI (Weill & Woerner, 2015a, 2015b). Firms that fail to respond appropriately will risk losing market opportunities and becoming obsolete or even extinct (Christensen, 1997; Lucas & Goh, 2009). On the contrary, firms that are agile in taking advantage of DDI can create a niche advantage (Kane et al., 2015; Lyytinen & Rose, 2004). While the disruption of DDI affects organizations both large and small, there is a lack of understanding on how SMEs achieve agility in response to DDI. The case analysis presented in this paper illustrated how an SME did so and proposed a framework (see Figure 3) on agility based on the dual process of mitigating organizational rigidity and developing innovative capabilities.

Although the need to develop capabilities in keeping with DDI in a hypercompetitive environment has been well established (Assink, 2006; Christensen, 1997; Teece et al., 2016), the concurrent need to mitigate against organizational rigidity has been much less appreciated (Leonard-Barton, 1992; Lu & Ramamurthy, 2011; Lucas & Goh, 2009). A key organizational rigidity often experienced by SMEs in response to disruption such as DDI is its idiosyncratic and focused resources and capabilities and its lack of slack resources (Levy & Powell, 1998; Neirotti & Raguseo, 2017; Street et al., 2017). In the case of Elixir Technology, despite its inherent constraints that limited its ability to invest in in-house product development capabilities, it was able to avoid the rigidity conundrum by leveraging on the mechanism of boundary openness. Boundary openness enabled Elixir Technology to integrate external partners' complementary capabilities with its existing capabilities so as to develop new products and respond to new business opportunities. This is akin to open innovation approaches (Chan, 2013; Chesbrough, 2003) where firms build up their innovative capability by tapping on and working with external partners' resources and capabilities (Rehm & Goel, 2017; Rindova et al., 2012; Sampson, 2007). Hence, through boundary openness, SMEs can overcome a key source of organizational rigidity, ie, their idiosyncratic and focused resources and capabilities, and thus enhance their agility in responding to DDI.

Besides dealing with rigidities emerging from idiosyncratic resources and capabilities, boundary openness also enabled Elixir Technology to overcome rigidities in its owner-managers' mindset. The Elixir Technology's Top Management Team, being open-minded, was highly cognizant and sensitized in the

handling of the latest industry trends and developments, thereby enhancing their sensing capabilities. With limited resources, most SMEs tend to shy away from new ventures unless they have strong confidence that those ventures will enhance their future options (Street & Meister, 2004) or improve their agility to respond to disruption in the environment such as DDI (Levy et al., 2001; Meister, 2017). As SMEs often operate with a relatively flat organizational structure, where most, if not all, of the strategic decisions are made by its Top Management Team or owner-managers (Gupta & Cawthorn, 1996), the Top Management Team or owner-managers usually determine the approach and direction of the business and in turn, the firm's performance and agility (Cragg et al., 2002; Levy & Powell, 1998; Street et al., 2017). It is therefore important for the SME's Top Management Team's or owner-managers' mindset to be open and flexible so that it will improve its sensing capability with respect to industry trends and developments. This form of open and flexible mindset underlies the boundary openness mechanism, and it is a critical component for SMEs' ability to remain agile in response to DDI. This is especially important as an open and flexible minded owner-manager is not only positively associated with agility in response to changes, but also to the overall firm performance (Thomas, Clark, & Gioia, 1993). As demonstrated by Elixir Technology, boundary openness can thus enhance the sensing capability of the owner-manager and consequently the agility of SMEs in responding to DDI.

In addition to mitigating organizational rigidity, developing innovative capabilities is the other half in the dual process of agility. Innovative capability has often been emphasized to be key for firms to be agile in responding to DDI (Chesbrough, 2003; Christensen, 1997; O'Reilly & Tushman, 2016). Thus, as illustrated in the case of Elixir Technology, it may be somewhat unsurprising that innovative capability is the focal capability that SMEs develop to be agile in responding to DDI. What is perhaps of greater interest is that SME innovative capability is developed through organizational adaptability. Adaptability is an important component since not all innovative capability necessarily leads to agility or is able to deal with DDI. For example, Brown and Eisenhardt (1997) found that firms with highly stable innovation system and structured processes can still innovate and produce new products quickly, although such innovations are often not well adapted to market condition and are thus not considered to be agile responses. To be agile and effective in response to DDI, firms need to develop adaptive innovative capability that is in tune to market dynamics. This organizational adaptability enables firm's structure, resources, and capabilities to be relatively malleable as it responds to emerging DDI (Eisenhardt & Martin, 2000; Karimi & Walter, 2015; Teece et al., 1997).

Compared with large firms, SMEs need to be more adaptive to market condition and responsive to consumer expectation given the larger impact of market changes on their revenue and profitability as well as the pressure to generate revenue and pursue sales growth (Meister, 2017; Street et al., 2017). At the same time, SMEs have less resource slack and more rigid capabilities (Street et al., 2017) that may negatively impact their ability to reconfigure resources in adapting to market condition such as DDI. In other words, even though the need to develop innovative capability through achieving organizational adaptability is acknowledged for SMEs, it is likely to be a challenge for most SMEs given their resource constraints. However, as we have noted above in the theory section, these challenges may be mitigated by SME's inherent characteristics of having flatter, leaner, and less institutionalized structures as the cost of reconfiguration is lower for them vis-a-vis larger firms. Putting together, we thus note that SMEs' development of innovative capabilities is underpinned by their organizational adaptability that allows them to reconfigure not just their product and service offerings but their internal organizational structure to support these changes.

Finally, our study shows that balancing the tension of organizational ambidexterity (Lavie, Stettner, & Tushman, 2010; O'Reilly & Tushman, 2016) is a key mechanism in both the development of innovative capability and mitigation of organizational rigidity. In particular, Elixir Technology has to balance between pursuing both exploitative innovation and explorative innovation. Exploitative innovation focuses on capitalizing existing resources and capabilities, often extending them incrementally to serve existing markets and consumers. As such, exploitative innovation usually results in near-term gain. In contrast, explorative innovation focuses on developing new products or services to address emerging market condition and emerging consumer expectation. While explorative innovation may still build upon existing resources and capabilities, it often requires the development of new resources and capabilities that do not yet exist in the organization (Lavie et al., 2010; O'Reilly & Tushman, 2016). As such, explorative innovation typically requires more investment and has a longer gestation period before yielding any result.

While extant research has argued that firms in general need both exploitative innovation and explorative innovation to have sustained success, this can be challenging for SMEs. Small- and medium-sized enterprises

have little slack resources and this forces them to decide either to direct their current resources to exploitative innovation to generate revenue income flow in the near term or to leverage them for explorative innovative to achieve longer term sustainability (Lavie et al., 2010; O'Reilly & Tushman, 2016). Elixir Technology was able to resolve this conundrum and balance the tension of organizational ambidexterity through boundary openness, which enabled them to leverage on external relationship networks to access appropriate external human and technical resources to cover their gaps and constraints (Nahapiet & Ghoshal, 1998; Yeow et al., 2018).

Therefore, as demonstrated by this study, balancing the tension of organizational ambidexterity is a key component as it is intimately linked to the two enablers of SME agility—capabilities development and mitigation of rigidities.

CONCLUSION

Small- and medium-sized enterprises are a vital component of the global economy and play a significant role in boosting economic growth, creating employment, and even realizing a more inclusive world (OECD, 2017; Street et al., 2017). At the same time, businesses across all industry sectors are severely impacted by the waves of different DDI that require firms to be on their feet and remain agile (Kane et al., 2015; Teece et al., 2016; Weill & Woerner, 2015a, 2015b). While SMEs may be more agile in comparison with large and well-established firms (Dibrell et al., 2008), they are also often hindered by idiosyncratic resource and capabilities as well as lack of slack resources (Street et al., 2017). As a result, they are often less able to respond effectively to DDI (Arendt, 2008; Meister, 2017). A better understanding of how SMEs achieve the agility required to respond to DDI is needed to provide better guidance to SMEs. These insights would enable SMEs to better fulfil their role in boosting economic growth, creating employment, and realizing a more inclusive world.

This paper presented a case study of Elixir Technology as it exemplified an innovative SME that achieved agility to respond to DDI. From the case analysis, it is conceptualized that SMEs are able to achieve agility through the dual process of mitigating organizational rigidity and developing innovative capability. Specifically, for SMEs, mitigating organizational rigidity is enabled by the mechanism of achieving boundary openness while developing innovative capability is enabled by the mechanism of achieving organizational adaptability. At the same time, given the inherent challenges of resource constraints, SMEs need to balance the tension of organizational ambidexterity as it is a necessary cooccurring component for achieving boundary openness to mitigate against organizational rigidity. These are depicted graphically in Figure 3.

In terms of research contribution, our study provides a framework that conceptualizes how SMEs achieve agility in face of DDI. This framework addresses the current lack of understanding in this important phenomenon. Generally, the IS discipline has neglected the nuanced characteristics of SMEs, either treating all firms to be alike regardless of their sizes or completely excluding SMEs from investigation. However, research has indicated that firm size can affect how firms use and respond to information systems (Street et al., 2017). We argue that firm size may have been conflated with specific features of SMEs, such as resource constraints and influence of its owner-managers (Levy & Powell, 1998; Meister, 2017; Street et al., 2017). We propose that it is important to take such SME characteristics seriously in our theorizing as our study has shown that they were significant influences on how SMEs achieve agility.

Future research can build upon this study to further examine how SMEs achieve agility in response to DDI. For instance, future research can investigate further into the symbiotic relation between mitigating organizational rigidity and developing innovative capability. Furthermore, considering the relevance of organizational ambidexterity to both mitigating organizational rigidity and developing innovative capability, future research can also further explore what are other ways besides achieving boundary openness and organizational adaptability by which SMEs can balance the tension of organizational ambidexterity.

In terms of practice, the conceptualization of how SMEs achieve agility in response to DDI can serve as a reference for SMEs in strategizing and structuring their operations in face of the stream of DDI confronting their business. First, owner-managers and Top Management Teams should adopt an open and flexible mindset towards innovation, business strategies, and organizing of products and structures. This mindset is key towards encouraging boundary openness. Second, SMEs should actively seek opportunities to work with

partners to identify areas of collaboration so as to integrate the partners' complementary capabilities with their own existing capabilities. Finally, SMEs should proactively manage the tension of organizational ambidexterity by appropriating and leveraging external resources where feasible to deal with internal gaps and constraints. Small- and medium-sized enterprises also need to harness their lean and flat structures to be organizationally flexible so as to achieve both exploitative innovation and explorative innovation.

In conclusion, this paper can be seen as an initial attempt to make sense of and help SMEs in responding to DDI. Considering the rampant proliferation DDIs in recent years and the significance of SMEs in boosting economic growth, creating employment, and realizing a more inclusive world, further research into how SMEs respond to DDI is certainly justifiable. Information system researchers are thus encouraged to direct research into this area and make their contribution towards economic growth, employment creation, and a more inclusive world.

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APPENDIX A

Interview Protocol

Background

1. When did you join Elixir Technology Pte. Ltd., Singapore?
2. What was your role when you initially joined the company?
3. What is your current role and responsibilities?
4. What do you see as key challenges and opportunities to and for disruptive digital innovations?

Organizational Rigidities

5. What are the organizational rigidities of this company? Please name and provide specific example/s how these rigidities prevented the company from changing or responding to disruptive digital innovations.
6. How is the tension between capability development and rigidity mitigation in responding to disruptive digital innovations managed?
7. How does your Management manage the tension between capability development and rigidity mitigation in responding to disruptive digital innovations?
8. Has there been situation where one group of employees exhibit organizational rigidities (e.g. resisting change and innovation) while another group of employees attempt to innovate and develop new capabilities? What are your strategies in dealing with such situation? How do you overcome it?
9. How capable are employees in your company in adapting to changes? How do they do so?
10. How do you think the Management is embracing disruptive digital innovations? Why do you think so?
11. What are your strategies in managing organizational rigidities? How do you efficiently and effectively overcome rigidities?
12. How do the company marshal resources to overcome organizational rigidities?
13. Do you think the company is agile in responding to disruptive digital innovations? Why?

Innovative Capabilities

14. What are the strategies that have helped this company to be successful over the years? How have the strategies empowered managers with the capacity to innovate?
15. How has the company managed to efficiently and effectively react and respond to disruptive digital innovations? Please provide examples to illustrate? What is your role in this?
16. How has the company cope with rapidly changing environments? Please provide examples.
17. What are the strategies or processes (such as product development, alliancing and strategic decision-making) that has helped the company in responding to disruptive digital innovations?
18. How has the company been able to manipulate resources to develop new value-creating strategies? Please provide an example.
19. How has the company organized and marshalled capabilities to cope with innovation?
20. How has top management been able to develop appropriate strategies in respond to disruptive digital innovations?
21. How has such strategy been communicated and embraced throughout the company?
22. How have your company explored and utilized its capabilities to respond to threats from disruptive digital innovations?
23. What role have you played in responding to disruptive digital innovations?
24. Is this a fast-changing company? Please provide example/s to your view.
25. What encouragements and support are given to staff in responding to disruptive digital innovations?
26. What are secrets to your continual success in responding to disruptive digital innovations?