Achieving ISD Agility: Routines and Microfoundations

Yi-Te Chiu  
*Victoria University of Wellington, yi-te.chiu@vuw.ac.nz*

Zheng-Tang Guo  
*National Taiwan University, zhengtangguo@ntu.edu.tw*

Yu-Qian Zhu  
*National Taiwan University of Science and Technology, yzhu@mail.ntust.edu.tw*

Houn-Gee Chen  
*National Taiwan University, hgchen@ntu.edu.tw*

Follow this and additional works at: [https://aisel.aisnet.org/irwitpm2018](https://aisel.aisnet.org/irwitpm2018)
ABSTRACT

Much attention is paid to information systems development (ISD) agility, which has positive consequences for ISD projects, teams, and their organizations. ISD agility enables organizations to react to ISD-related changes with speed and flexibility while constantly contributing to the delivery of value via IS. This article investigates how IS departments maintain their continual readiness for ISD agility. Drawing on a dynamic capability perspective, we suggest that routines underlie ISD agility. The analysis of three high-performing IS departments identifies six aspects of routines conducive to ISD agility: continuous discovery and validation of customer needs, continuous evolution of IS-enabled products and services, resource optimization, continuous integration and deployment, continuous management of risk, and continuous learning. In light of microfoundations, individual competence and mindset, constructive dialogue, and structural arrangements are essential components of routines and ISD agility. Theoretical and practical insights are discussed.

Keywords
ISD agility, dynamic capabilities, routines, microfoundations

INTRODUCTION

In a rapidly changing digital business world, information systems development (ISD) must be agile (Forsgren et al. 2018) to address challenges caused by diversified customer needs, emergent technologies, and disruptive markets (KPMG 2016). ISD methods, agile methods mainly, are in the spotlight concerning ISD agility as they are comprised of recommended means to engage stakeholders, increase delivery speed, respond to change, and add business value (Conboy 2009; VersionOne 2018). Despite the promised benefits of agile methods, many firms have not reaped the full benefits. In the State of Agile Survey, with almost 1,500 practitioners across the world, 84% of respondents stated that their organization was at or below a “still maturing level of agility” (VersionOne 2018). After decades of agile movements, people still hold a fragmented understanding of ISD agility let alone achieving agility (Gregory et al. 2016). For example, some firms equate agility with the velocity of delivery (Dikert et al. 2016) and overlook the development of capabilities to cope with ISD-related changes and generate value via IS. Furthermore, scaling agility exacerbates the challenges in the development of agility. The existing agile methods mostly provide recommendations at the project level and do not always achieve organization-wide impacts. The project-level methods disregard the interdependencies of projects, systems, and stakeholders and endanger delivering the value of IS (Jiang et al. 2018). A couple of nascent agile frameworks, such as the Scaled Agile Framework (SAFe) and Large-Scale Scrum (LeSS), tackle the scaling issues and touch upon management principles at the organizational level. However, the prescribed practices are not systematically validated, and the claimed benefits are experienced-based (Dikert et al. 2016). It remains elusive what makes ISD agile and how ISD agility is attained.

Therefore, this study aims to clarify the underlying meaning of ISD agility and unveil mechanisms to develop ISD agility. We analyzed the definitions from previous literature and propose a concise definition for ISD agility: the capability of IS department (or any equivalent unit responsible for ISD) to react to ISD-related changes with speed and flexibility while constantly contributing to the delivery of value via IS. Since ISD agility comes within the purview of the IS department, we suggest shifting the central focus away from selecting and adopting agile methods and looking into the development of organizational capabilities. Organizations can concentrate on resource configurations (e.g.,
people, processes, products, and technology) and formulate a holistic approach to achieve ISD agility. Drawing on a dynamic capabilities perspective, which concerns the capability development toward changing environmental dynamics, we apply the theoretical underpinnings of dynamic capabilities – routines and their microfoundations (Teece 2007; Teece et al. 2016) – to understand the development of ISD agility. Organizational routines build organizational capabilities (Winter 2000) as a result of “complicated, detailed, analytic processes that rely extensively on existing knowledge and linear execution to produce predictable outcomes” (Eisenhardt and Martin 2000, p. 1106). Consistency in complex problem-solving through routines shapes organizational capabilities. Such routines persist as they prove to be effective, but some of them have to evolve for change. The evolution of routines represents dynamism of capabilities. Recent research further delves into the sources of dynamism and studies people, their interactions, and the context where individuals and routines are situated – so-called “microfoundations” (Barney and Felin 2013). We contend that the theory of routines advances our understanding of ISD agility as it can not only inform the sustainable value creation via IS, but also elucidate responses to ISD-related changes with speed and flexibility ( Dönmez et al. 2016). Moreover, microfoundations explain how routines develop and evolve, thereby enhancing ISD agility. In essence, routines and microfoundations expand the focus of ISD agility from an ISD method to the nature and origin of the dynamism of ISD agility and the context where ISD agility breeds.

We illustrate the development of ISD agility based on data from three IS departments with high ISD agility. We do not move the level of analysis to the firm level because it requires capabilities more than ISD agility, that is, IT-dependent organizational agility – “the ability to respond operationally and strategically to changes in the external environment through IT” (Fink and Neumann 2007, p. 444). Besides ISD agility, IT-dependent organizational agility requires IT-dependent information agility as well as IT-dependent strategic agility. It contains far more elements and offers more comprehensive outcomes for firms than ISD agility alone.

Our contribution is twofold. From the theoretical perspective, we develop an empirically-grounded framework that unifies routines and microfoundations for ISD agility. It is premised on the dynamic capability perspective and highlights the important role of routines and their microfoundations. The findings illuminate the path toward ISD agility. For practical insights, we offer recommendations on types of routines that IS departments should focus on, as well as the complementary requirements based on microfoundations: individual mindset and competence, interaction, and structural arrangements.

In the next section, we first elucidate the nature of ISD agility in conceptual terms. Then, we discuss constituents of dynamic capabilities that may inform the development of ISD agility. After outlining the research method, we present the empirical results from our case study analysis. Finally, we conclude by offering theoretical and practical insights before listing the limitations of this study.

**THE CONCEPT OF ISD AGILITY**

Considerable research has contributed to an understanding of ISD agility. Nevertheless, there is still no consistent definition (Abrahamsson et al. 2009; Conboy 2009; Gregory et al. 2016). An exhaustive review of the debate around ISD agility is beyond the scope of this article (c.f. Laanti et al. 2013). Instead, we select seminal works to define ISD agility. Following MacKenzie et al.(2011), we analyze the conceptual domain (e.g., feeling, behavior) to which the construct refers (i.e., property), the entity of the property (e.g., individual, team), and the necessary and sufficient attributes to represent the conceptual theme of ISD agility (see Table 1).

ISD agility has been referred to as a capability of an ISD method, a team, and a firm. Different entities in various definitions stem from researchers’ propositions about whether ISD methods, teams, or firms account for ISD agility. As discussed in the introduction, we shift the entity from ISD methods to the IS department. Consistent with previous definitions, ISD agility is conceptualized as a capability in response to changes. The common attributes of responses consist of flexibility (i.e., adapt without change or with minimum efforts) and speed (e.g., “quickly,” “swiftly,” “rapidly”). We side with Conboy’s view that, besides reactive responses, agility connotes proactive nature and should encompass continual improvement that adds value. To sum up, we define ISD agility as the capability of IS department (or any equivalent unit responsible for ISD) to react to ISD-related changes with speed and flexibility while constantly contributing to the delivery of value via IS.

<table>
<thead>
<tr>
<th>ISD agility</th>
<th>Property</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The continual readiness of an ISD method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment (Conboy 2009)

<table>
<thead>
<tr>
<th>The continual readiness of an ISD method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment (Conboy 2009)</th>
<th>ISD method</th>
<th>A capability of an ISD method in response to changes</th>
<th>Necessary: ISD method must be in the continual readiness state to rapidly or inherently create change, proactively or reactively embrace change, and learn from change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agility means to strip away as much of the heaviness, commonly associated with traditional software-development methodologies, as possible to promote quick response to changing environments, changes in user requirements, accelerated project deadlines, and the like (Erickson et al. 2005)</td>
<td>ISD method</td>
<td>A capability of an ISD method in response to changes</td>
<td>Necessary: ISD method must be lean and promote quick response to changing environments, changes in user requirements, and accelerated project deadlines</td>
</tr>
<tr>
<td>The ability of information systems development and deployment methods to swiftly adapt to the changing business requirements (Lee et al. 2006)</td>
<td>ISD method</td>
<td>A capability of an ISD method in response to changes</td>
<td>Necessary: Agile method must swiftly adapt to the changing business requirements</td>
</tr>
<tr>
<td>A software team’s ability to efficiently and effectively respond to user requirement changes during the project life cycle (Lee and Xia 2010)</td>
<td>Team</td>
<td>Team ability in response to changes</td>
<td>Necessary: Efficient and effective response to requirements change</td>
</tr>
<tr>
<td>An ISD organization’s ability to sense and respond swiftly to technical changes and new business opportunities (Lyytinen and Rose 2006)</td>
<td>Organization</td>
<td>An ISD organization’s ability to sense and respond to changes and opportunities</td>
<td>Necessary: An ISD organization must sense and respond swiftly to technical changes and new business opportunities</td>
</tr>
</tbody>
</table>

Table 1. Definitions of ISD Agility

ACHIEVING ISD AGILITY

Dynamic capability and ISD agility share the commonality of both being organizational capabilities that enable organizations to adapt to change in a complex business environment. The objective of dynamic capabilities is grander – not only adding value to customers but also sustaining competitive advantages (Teece et al. 1997; Winter 2003). The goal of ISD agility, although it should contribute to business outcomes ultimately, is closely related to IS-enabled business. ISD agility can be considered as a subset of the broad area of dynamic capabilities. A dynamic capability perspective offers insights into how organizational capabilities evolve and, therefore, should be able to shed lights on the development of ISD agility. Notably, we concentrate on two essential areas in dynamic capabilities: routines, which entail reliable and systematic performance while being adaptable to change, and microfoundations, which investigates how micro-level elements interact and emerge forming the collective phenomenon (i.e., routines and ISD agility). In the following section we introduce key theoretical ideas underpinning dynamic capabilities: routines, routine dynamics, and microfoundations.

Routines, Capabilities, and ISD Agility

It should first be noted that routines underlie capability (Winter 2000). Routines as “repetitive, recognizable patterns of interdependent actions, carried out by multiple actors” (Feldman and Pentland 2003, p. 95) ensure organizations reliably provide services and products. Routines can be either rigid or fluid (Felín et al. 2012), and have the benefits of stability and flexibility. An integration of routines supporting stability and flexibility is vital to ISD agility because a portfolio of routines allows response to change while maintaining productivity and quality (Dönmez et al. 2016). For instance, a time box defines a period for a team to achieve specified goals. If a 2-week sprint routine is adopted,
a team needs to get agreed-upon deliverables done by then. Such a rigid routine assures steady delivery. Meanwhile, a team can implement another agile practice to generate flexibility. Instead of assigning tasks to a developer, in daily standup meetings team members share impediments they are facing and support each other. Task allocation can be fluid, in which available and capable team members work on tasks in need of resources to move the project forward.

**Routine Dynamics and ISD Agility**

Uncertainty demands changes of routines. Although cognitive and behavioral regularities rooted in routines imply inertia, routines can be livelier than they appear. Routines evolve and adapt when firms implement meta-routines (Adler et al. 1999; Nelson and Winter 1982). Put differently, firms need to leverage routines to change other routines that are no longer suitable for new environmental conditions. Zollo and Winter (2002) propose to enhance dynamic capabilities by engaging in experiential learning, articulating new knowledge for changes, and codifying knowledge. Deliberate learning is a type of meta-routine and can generate new routines and modify existing routines. A transformation of Ericsson, a Swedish telecommunications company, from a plan-driven to an agile method organization illustrates how deliberate trial-and-error processes help members in the ISD unit to learn and undertake changes in ISD routines (Lindkvist et al. 2017). Besides a trial-and-error learning approach, various meta-routines embedded in agile methods support deliberate learning (Annos et al. in press; Bjørnson and Dingsoyr 2008). For example, collaborative spaces, including physical and virtual ones, allow team members to learn from each other and share knowledge. Moreover, sprint and project retrospective meetings are designated to improve routines. Dönmez (2016) observed that teams replace the sprint backlog of tasks with a Kanban workflow system to limit the number of work-in-progress items, leading to improvements in slack and flexibility.

Although organizations can prescribe the structure of the routines for employees to follow, employees can act differently at different times and places, which has been named “performative routines” (Feldman and Pentland 2003). In the ISD setting, Fitzgerald et al. (2002) differentiate “formalized ISD methods” (i.e., a prescribed collection of best practices) from “methods-in-action” (i.e., best practices modified by field practitioners for the contexts) that denote performative routines. To develop functional performative routines, Salvato (2009), in his analysis of 90 new product development routines across 15 years, points out that mindful actions, emerging from individuals instead of strategic initiatives, contribute to a continual adaptation of the routines in a changing environment. McAvoy et al. (2013) offer a similar suggestion that ISD agility is not only about following routines, but team members “continuous attention to detail” and “vigilance to minimise errors and respond effectively to unexpected events” (p. 159).

**On Microfoundations of Routines and ISD Agility**

Microfoundations explain the collective phenomenon by systematically looking at its origins and nature (Barney and Felin 2013). Multiple microfoundational elements form and explain routines and capabilities. Individuals serve as microfoundational constituents because they operate routines and can make a change to routines. Routines mature over time as individuals learn and develop habits, supporting the reliable operations of organizations (Salvato and Rerup 2011). Since individuals are not situated in a vacuum, other microfoundational constituents, such as interpersonal interactions and the context where individuals are embedded, can enable or hinder individual behaviors (Felin et al. 2012). We explain their role in ISD agility as follows.

**Individuals and their interactions**

In the early literature of dynamic capability, the role of managers is emphasized (Teece et al. 2016). Their competence, such as dynamic managerial capabilities (Adner and Helfat 2003), influences the strategic choices and actions when facing change (Helfat and Peteraf 2015). Extending this line of work, the literature on microfoundations of dynamic capabilities suggests that individuals, regardless of rank, should all be considered (Abell et al. 2008; Felin et al. 2012; Helfat and Peteraf 2015; Salvato and Rerup 2011). Individual differences affect the attainment of agility because people react to change differently. Some can sense opportunities and are willing to initiate change, while others resist changing their behaviors, and hold negative emotions amid adaptation (Salvato and Rerup 2011; Salvato and Vassolo 2018). The predicament calls for the investigation of ways to better manage diverse individual members.

First, firms can nurture the talent by shaping their cognitive capability and attitudes, such as openness to change and learning (Balijepally et al. 2015), and tolerance for ambiguity (Cools and den Broeck 2007). People possessing such attributes are more likely to improve routines and react swiftly when routines cannot operate. Although ISD
personnel’s competence for organizational capability is widely studied (e.g., Fink and Neumann 2007), limited empirical research has been done on what competence for ISD agility should be based on.

Second, the recent research looks at the interactions among individuals, specifically, how diverse experts collaborate to generate dynamic capabilities. The interaction mechanisms can be established formally as meta-routines, emerge informally like group norms and shared mental models, or a combination of the both. Building upon a multilevel framework of dynamic capabilities, Salvato and Vassolo (2018) propose constructive dialogue as an interaction mechanism for adaptation. Constructive dialogue (1) embodies routines of cooperation to build relationships and minimize relationship conflict; (2) enables individual and collective learning via constant knowledge creation and sharing; and (3) enhances team cohesion through sharing goals and challenges. The theoretical mechanisms of constructive dialogue reinforce the idea of communication and collaboration in agile methods. Cooperation, collective learning, and cohesion signal that people are “being agile” beyond “doing agile” (McAvoy et al. 2013).

Structure

Structure concerns “specialization of tasks, hierarchical arrangements, as well as formalization of objectives and procedures” (Bresman and Zellmer-Bruhn 2013, p. 1120). When adapting to change, organizations need to be organic, characterized by fluid roles and responsibilities, decentralized authority, and fewer rules and procedures. The flat organizational structure allows units to be responsive and nimble to change. However, the coordination cost can be heightened (Foss 2003), leading to fragmentation. More recently, the matrix organizational structure encourages cross-unit collaboration. On the extreme is the so-called Spotify model where, to meet 70 million subscribers’ needs, Spotify leverages tightly bonded small core units called squads. Squads with different development foci, when combined, bring new ideas and spark innovation. Squad members belong to other larger formal and informal teams, such as Chapters, Tribes, and Guilds, to build a shared understanding of tasks and teams (Kniberg and Ivarsson 2012). Similarly, the DevOps model breaks the boundary between development, operation, and business units to quickly deliver digital services (Forsgren et al. 2018). Both models inform how structural arrangements can engender changes in routines and enhance ISD agility.

Based on the literature review, routines, individuals, interactions, and structure help us make sense of data from three cases. In the next section, we discuss a case study approach, case selection, case background, and data collections and analysis.

RESEARCH METHOD

To explore how routines and microfoundations constitute ISD agility, we adopted a qualitative research method using a positivist multiple-case study design (Paré 2004; Yin 2009). The multiple-case study approach is suitable for the less explored phenomenon that requires contextualized understanding. Multiple cases enable comparisons among sites and help demonstrate the influence of variability in context (Pettigrew 1989). We selected firms that have received wide recognition for their ISD agility. We sought firms which considered ISD a core competence where the continual evolution of IS applications and IS-enabled services are necessary to sustain competitive advantages. Per our working definition of ISD agility, we focus on the IS department (or any equivalent unit responsible for ISD). We included IS departments from both the in-house and vendor setting to maximize variation in our sample and enhance the external validity. The cases involve one worldwide leading IS security software company (hereafter SoftCo), one regional bank (hereafter BankCo) famed for its digitization services and recognized by several awards in the Asia/Pacific region, and one leading system integration company in Asia (hereafter SysCo). All three firms, more than 30 years old, received innovation awards in 2017 that recognize their performance in ISD.

We use multiple data collection methods, including semi-structured interviews and secondary data, to triangulate our findings. The sources and nature of data is described in Table 2. The overview of cases is summarized in Table 3.

<table>
<thead>
<tr>
<th>Sources of data</th>
<th>Description</th>
</tr>
</thead>
</table>
| Interviews      | • Participants: managers who oversee ISD and understand the detailed operation of ISD as they possess comprehensive knowledge of the IS department; Senior engineers who possess good knowledge of routines as well as the interaction among colleagues.  
• When and how: a total of eight semi-structured interviews lasting 90 minutes on average were conducted between May 2017 and October 2018 (three interviews in BankCo, three
Interviewees were asked to describe ISD-related challenges their department/team face and how they cope with them with speed and flexibility.

- **Trustworthiness:** The interviews were recorded and transcribed. To strengthen content-validity from empirical induction, we discussed and clarified our research with our informants with condensed transcripts and summary writings within 2 weeks after each interview session.

Secondary data

- Company documents and media coverage to understand their IT strategy, achievements, vision, and industry context.
- Publicly available interviews between 2017 and 2018.
- Employee presentations in well-known practitioner-oriented conferences in 2018 (e.g., Agile Summit, Agile Tour). We include those presentations based on the speaker’s position in the firm (e.g., seniority, formal/informal leadership). The detailedness of the presentation or slides is another good indicator of the speaker’s knowledge on ISD operations.

### Table 2. Sources and Nature of Data

<table>
<thead>
<tr>
<th>Business Context</th>
<th>SoftCo</th>
<th>BankCo</th>
<th>SysCo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core Values</strong></td>
<td>IT security software</td>
<td>Commercial banking.</td>
<td>System integration and solution provider</td>
</tr>
<tr>
<td><strong>The need for agility</strong></td>
<td>Constant evolving cyber threats and risks, rapidly changing hardware and software that IT security software works upon and with, and ever-shifting customer demand</td>
<td>The unprecedented pace of technological disruptions along with big data, P2P lending, mobile payment, and deep learning, demands innovation in IS to meet customers’ needs, desires, and expectations; the adaptation of IS for evolving cyber risks and the regulatory requirements</td>
<td>Intensified competition and changing market demand</td>
</tr>
<tr>
<td><strong>Informants</strong></td>
<td>VP of product development (interview), senior product manager (interview), VP of MIS (interview), VP of R&amp;D (secondary data), project manager of R&amp;D (secondary data), senior engineer and team lead (interview + secondary data), principal engineer (secondary data)</td>
<td>VP of MIS (interview - twice), Chief Digital Officer (interview), Chief Information Officer (secondary data)</td>
<td>CEO (interview – twice)</td>
</tr>
<tr>
<td><strong>Outcomes of agility</strong></td>
<td>Short release, high customer retention, highly responsive to customer needs, innovative services and products</td>
<td>Reduced operation cost, reduced operation risks, highly automated process, deeper customer insights, innovative services and products</td>
<td>On-time delivery, high client satisfaction, efficient use of resources, adaptation to risks and uncertainties</td>
</tr>
</tbody>
</table>

### Table 3. Overview of Cases and Collected Data

Analysis of data began during data collection. We applied a thematic analysis approach starting with the deductive coding approach (Fereday and Muir-Cochrane 2006). As shown in Table 4, the four themes based on our review of
the literature guided our investigation. Beneath each theme, we developed broad codes to organize related text. New codes emerged during the analysis process. Two of the investigators independently coded all the interviews. Disagreements were discussed with the team and reconciled. Meanwhile, we conducted cross-case comparisons and interpreted the meaning of a collection of codes. For instance, underlying people-oriented routines, we discovered routines that have been used to detect what customers need (sensing customer needs) and engage customers (customer involvement). Maintaining a high-level understanding of customers as well as engaging relationships equip an IS department with an ability to respond to change arising from customers with speed and flexibility, and ultimately generate value to customers. The results of the analysis are presented in the next section.

<table>
<thead>
<tr>
<th>Themes for ISD agility</th>
<th>Description</th>
<th>High-level codes</th>
<th>Emerging codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routines</td>
<td>Repetitive, recognizable patterns of interdependent actions, carried out by multiple actors. (Feldman and Pentland 2003)</td>
<td>People (routines that address challenges arising from people), Process (routines that undergird management/development processes, such as scheduling, budgeting, risk management, and requirement management), Product (routines capable of addressing challenges regarding scope, quality, and product vision), and Technology (routines that concerns the use of technologies) (Nelson 2007)</td>
<td>People: sensing customer needs, engaging customers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Process: resource estimation, resource allocation, resource optimization, risk management, knowledge management and learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Product: identification of problems, formulation of solutions, quality assurance, code integration, code deployment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Technology: process automation, communication support, coordination support, knowledge management support</td>
</tr>
<tr>
<td>Individuals</td>
<td>Individual-level components</td>
<td>Knowledge, skills, abilities, emotion, behaviors</td>
<td>Agile mentality, collaboration mindset, boundary spanning, growth mindset, openness to change</td>
</tr>
<tr>
<td>Interactions</td>
<td>Interactions among people, and interactions between individuals and routines</td>
<td>Constructive dialogue (Salvato and Vassolo 2018)</td>
<td>Constructive dialogue with: colleagues, clients, partners, and managers</td>
</tr>
<tr>
<td>Structure</td>
<td>Specialization of tasks, hierarchical arrangements, as well as formalization of objectives and procedures</td>
<td>Task specialization, Organizational hierarchy, and Formality of the structure (Bresman and Zellmer-Bruhn, 2013)</td>
<td>Governance unit, data analytics units, cross-functional arrangement, autonomy, centralization, stable structure, fluid structure</td>
</tr>
</tbody>
</table>

Table 4. Descriptions of Themes and Codes

FINDINGS

We group codes under routines into six clusters and illustrate how individuals, interactions, structure support ISD-related routines as follows.

1. Continuous discovery and validation of customer needs: To enhance customer experience and rapidly respond to customer needs, all companies proactively detect needs of customers either through data analytics (BankCo and SoftCo) or frequent interaction with customers (SysCo and BankCo). For example, BankCo creates the data science team to understand customers’ preferences and behaviors. The specialized taskforce contributes to the development
of a chatbot capable of giving personalized advice, leading to enhanced customer experience. SoftCo sets up the business intelligence system to capture customer profiles and usage behaviors, and responds to customer demands more efficiently. Alternatively, the discovery of customer needs can be done by interacting with customers. Senior managers in SysCo build their understanding of customer insights by site visits. The gained knowledge through site visits are shared with the development teams, resulting in the enhancement of IS. The long-term relationships with customers make the conversation effective. After sensing the environment, gathering feedback to validate customer needs is pivotal. BankCo and SoftCo engage customers via routines, such as applications of persona and user story mapping during the opportunity identification and solution formulation phase. In the development phase, experiments through workshops and usability lab studies are conducted to validate the ideas (SoftCo).

Our data suggest that the continuous discovery of customer needs require constructive dialogue. All three companies emphasized the importance of soft skills to engage customers. BankCo and SysCo explicitly state that they crave and nurture the specialized generalists, so-called T-shaped or π-shaped professionals. That is, the professionals possess expertise in one (i.e., the one leg of T) or a couple (i.e., the two legs of π) of domain area(s) and, more importantly, they should be able to span the boundaries within and between disciplines by holding communication skills and a broad understanding of multiple disciplines (Gardner and Estry 2017). Said differently, boundary spanners know how to work in the diverse and complex environment, integrate knowledge held by different people, engender trust and respect, and dedicate themselves to knowledge search and dissemination (Miller 2008). The characteristics are conducive to constructive dialogue, which accordingly can lead to better coordination, learning, and cohesion required in the adaptation (Salvato and Vassolo 2018). Similarly, SoftCo establishes their core value in collaboration, trustworthiness, and customer first. It is demonstrated by open and honest relationships among team members, as well as caring behaviors toward customers. Constructive dialogue contributes to the operation of routines and the attainment of ISD agility.

<table>
<thead>
<tr>
<th>SoftCo</th>
<th>BankCo</th>
<th>SysCo</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Sensing customer needs: data analytics routine to discover customer insights</td>
<td>(1) Sensing customer needs: data analytics routine to discover customer insights; regular interaction with on-site customers *Supported by Structure - the data science team</td>
<td>(1) Sensing customer needs: market research via site visits *Supported by Individuals (T-shaped professionals) and Interaction (constructive dialogue based on engaged relationships)</td>
</tr>
<tr>
<td>(2) Validating customer needs via routines, such as user story mapping, paper prototyping, customer validation workshops, and usability test *Supported by Individuals (collaboration mindset) and Interaction (constructive dialogue based on engaged relationships)</td>
<td>(2) Validating customer needs via routines, such as the application of persona and prototyping with on-site customers *Supported by Individuals (T-shaped professionals) and Interaction (constructive dialogue based on engaged relationships)</td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Routines under Continuous Discovery and Validation of Customer Needs

2. Continuous evolution of IS-enabled products and services: For firms that need to transform their IS-enabled products and services (Ross et al. 2017) the routines related to design thinking, such as problem analysis (BankCo), product drawing games, design sprints, the creation of minimum viable products (SoftCo), are implemented to transform their products. The idea of exploring problems and using design to solve them is the spirit of the routines. It also acknowledges that there is no perfect design. Instead, a design viable for business and feasible based on firms’ resources should be pursued. Routines allow teams to experiment ideas across problems, solutions, customer segment, marketing, finance, etc. In other words, the notion of “fail fast and learn fast” is manifested in these routines. The design-thinking routines accelerate the provision of enhanced products and services.

Both SoftCo and BankCo configures cross-functional teams to generate creative solutions. The teams are diverse, purpose-driven, and empowered so that they are not bounded by the silo-view of the problems and solutions as well as the authority. Furthermore, the effectiveness of these routines depends upon a few conditions. Team members are open to divergent ideas. When disagreement emerges, they dare to speak up and engage in the conversation. They put
the collective benefits ahead of their own. The constructive dialogue is built upon cohesive relationships in these teams. The conflict remains in the meetings and rarely escalates to relationship issues. Besides collaborative mindset and solidarity in teams, the structure prescribed by design-thinking routines (e.g., idea generation, ideas matching, idea presentation using visual-aids, idea discussion, and consensus building) facilitates the collaboration processes. SoftCo has launched several successful products within a short period originating from these routines. BankCo rolled out a new mobile banking app that differentiates itself from others, and 90% of customers adopted the new app.

<table>
<thead>
<tr>
<th>SoftCo</th>
<th>BankCo</th>
<th>SysCo</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Problem identification and solution formulation using design thinking. e.g., customer journey maps, design spirits, brainstorming, product drawing games, and impact mapping</td>
<td>(1) Problem identification and solution formulation using design thinking. e.g., problem identification process using business analysis techniques, brainstorming, prototyping</td>
<td>Not observed</td>
</tr>
<tr>
<td>*Supported by Structure – empowered, cross-functional team</td>
<td>*Supported by Structure – empowered, cross-functional team</td>
<td></td>
</tr>
<tr>
<td>*Supported by Individuals (collaboration mindset) and Interaction (constructive dialogue based on team cohesion)</td>
<td>*Supported by Individuals (collaboration mindset) and Interaction (constructive dialogue based on team cohesion)</td>
<td></td>
</tr>
</tbody>
</table>

Table 6. Routines under Continuous Evolution of IS-enabled Products and Services

3. Resource optimization: Resources for ISD include human, finance, time, and IT assets (e.g., codes and libraries). Routines for optimizing resources endow firms with speed and flexibility to respond to change, ultimately sustaining value. All three firms have routines dedicated to resource optimization. Reliable and accurate estimation of resource requirements is a precondition for resource optimization. The estimation outcomes enable firms to preserve essential slack for uncertainties (Teece et al. 2016). The routines that collect historical project data and applies resource estimation suit the purpose (SysCo). Setting the priority of the projects also exemplifies resources going to where they can create the most value. BankCo relies on a business analysis team to build business cases for determining the priority level, ensuring that the right initiative starts at the right time and in the right way. Moreover, a routine on the selection of appropriate ISD method is of value. Depending on the degree of uncertainties, BankCo adopts agile methods for uncertain projects whereas plan-driven methods are used for projects in which requirements are relatively stable. Besides business-related resources, BankCo and SoftCo have routines that optimize the use of IT assets. BankCo designs IS applications that conform to their microservice architecture. SoftCo has internal standards to write codes and uses tools to generate live documentation. Since the code review has been a routine, under the peer pressure, programmers make the code base organized and understandable. New programmers can make sense of the codebase shortly after they join the department. The optimization of IT assets ultimately benefits the speed and flexibility of ISD.

Resource optimization can also be manifested in routine modification. For example, SoftCo devises a ScrumThon (i.e., review, planning, retrospective within a day) in which a scrum team collaborates intensively on a scrum review for the previous sprint and a scrum planning for the next sprint. These scrum activities, which used to be held on multiple days, are condensed to less than one day. The new routine lets team members focus on their tasks and minimize interruptions caused by scrum activities. Additionally, the attendance of customers (lacking thereof as a common risk in agile teams (Cao and Ramesh 2008)) increases significantly.

All three firms designate a governance unit (e.g., project management office (PMO), software quality center of excellence) to govern continued optimization of resources. However, the influence of a governance unit differs. BankCo and SysCo prescribe guidance on the routines for ISD agility. Conversely, despite the existence of a governance unit in SoftCo, the source of routines that enables optimization origin from team members. Employees in SoftCo possess strong collaboration mindset and agile mentality. Accordingly, via numerous retrospectives, routines evolve from the bottom up and lead to ISD agility.
(1) customized burndown chart to support teams in different velocity and delivery dates
(2) one-day ScrumThon (review, planning, retrospective within a day)
(3) modified sprint planning (sub-group estimation and then group estimation, acceptance criteria-driven planning, flexible sprint periods)
(4) code review based on the criticality of the codes

*Supported by Individuals (collaboration mindset and agile mentality) and Interaction (constructive dialogue via team retrospectives)

| (1) the criteria for selecting ISD methods (2) apply business analysis techniques to determine the priority of new projects (3) the development of a microservice architecture | (1) historical project data to support estimation and scheduling *Supported by Structure – a governance unit |

**Table 7. Routines under Resource Optimization**

4. Continuous integration and deployment: continuous integration (CI) and deployment (CD) are essential to more frequent and reliable delivery. CI contains routines for committing codes, version control, code validation, packaging, and build. Then, CD automatically deploys the package to the selected environment. These routines generate efficiency, quality, and speed. We only identified SoftCo as following the routines. This can be due to the need for CI and CD for regular updates at a higher rate in SoftCo than BankCo and SysCo. SoftCo can justify the cost of regular testing on the configuration of CI and CD so as to ensure its robustness. In SoftCo the establishment of DevOps structure, as well as individuals’ embracing writing tests early and frequently, make CI/CD effective.

<table>
<thead>
<tr>
<th>SoftCo</th>
<th>BankCo</th>
<th>SysCo</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) automated testing using the Robot framework (2) automated builds (3) automated deployment</td>
<td>Not observed</td>
<td>Not observed</td>
</tr>
</tbody>
</table>

*Supported by Individuals (openness to change - test-driven development) *Supported by Structure (Empowered, cross-functional teams; DevOps)

**Table 8. Routines under Continuous Integration and Deployment**

5. Continuous management of risk: IS departments with high ISD agility are vigilant to risks, including but not limited to project risk, cybersecurity, product risk, as they must respond to risk proactively and rapidly. All three firms embed risk management in routines, ranging from risk prediction, project review, reporting processes, to risk management processes. Across three firms, a governance unit (e.g., PMO) is set up to facilitate the management of risk.

<table>
<thead>
<tr>
<th>SoftCo</th>
<th>BankCo</th>
<th>SysCo</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) risk prediction by iterative burnup chart (2) project health dashboard</td>
<td>(1) regular architectural review (2) regular project review (3) secure software development life cycle (S-SDLC) (a routine to follow recommended guideline suggested by OWAP, the Open Web Application Security Project, at each phase of a development life cycle) (OWASP n.d.)</td>
<td>(1) PM/ISD processes that conform to CMMI Level 5 standards (2) daily reporting (3) project auditing (regular and ad-hoc) (4) the Red Alert Mechanism that allows employees to go directly to top management teams in times of emergency (5) project risk databases</td>
</tr>
</tbody>
</table>

* Supported by Structure – a governance unit

*Supported by Structure - a governance unit

**Table 9. Routines under Continuous Management of Risk**

6. Continuous learning: Learning is vital to adaptation (Conboy 2009). Continuous learning of new business and IT knowledge is encouraged in all three firms. Individuals show high motivation to learn during and outside the work hours (SoftCo and BankCo). Learning from peers (e.g., communities of practices and knowledge sharing sessions) and processes (e.g., retrospectives) are prevalent in these three firms. Learning routines create spaces for constructive dialogue and routine modification (Lyytinen et al. 2010). Prevalent learning routines across the three firms are not a
coincidence and can be considered as meta-routines. Routines in the above five aspects can decay without continuous learning.

<table>
<thead>
<tr>
<th>SoftCo</th>
<th>BankCo</th>
<th>SysCo</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) search for new IT and business knowledge</td>
<td>(1) search for new IT and business knowledge</td>
<td>(1) search for market trends and knowledge of new technology</td>
</tr>
<tr>
<td>(2) self-learning</td>
<td>(2) self-learning</td>
<td>(2) self-learning</td>
</tr>
<tr>
<td>(3) peer-learning</td>
<td>(3) peer-learning</td>
<td>(3) peer-learning</td>
</tr>
<tr>
<td>(4) retrospectives</td>
<td>(4) retrospectives</td>
<td>(4) retrospectives</td>
</tr>
<tr>
<td>* Supported by Individuals (Growth mindset)</td>
<td>* Supported by Individuals (Growth mindset)</td>
<td></td>
</tr>
</tbody>
</table>

Table 10. Routines under Continuous Learning

The findings suggest six aspects of ISD-related routines conducive to ISD agility. Microfoundations, including individuals, interactions, and structure, support ISD-related routines. Figure 1 illustrates a framework for the development of ISD agility.

DISCUSSION AND CONCLUSION

Our study aims to understand how IS departments maintain its continual readiness for ISD agility. Our analysis of IS departments in three top performing firms reveals that, consistent with the literature of dynamic capabilities, routines underpin ISD agility. Extending research in ISD routines (Dönmez et al. 2016), we discover that routines for ISD agility can be established in six different aspects.

We argue that the strategic orientation of the firm should determine which aspects of routines will receive more investment. In the adaptation context, firms can increase ISD agility by making the best use of what they have (i.e., exploitation) (March 1991). Routines under “resource optimization,” “continuous integration and deployment,” and “continuous management of risks” all conduce to discover what can be improved to adapt to changes. On the other
hand, firms can be oriented to explore new opportunities through search, discovery, experimentation, and innovations (i.e., exploration) (March 1991). Routines related to “continuous discovery and validation of customer needs” and “continuous evolution of IS-enabled products and services” prepare IS departments to attain the exploration purpose. As shown in Table 11, BankCo and SoftCo devote efforts to exploration-related routines whereas SysCo mainly invests in exploitation-related routines. The business environment where a firm is situated can account for different strategic choices. BankCo and SoftCo are in hyper-competitive environments and thus their ISD agility should cover exploration. SysCo is a system integration vendor who needs to fulfill contractual obligations. Enhancing ISD agility by exploiting their human resources and ISD processes is the priority. BankCo and SoftCo both develop exploitation-related routines as these routines are the operational backbone (Ross et al., 2017). To what extent IS departments should invest in exploration or exploitation is beyond the scope of this research. The ambidexterity literature on whether the simultaneous pursuit of exploration and exploitation is desirable (Cao et al. 2009) can shed lights on this challenge.

<table>
<thead>
<tr>
<th>Continuous discovery and validation of customer needs</th>
<th>Exploration</th>
<th>Exploitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>BankCo (high), SoftCo (high), and SysCo (low)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous evolution of IS-enabled products and services</td>
<td>SoftCo, BankCo</td>
<td></td>
</tr>
<tr>
<td>Resource optimization</td>
<td>BankCo, SoftCo, and SysCo</td>
<td></td>
</tr>
<tr>
<td>Continuous integration and deployment</td>
<td>SoftCo</td>
<td></td>
</tr>
<tr>
<td>Continuous management of risk</td>
<td>BankCo, SoftCo, and SysCo</td>
<td></td>
</tr>
</tbody>
</table>

Table 11. The Relationship between Strategic Orientations and Routines

We also find that individual competence and mindset, constructive dialogue, and structural arrangements compose microfoundation of routines and ISD agility. Individuals should possess agility mindset and competence to operate routines. Since, over time, the routine may no longer serve the purpose, it is important to empower individuals to modify or decommission routines for the sake of ISD agility. The structural arrangements, such as the inclusion of the data analytics group for sensing, a governance unit for monitoring, a cross-functional team for knowledge creation and integration, further complement what individuals can accomplish. Finally, ISD agility lies in constructive dialogue as it indicates that stakeholders interact and make sure ISD is evolving.

Our study contributes to bringing a dynamic capability perspective, particularly routines and microfoundations, to ISD agility, which moves beyond the current focus on ISD methods. We provide relevant insights to managers about the organizing principles for managing IS departments in need of ISD agility. Despite the contribution, the reader should exercise caution with the results as the evidence from these cases is preliminary. Although informants possess an in-depth understanding of ISD operations and our effort to triangulate data from multiple sources, they, especially managers and speakers, may present a polished version of ISD-related routines. Future research can use ethnography and observation to gain an authentic understanding of routines. Second, our study does not account for the evolution of routines in parallel to specific events related to ISD agility. Future research can choose routines as the unit of analysis. Still, our study offers glimpses of evidence and proposes a framework to move the research of ISD agility forward. We call for more research to accumulate strong theoretical knowledge to inform practitioners on the topic of ISD agility.

REFERENCES


