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A study of IS assets, IS ambidexterity, and IS alignment: the dynamic managerial capability perspective

Jeffrey C.F. Tai[a], Eric T.G. Wang[b,*], Hsi-Yin Yeh[c]

[a] Department of Management Information Systems, School of Management, National Chiayi University, No. 580, Xinmin Rd., West Dist., Chiayi City, 60004, Taiwan (R.O.C.)

[b] Department of Information Management, School of Management, National Central University, No. 300, Jhongda Rd., Jhongli City, Taoyuan County, 32001, Taiwan (R.O.C.)

[c] Science & Technology Policy Research and Information Center, National Applied Research Laboratories, 1, 14-15F, No. 106, Heping E. Rd., Sec. 2, Taipei City, 10636, Taiwan (R.O.C.)

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ABSTRACT

This study aims to explore how IT-business alignment can be better achieved. Drawing on the dynamic capability view, information systems (IS) alignment and IS ambidexterity are theorized as IT departments' ordinary capability and dynamic managerial capability, respectively. Four IS assets are identified as antecedents of both IS ambidexterity and IS alignment. A research model with 14 hypotheses is tested with a sample of 162 manufacturing firms. The PLS analysis shows that IS ambidexterity can increase IS alignment in terms of operational support and that the four IS assets can affect IS alignment directly or indirectly. Implications for research and practice are provided.

1. Introduction

IT-business alignment has received much research interests since the 1980s [1–4]. Because of the unobservable nature of alignment, earlier research has focused on conceptualizing and measuring IT-business alignment [1,5]. For example, alignment has been described in terms of linkage [6,7], harmony [8], integration [9], and fit [10–12]. In different research domains, IT-business alignment has also been studied in terms of intellectual (or strategic) alignment, operational (or structural) alignment, business alignment, IT alignment, cross-domain alignment, and social alignment [5–7,13]. By generating a more focused, strategic use of IT [10], IT-business alignment can positively impact IT business value [14], firm agility [15], firm performance [10,12], and competitive advantages of the firm [16]. Generally, prior studies corroborate that firms gain when business strategy/infrastructure and IT strategy/infrastructure are aligned with each other [2].

Despite the fruitful research findings, our knowledge regarding the factors that enable firms to achieve and sustain IT-business alignment remains insufficient. Earlier studies argued that IT-business misalignment occurs because IT strategies/plans are developed sequentially in response to business strategies/plans [1]. To avoid the misalignment caused by the lead-lag problem, researchers recommended two-way alignment and social alignment mechanisms that can facilitate the fusion of IT and business strategies/plans [3,17]. For example, reciprocal planning participation between IT and business executives was found to enhance IT-business alignment [16,18]; social alignment, referring to that IT and business executives mutually understand and commit to each other's mission, objectives, and plans, was found to enhance intellectual alignment [7,13]. These findings informed scholars to study IT-business alignment from the resource-based view (RBV) by identifying the relevant factors (e.g., shared domain knowledge and shared understanding) as resources that can facilitate IT-business alignment [19]. Nevertheless, because firms are constantly challenged by organizational and environmental changes, scholars argued that IT-business alignment should not be seen as a static end-state but a moving target [20]. Accordingly, firms additionally need the capacity of adjusting to IT and/or business changes in order to maintain IT-business alignment. Although this need has been suggested [21,22], the exact needed adaptive capacity for addressing it remains largely unexplored. Furthermore, extant research has not yet examined the relationship between such adaptive capacity and IT-business alignment. Therefore, this study aims at filling this research gap.

Traditionally, IT-business alignment was examined at the firm level by measuring cross-referencing between IT and business plans (i.e., alignment in intended strategy) [7,16,18,23] or by calculating the fit between actual business activities and actual IT use (i.e., alignment in

* Corresponding author.
E-mail addresses: jeffreycftai@mail.ncyu.edu.tw (J.C.F. Tai), ewang@mgt.ncu.edu.tw (E.T.G. Wang), shyiyz@gmail.com (H.-Y. Yeh).

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realized strategy) [11,12]. While these approaches permit the investigation of whether the extent of alignment affects firm performance, they cannot address how the alignment may be achieved and sustained. Hence, Coltman et al. [3] called for the study of microfoundation of IT-business alignment. Because the job of IT departments is to manage IT resources and provide IT services in the organization, this study contends that IT departments should play a key role in sustaining IT-business alignment. We thus propose *IS ambidexterity* to capture this adaptive capacity, referring to the capability of IT departments to perform exploitative and explorative IT activities simultaneously [24]. We also conceptualize *IS alignment* to denote that information systems are aligned with required strategic decision supports and operational supports. Therefore, our first research question is as follows: *Does IS ambidexterity positively influence IS alignment?*

Extant empirical research on IT-business alignment has been criticized as atheoretic [1]. Earlier research mostly drew upon contingency theory, while later research increasingly adopted the RBV [16,18]. These perspectives are static in nature and thus limited in explaining the dynamics of IT-business alignment [24]. Luftman et al. [25] indicated that the dynamic capability lens is appropriate to study IT-business alignment as a dynamic relationship between the business and IT. O'Reilly et al. [26] further stressed that ambidexterity is a dynamic capability for resolving dilemma, supporting our proposition that IS ambidexterity is a dynamic capability of IT departments to address the paradoxical needs that are necessary for sustaining IS alignment. Accordingly, the dynamic capability view (DCV) is invoked as the theoretical basis to understand the relationship between IS ambidexterity and IS alignment [27,28]. In addition, while earlier research examined dynamic capability in terms of its enabling organizational processes [29], this study follows O'Reilly et al. [26] to assert that ambidexterity is rooted in managerial capability. This study thus identifies the antecedents of IS ambidexterity based on the dynamic managerial capability literature, in which managerial cognition, managerial social capital, managerial human capital, and resource deployment flexibility are suggested as underpinning the capability. Consequently, four IS assets are proposed as the antecedents of IS ambidexterity: *understanding business situations*, *interacting with users*, *acquiring new technology skills*, and *flexible technology assets*. Our second research question thus is as follows: *Do the four IS assets positively influence IS ambidexterity?* As mentioned previously, RBV-based alignment research has indicated that IS assets may influence IT-business alignment [16,18,19]. This study hence examines *whether the four IS assets positively influence IS alignment also.* With the three research questions, this study attempts to shed light on how and why IT departments with those four IS assets can better achieve IS alignment.

The remainder of this paper is organized as follows. Section 2 describes the theoretical foundation. Section 3 discusses the research constructs and research hypotheses. Section 4 describes the methodology, followed by data analysis and explanation of research findings in Section 5. Section 6 then discusses the theoretical and managerial implications of our findings. Finally, the paper concludes with the limitations and future research directions of our study.

2. Theoretical framework

DCV was developed to address how firms build successive temporary advantages by effectively responding to ensuing environmental shocks [30]. For example, Teece et al. [31] proposed dynamic capabilities as "the firm's abilities to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (p. 516). In contrast to the RBV, DCV argues that valuable, rare, inimitable, and nonsubstitutable resources are insufficient for firms to sustain competitive advantage in changing environments [32]. Instead, DCV contends that firms require dynamic capabilities to achieve technical and evolutionary fitness [27]. Technical fitness refers to how effectively a firm performs its ordinary activities, while evolutionary fitness means how well a firm makes a living by creating, extending, or modifying resource bases.

Dynamic capabilities have been conceived in terms of latent action as abilities/capacities [27,31] or their constituent elements as processes/routines [33,34]. Depending on the locus of change, dynamic capabilities were posited to play the role of changing resources [33], capabilities [31,35], operating routines [34], or a combination of these [27,36]. This study adopts the conception that dynamic capabilities pertain to the capacities of changing ordinary capabilities [37]. Ordinary capabilities involve the performance of administrative, operational, or governance-related functions that are necessary for firms to accomplish tasks [35,37]. Dynamic capabilities comprise the capacities of sensing, seizing, and transformation (or reconfiguration) [28]. Specifically, sensing refers to the identification of market and technological opportunities or threats; seizing relates to the mobilization of resources to address opportunities or threats; and transforming involves the reconfiguration or renewal of resource bases (i.e., assets and associated skills, processes, or routines). Transformation serves as the goal process of dynamic capabilities, while sensing and seizing are enabling processes for transformation [29]. With dynamic capabilities, firms can repeatedly achieve technical fitness by altering their capacities of carrying out ordinary activities in changing environments through reconfigured resource bases. Such capacities to matching or even creating market changes enhance the evolutionary fitness of firms [27,31,33].

Our choice of conceiving dynamic capabilities as latent action is deliberate [38] because the examination of dynamic capabilities solely from the viewpoint of undergirding processes or routines can be vulnerable [37]. As processes (or routines) can be learned and replicated over time, dynamic capabilities as processes (or routines) are imitable and unable to sustain competitive advantages. Teece [37] then argued that dynamic capabilities involve a combination of organizational routines and entrepreneurial leadership/management. Such conception additionally includes nonroutine elements such as leadership/management, playing the functions of strategizing (e.g., identifying, prioritizing, and selecting opportunities) and asset orchestration (i.e., identifying complementarities, fulfilling missing assets, and then aligning them) [27,37]. Because entrepreneurial and creative managerial actions can be routinized only in a limited way, dynamic capabilities become imperfectly imitable. In other words, the management element of dynamic capabilities (i.e., dynamic managerial capability) permits firm-level heterogeneity and, thus, can properly account for the sustainability of competitive advantages.

Prior research further identified a set of managerial assets that underpin dynamic managerial capabilities: (1) managerial cognition, (2) managerial human capital, and (3) managerial social capital [39,40]. *Managerial cognition* consists of mental models and belief systems (i.e., knowledge structures) that managers utilize for decision-making [40]. Such knowledge structures can influence managers' way of perceiving and interpreting information about the world. Hence, managers can sense and respond to opportunities/threats differently, leading their firms to differentiated strategic changes [41]. *Managerial human capital* refers to learned skills and knowledge that managers develop through prior experience, training, and education [40]. Because of distinct learning trajectories, managers typically differ in both the mix of their skills and in the level of ability for each type of skill. Accordingly, managers may possess different absorptive capacities for sensing opportunities/threats. Distinct bases of expertise also lead managers to make different investments/commitment decisions, thereby resulting in differentiated ways of seizing and reconfiguration [39]. *Managerial social capital* refers to goodwill derived from managers' relationships with others [40]. Managers with distinct managerial social capitals have different capacities to acquire information from colleagues important for environmental scanning and opportunity/threat identification [40]. Managerial social capital also affects managers' capacity to access and mobilize resources in their social networks, which in turn influences their capacity to seize opportunities/avoid threats or reconfigure

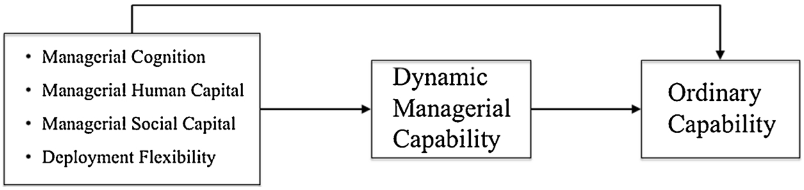


Fig. 1. Theoretical Framework.

resources [39].

In addition to these managerial assets, Anand and Singh [42] also pointed out the influence of organizational assets on dynamic managerial capability. They indicated that organizational assets can differ in their *deployment flexibility*. High deployment flexibility means that an organizational asset can be redeployed efficiently and effectively to different applications [43]. Because deployment flexibility can affect managers' capacity to structure, bundle, or leverage organizational assets [44], it is included in this study as the fourth antecedent of dynamic managerial capacity.

From the above discussion, this study proposes a theoretical framework to depict the relationships among ordinary capability, dynamic managerial capability, and the four antecedents of dynamic managerial capability of IT departments (as shown in Fig. 1). Notably, because capabilities arise in part from organizational resources (i.e., tangible or intangible assets) [37], the four assets are also posited to directly influence ordinary capability. The following section draws upon this framework to discuss the research constructs and then develop the associated hypotheses.

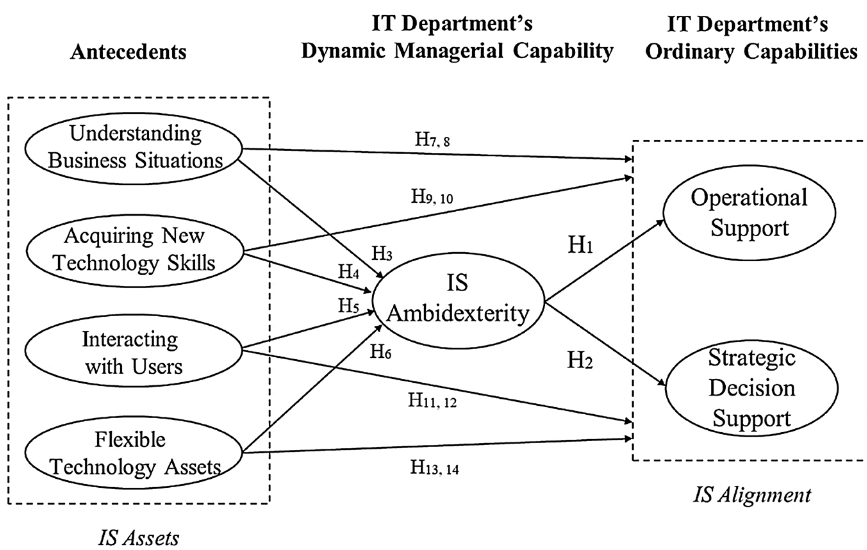
3. Research model and hypotheses

According to the theoretical framework, a research model is formulated as shown in Fig. 2. In the model, the two IS alignment constructs reflect IT departments' ordinary capability of deploying information systems to meet the required strategic decision supports and operational supports. IS ambidexterity represents IT departments' dynamic managerial capability, which is underpinned by IS exploitation and IS exploration. Four IS assets are proposed as the antecedents of IT departments' dynamic managerial capability, thus affecting IS ambidexterity. They also are posited to influence operational support and strategic decision support because the two IS alignment constructs represent IT departments' ordinary capabilities. The research constructs and their associated hypotheses are discussed below.

3.1. IS alignment as ordinary capabilities of IT departments

According to Porter [45], strategic positioning and operational effectiveness are two key business objectives for firms to achieve superior performance. Strategic positioning entails performing different activities or performing similar activities in strategically different ways. Operational effectiveness entails performing similar activities better than rivals. Tallon et al. [46] suggested that the two business objectives can be directly translated into corresponding goals for IT. This study thus conceptualizes IS alignment in terms of two constructs: strategic decision support and operational support. *Strategic decision support* refers to that information systems are aligned with the business objective of strategic positioning by supporting strategic decisions, modeling, and planning. *Operational support* reflects that information systems are aligned with the business objective of operational effectiveness by facilitating efficient execution, analysis, and coordination of business operations.

In addition, a large number of studies suggested that IS alignment should not be a static event but a capacity that is repeatable [47,48]. Gupta et al. [49] further demonstrated that IT-business alignment entails a particular set of IT management practices (e.g., IT planning, IT control, IT organization, and IT integration) for each competitive strategy (Defender, Prospector, Analyzer, and Reactor). For instance, they found that defender firms would pay more attention to centralized IT control, which is characterized by the dependence on single-core technology, development of vertical IS, and continuous improvements in technology; prospector firms tend to adopt decentralized IT control



Notes:
1. IS Ambidexterity is measured by using product indicators that are created by multiplying items of IS Exploitation with those of IS Exploration.
2. Control variables for IS ambidexterity and IS alignment constructs: firm size and IT department size

Fig. 2. Research Model.

by relying on multiple, flexible, and prototypical technologies in order to respond to environmental changes rapidly. The common ground of these studies is that IS alignment was conceived as a capability or competence. Because capabilities are embedded in processes, procedures, and systems [33], they permit a reliable execution of the activities and do not disappear immediately after their use [35]. Therefore, this study argues that IS alignment represents an ordinary capability of IT departments. That is, IS alignment denotes IT departments' capacities to deploy information systems so that it can support the required strategic decisions and operations.

3.2. IS ambidexterity as a dynamic managerial capability of IT departments

Ambidexterity was initially proposed by Duncan [50] and then defined by March [51] as the capacity to exploit and explore simultaneously. Originally, exploitation referred to using and refining existing knowledge, whereas exploration referred to pursuing new knowledge [52]. Afterward, exploitation was broadened to mean that an organization persists within an existing technological trajectory and leverages its existing skills or assets, while exploration means an organization shifts away from its current technological/product-market trajectories and thus needs to develop new skills or assets [53]. Exploitation is related to efficiency, increased productivity, and variance reduction, but exploration is associated with search, discovery, and embracing variance [26]. Because exploitation is oriented toward enhancing adjustment to current environment, it is expected to generate predictable benefits in the short run [53]. By contrast, exploration aims to enhance future adaptability and thus contributes to long-term performance [53]. Because of the differential performance effects, organizations need to pursue both exploitation and exploration in order to achieve sustained performance [54]. Otherwise, stressing either exploitation or exploration exclusively may cause organizations to be caught in competence traps or failure traps [52].

Although it is important to pursue both exploitation and exploration, it was argued that the two activities can compete for scarce resources and entail different organizational capabilities [51]. In order to resolve such tension, several solutions have been proposed. Structural ambidexterity posits that exploitation and exploration can be simultaneously pursued in structurally separated business units, which possess distinct structures, systems, and cultures [54]. Such arrangement permits conflicting demands to be fulfilled and contained within individual business units while allowing the whole organization to remain ambidextrous. Alternatively, Gibson and Birkinshaw [55] argued that contextual ambidexterity allows exploitation and exploration to be carried out simultaneously within the same organizational unit. This is made possible by designing a set of processes or systems that enable and encourage individuals to make their own judgment about how to best divide their time and resources between exploitation and exploration. While these two solutions improve behavioral capacities of fulfilling conflicting demands by delegating the ambidextrous activities to lower levels of the organization, the tension about how to reconcile and respond to the needs of exploitation and exploration remains to be resolved. Hence, the leadership solution was suggested, thus stressing that top management serves as the “glue” that holds the organization together. For example, it was found that management team with shared vision and social integration can coordinate and manage conflicts among business units [56].

The above solutions reveal that pursuing ambidexterity embodies a complex set of routines including decentralization and differentiation (e.g., structural and contextual solutions) as well as targeted integration (e.g., leadership solution) [57]. However, management still needs to sense environmental changes and then seize opportunities or avoid threats through orchestrating assets so as to properly handle the complex trade-offs of pursuing both exploitation and exploration simultaneously [57]. Further, because exploitation and exploration could enhance technical fitness (short-term performance) and evolutionary fitness (long-term performance) [53], respectively, researchers have increasingly recognized ambidexterity as a dynamic capability rooted in senior management [26,37,57]. This study therefore similarly conceives IS ambidexterity as a dynamic managerial capability at the level of IT department, thus reflecting the simultaneous pursuit of IS exploitation and IS exploration by IT departments. IS exploitation involves leveraging or refining existing IS assets or skills [24]. It entails activities of adjusting current information systems for enhancing IS products/services. IS exploration involves acquiring or experimenting new IT assets and skills [51]. It entails activities of facilitating the diffusion of emerging IT applications.

3.3. Relating IS ambidexterity to IS alignment

As discussed previously, operational support represents the ordinary capability of IT departments to deploy information systems in a way that can meet the required operational supports. Environmental changes, however, can inhibit organizations from achieving such aspect of IS alignment. Sabherwal et al. [20] adopted the punctuated equilibrium perspective to explain the associated dynamics. Specifically, organizations can be conceived as going through long, relative stable periods (evolutionary change), interrupted by short periods of quick and extensive changes (revolutionary changes). Evolutionary changes alter business operations slightly and gradually, but they can make extant information systems less efficacious for satisfying business needs. For example, a firm may increasingly rely upon information systems to support globalized business operations as its customer and supplier bases are expanding worldwide. Its IT department hence needs to transform the firm's enterprise systems and business processes to support multiple sites. Specifically, IT departments can choose to integrate multiple IT applications located in different sites and fix related business processes that were disconnected before. Such IS exploitation activities permit IT departments to maintain the ordinary capability of operational support in a timely and efficient manner in the short term. Alternatively, the firm may consider to renew the enterprise systems by implementing a new ERP package. This typically requires searching for appropriate commercial-of-the-shelf ERP products and even reengineering extant business processes. Although experimentations with new IT applications and practices are costly and time consuming, such IS exploration activities are more likely to generate positive impact on the current and future business operations [58]. Furthermore, prior studies suggested that continuous improvement after IS exploration (e.g., ERP implementation) is necessary for optimizing information processing and operational activities, thus facilitating competitive operational transformations [59]. Accordingly, IS exploitation and IS exploration are not only pivotal but also synergetic for IT departments to generate the ordinary capability of aligning information systems with changing operational requirements [24]. As a result, this study proposes that IS ambidexterity has a positive impact on operational support.

H1. IS ambidexterity positively affects operational support

Similar to operational support, IS exploitation and IS exploration together can enhance the ordinary capability of strategic decision support. The traditional way of increasing IS support for strategic decision-making is the addition of more analysis and reporting functions on top of various information systems. Because the required data typically are dispersed across multiple data sources, existing IT applications need to be interconnected and adjusted for generating comprehensive and detailed analysis or plans [60]. The implementation of business intelligence is one such endeavor. It integrates a number of technologies (e.g., data warehouse, data mining, information visualization and dashboard, query and reporting tools) to extract, transform, load, and analyze data from existing enterprise systems (e.g., ERP, CRM, and SCM) for subsequent analysis and presentation of strategic decision information [61]. With such IS exploitation efforts, IT departments are permitted to provide a more granular and integrated support of strategic decision-making [62]. Furthermore, extracting strategic implications solely based on existing data sources or data analysis techniques may hinder organizations from capturing and experimenting emerging ideas. Therefore, IS exploration activities, such as the implementation of business or big data analytics, allow for the generation of strategic insights that organizations can explore for coevolving with changing competitive and customer demands. For example, big data analytics applications can retrieve and analyze unstructured data collected from Web 2.0 services and various Internet of Things devices [63]. They can support strategic decision-making in areas such as problem formulation (e.g., identifying emerging patterns in the observed data) and problem solving (e.g., developing models for predicting new data observations) on the basis of the observed data rather than predetermined business rules [64]. Because both IS exploitation and IS exploration permit the development of information systems that can generate a more balanced and completed strategic analysis and plans for coping with changing environments, this study proposes that IT ambidexterity can facilitate the ordinary capability of strategic decision support.

H2. IS ambidexterity positively affects strategic decision support.

3.4. Antecedents of IS ambidexterity

IS ambidexterity is conceived as IT departments' dynamic managerial capability that facilitates the simultaneous pursuit of IS exploitation and IS exploration. IS ambidexterity can then be benefited by managerial decisions and actions that facilitate IT departments' sensing, seizing, and transformation actions [26]. This is because IS exploration requires sensing for opportunities, which entails entrepreneurial decisions about how much scanning and searching need to be done [51,52]. IS exploitation entails seizing the opportunities in a timely manner; this requires managerial insights for selecting targeted opportunities and skills for acting on them with appropriate resource allocation and organizational arrangements [26]. Because ambidexterity requires both IS exploration and IS exploitation, IT personnel have to make balanced decisions regarding resource allocation between the two activities. As suggested by Gregory et al. [65], IT managers require cognitive and behavioral capacities to find blended solutions or devise compromises to resolve paradoxes associated with IT transformation programs. To understand how IS ambidexterity can be improved, it is therefore important to identify factors that affect IT departments' managerial capacities associated with sensing, seizing, and transformation. Accordingly, the following introduces four factors that correspond to the antecedents of dynamic managerial capability identified in our theoretical framework.

3.4.1. Understanding business situations

Understanding business situations is an IT human asset [66,67] that captures the managerial cognition of IT personnel [39–41]. A more comprehensive business understanding means IT personnel are familiar with the connections and interdependencies in business activities. This helps them to incorporate more business systems thinking into their belief systems and mental models [40,67]. With such cognition, IT personnel can build a more holistic view of current business activities that allow them to attend to unspotted business requirements [19,41]. Understanding business situations also enables IT personnel to adopt business-oriented reasoning when selecting IS adaptation opportunities and thus is helpful in conceiving IT solutions that can address business units' critical problems under stringent time pressures [41]. In addition, IT personnel tend to focus on technological merits and hence favor experimenting emerging IT solutions. With business understanding, however, IT personnel will be more sympathetic to business units' desires of solving their immediate problems and thus consider more familiar, efficient, and rapidly deployable IT solutions. IT departments thus tend to make a more balanced evaluation between IS exploitation and IS exploration and perform the appropriate activities accordingly. This study therefore holds that understanding business situations can facilitate IT departments' dynamic managerial capability for performing ambidextrous IS activities [41].

H3. Understanding business situations positively affects IS ambidexterity.

3.4.2. Acquiring new technology skills

Acquiring new technology skills is related to IT human assets [67]; it is a kind of human capital that IT departments can utilize to manage IS [39,40]. It refers to that IS personnel constantly update their proficiency in IT infrastructure design, systems analysis and design, programming, and emerging technologies [66]. Given rapidly changing technological environments, acquiring new technology skills permits IT personnel to renew their technical skills required for conceiving and implementing new IT solutions.

Acquiring new technological skills is valuable for sensing activities, especially when technology trends are difficult to discern [26]. With the state-of-the-art technical knowledge, IT personnel will be more sensitive to emerging technological opportunities and recognize their value [67]. This can reduce the likelihood of an IT department being locked into existing technological trajectories, thus enhancing IS exploration [26]. Besides, technical skills are necessary for IT architectural planning and making technology work [68]. Sound architectural planning can create a coherent blueprint of technical platforms that responds to current and future business needs. Technologically savvy IT personnel can rapidly trouble shoot problems and identify IT solutions to business needs that existing IT cannot satisfy. Accordingly, IT departments can seize opportunities better by quick planning and implementing the necessary applications [67]. The following example illustrates how acquiring new technical skills enables IT departments to leverage existing systems while experimenting with emerging technologies. For example, firms can achieve intraorganizational, interorganizational, and hybrid application integration by adopting enterprise application integration (EAI) technologies [69]. When IT personnel steadily acquire the technical skills needed for implementing EAI, they can reuse existing IS assets and extend current systems to satisfy more business requirements. Furthermore, more and more organizations are pursuing digital technology-based innovations [70]. Such innovations are characterized as combinatorial innovations, which indicate that new IS products or services are created by recombining existing digital artifacts or modules [70]. IS personnel who can continue to learn new technical knowledge and development skills should be more capable of reaping the value of combinatorial innovations [71]. Consequently, this study suggests that both IS exploitation and IS exploration can be enhanced by IT personnel who continually acquire new technology skills, and IT departments that possess such managerial human capital would possess greater capacity to utilize and mobilize technologies for pursuing IS ambidexterity.

H4. Acquiring new technology skills positively affects IS ambidexterity.

3.4.3. Interacting with users

Interacting with users is a type of IT relationship asset [67] that captures the managerial social capital of IT departments [39,40] and refers to that IT personnel have close work relationships with users [67]. It permits IT personnel to consult users for sensing unfulfilled or emerging business requirements that can be utilized for IS exploitation or IS exploration. IT personnel can also clarify business units' prioritization of new IS requirements by communicating, coordinating, and negotiating frequently with users, thus facilitating them to select and seize critical IS adaptation opportunities [67]. Moreover, IT departments may be conservative to explore potential IT applications with unclear short-term benefits but possibly leading to long-term gains.

Because interacting with users can nurture mutual trust that is beneficial to IT-business partnership [67], the contradictions between IS exploitation and IS exploration can thus be mitigated. Because interacting with users facilitates and balances IS exploitation and IS exploration, IT departments with such a trait should thus have greater dynamic managerial capability for conducting ambidextrous IS activities.

H5. Interacting with users positively affects IS ambidexterity.

3.4.4. Flexible technology assets

Flexible technology assets capture the characteristics of technological IT assets that can affect IT departments' deployment flexibility for ambidextrous IS activities [44,67]. They refer to sharable IT hardware/software platforms and reusable IS components, which can be efficiently and effectively redeployed to different applications [72]. This study argues that flexible technology assets can increase IT departments' dynamic managerial capability for IS ambidexterity. On the one hand, IS exploitation aims to fulfill business requirements by adjusting existing IT applications [24]. When a firm's IT applications are built upon flexible technology assets, IT departments can refine existing information systems by replacing some of their hardware components or software modules with more powerful ones [66,67]. This approach not only reduces development costs but also increases the performance of new IS products/services. On the other hand, IS exploration entails the experimentation of emerging IT for developing innovative IS products and services [24]. Yet, IS exploration can incur significant risks because it often involves immature technologies and needs a long development time. When IT assets are flexible, they are likely to be reusable in new applications. As such, not only the involved technological uncertainties can be reduced but also the development time shortened. Because flexible technology assets make existing hardware/software resources accessible and reusable, they can be easily redeployed to facilitate both IS exploitative and IS exploratory activities [73]. As a result, this study reports that the redeployment flexibility of technology assets can increase IT departments' capacities for engaging ambidextrous IS activities.

H6. Flexible technology assets positively affect IS ambidexterity.

3.5. Relating IS assets to IS alignment

Understanding business situations enables IT personnel to communicate with business units with shared language and shared cognition [19,73]. IT and business personnel typically possess diverse knowledge, perspectives, and experiences on where and how IS may enable or support business requirements. Without a common frame of reference, they cannot recognize, understand, or make sense of exchanged knowledge well. If IT personnel understand business situations, they can use common vocabularies to explain IS value and capability from business units' viewpoints. Business personnel are then more likely to consider their opinions during strategic and operational decision-making [73] and for improving the decision-making process. In addition, IT personnel who understand business situations possess shared cognitions about the collective goals and problems of the firm with business personnel. They thus can envision business units' IS requirements and conceive IT solutions that are more likely to be appreciated by the latter, thus making the latter more willing to adopt necessary strategic or operational adjustments [74]. Because understanding business situations can increase business units' motivations to adapt to IT department's proposals [19,73], this study argues that the firm's information systems will be better aligned with the required operational and strategic decision-making supports.

H7. Understanding business situations positively affects operational support.

H8. Understanding *business* situations positively *affects strategic decision support.*

Acquiring new technology skills indicates that IT personnel can keep up their technical knowledge with technology trends. Understanding latest technology signals IT personnel's professional capability, thus facilitating them to gain business personnel's trust [75]. Such trust leads business personnel to believe that IT personnel's assessments of technological opportunities for enabling business transformation (e.g., internal integration, business process redesign, business network redesign, and business scope redefinition [76]) are dependable. Accordingly, business units will be more likely to accept IT personnel's advices to leverage IT for pursuing competitive potentials or improving operations [6]. This study therefore argues that acquiring new technology skills can facilitate social alignment (i.e., capability trust) and in turn IS alignment [77].

H9. Acquiring new technology skills positively affects operational support.

H10. Acquiring new technology skills positively affects strategic decision support

Interacting with users refers to that IT personnel work closely and cooperatively with users. IT personnel typically rely on formal (e.g., regularly meetings) or informal (e.g., cross-functional events) mechanisms to interact with users [74]. These mechanisms provide opportunities for the two parties to consult each other to solve IT-related problems. During interactions, it is very likely that IT and business personnel develop expectations or norms about where and how IS should be applied to support or enable the business. When both parties can work together toward collective goals, the discrepancy between information systems and the needed supports for operations and strategic decision-making should reduce [73]. In addition, interacting for a long time permits IT personnel and users to acquire more information on each other's ability, benevolence, honesty, and reliability [75]. This allows the two parties to assess each other's motives and credibility, thus paving the way for developing trust [73,74]. Besides, informal interactions are also found to facilitate the building of positive, lasting relationships and hence trust [75]. Once mutual trust is established, users will tend to rely on IT personnel's opinions for assessing the firm's IS capabilities and the prioritization of organizational objectives [73]. This, again, can eliminate the potential gaps between information systems and the needed operational and strategic decision supports [13,73,74].

H11. Interacting with users positively affects operational support.

H12. Interacting with users positively affects strategic decision support.

Flexible technology assets refer to that IT infrastructure and service platforms are shareable, scalable, and reusable across IT applications [79]. Flexible technology assets make existing hardware components, data, and software service available to extended or new IT applications without the need of establishing underpinning technological infrastructure from the scratch. To the extent that technology assets are flexible, IT departments can build information systems to support or enable businesses with less time and cost. From the standpoint of business units, flexible technology assets also provide digital options that allow them to pursue IT-enabled business processes [78]. Because firms face environmental changes, business units will certainly prefer exercising such digital options to adopt other options that require much more extensive effort or require building information systems from the scratch. More flexible technology assets thus can provide greater motivation for business units to make strategic/operational adaptations that can be supported by the firm's technologies, thus leading to higher levels of IS alignment.

H13. Flexible technology assets positively affect operational support.

H14. Flexible technology assets positively affect strategic decision support.

In addition, larger firms with more resources may lack the flexibility to achieve IS alignment and IS ambidexterity [10,56]. Thus, this study identifies the number of employees in the firms as the indicator of firm size for controlling its potential impact on IS alignment and IS ambidexterity. Similarly, the size of an IT department might affect the heterogeneity of the department; this might influence the achievement of IS alignment and IS ambidexterity [56]. Hence, the number of employees in an IT department is used to represent IT department size, which serves as the other control variable for IS alignment. Overall, as depicted in Fig. 2, our research model includes six hypotheses and two control variables.

4. Method

4.1. Data collection

A cross-sectional mail survey was administered to collect data from large- and medium-sized manufacturing firms in Taiwan. The sampling firms were drawn from the "Taiwan Top 1000″ list issued by the China Credit Information Service, a leading business database in Taiwan. The responses were kept anonymous to increase the response rate and to lower potential nonresponse bias. This study analyzed the demographic information (e.g., averaged yearly sales, number of employees, and averaged capital amount) of the samples for selecting key informants [80]. Managers and executives of IT departments were selected as the survey's target informants because they were considered most knowledgeable and reliable for our study.

After compiling the English version of the questionnaire, the draft survey items were first translated into Chinese by a bilingual research associate and then verified and refined for translation accuracy by one MIS professor and two senior doctoral students. The Chinese version of the draft was then pretested by several senior IS managers for checking face and content validity. The final version of the survey was sent to 1000 sampling firms, among which 211 returned. Five questionnaires were incomplete and thus discarded. A total of 206 completed responses were collected, thus yielding a response rate of 20.6%. However, among the completed responses, 44 were answered by IT staffs. These respondents were considered to be less knowledgeable about the actual status between the IT department and the entire organization and therefore were excluded. The remaining 162 responses answered by IT department managers or executives were kept for subsequent analyses. As indicated in Table 1, the average company tenure of the respondents was 11.97 years (S.D. = 7.70), and the average tenure of their current position was 5.07 years (S.D. = 4.26).

As indicated in Table 2, the responding firms are from a wide range of industries covering electronics, metal, finances and stocks, and petrochemicals and rubbers. Over 80% of the firms' average annual sales

Table 1
Demographic Profile of IT Managers and IT Executives (N = 162).

Demographic Variables	Count	Percentage
Respondent Position		
IT Executive	22	13.6%
IT Manager	140	86.4%
Respondent's Service Year (Mean = 11.97, S.D. = 7.70)		
0–5 years	38	23.5%
6–10 years	45	27.8%
11–15 years	38	23.5%
Above 16 years	41	25.3%
Years in Current Position (Mean = 5.07, S.D. = 4.26)		
0–5 years	110	67.9%
6–10 years	40	24.7%
11–15 years	10	6.2%
Above 16 years	2	1.2%

Table 2
Profile of the Sample Firms (N = 162).

Industry Types	Count	Percentage
Electronics	61	37.7%
Metal/Machinery	14	8.6%
Finances/Stocks	14	8.6%
Petrochemicals/Rubbers	13	8.0%
Stores/Logistics	11	6.8%
Others (Food, Transportation, Information Service, Construction, Textile, Import/Export)	49	30.3%
Average Sales Amount (Billion, NT$)	**Count**	**Percentage**
Over 10.1	66	40.7%
5.1–10	43	26.5%
2.6–5.0	33	20.4%
1.1–2.5	6	3.7%
Below 1.1	14	8.7%
Years of Operation	**Count**	**Percentage**
Over 21	107	66.1%
16–20	17	10.5%
11–15	24	14.8%
6–10	11	6.8%
Below 5	3	1.8%
No. of Employees	**Count**	**Percentage**
Over 3001	28	17.3%
1001–3000	38	23.5%
501–1000	39	24.1%
301–500	16	9.9%
101–300	25	15.4%
51–100	14	8.6%
Below 50	2	1.2%

are greater than NT$2.5 billion, and 76% of the firms have been operating for more than 15 years. Approximately 60% of the firms have more than 500 employees. Thus, our sample consists of medium- to large-sized firms in Taiwan.

Nonresponse bias was assessed by commonly applied wave analysis [81]. On the basis of the assumption that late respondents are more likely to resemble nonrespondents, we detected nonresponse bias by comparing the demographic characteristics of the early 10% respondents with those of the late 10% respondents. The results of independent sample *t*-tests (p = 0.13 and 0.20, respectively) showed that no significant differences in the means of annual sales and employee numbers exist between the two groups. Accordingly, nonresponse bias should not be a major problem in this study.

We also ran the test for common method bias because this study adopted a mono-method, self-report survey to collect data. Such a research design may cause covariance sharing within all the indicators (i.e., common method variance, CMV), which may inflate or deflate the observed relationships between the constructs [82]. Therefore, the Harmon's single-factor test was applied to assess CMV [82]. All the 24 variables were entered into an exploratory factor analysis, and five factors with eigenvalues greater than 1.0 were extracted. These factors totally accounted for 65.7% of the variance, while the largest of them accounted for 36.8%. Because no single factor accounted for the majority of the covariance among the variables, common method bias should not be a major concern in this study.

4.2. Measures

IS alignment is defined as the extent to which information systems are aligned with required strategic decision supports and operational supports. It is operationalized in terms of two first-order reflective constructs: operational support and strategic decision support. Operational support refers to that information systems improve the efficiency, coordination, and analysis of business activities, and strategic decision support refers to that information systems support the planning and analysis of strategic decisions [12,46]. Both of them are measured with three items adapted from the scale developed by Chan et al. [10].

IS ambidexterity is defined as the extent of simultaneousness of exploitative and explorative IS activities. IS ambidexterity is operationalized in terms of two underlying dimensions: IS exploitation and IS exploration [24,56]. IS exploitation refers to IS activities that focus on adjusting or refining existing IT applications for meeting current business needs; IS exploration refers to IS activities that aim to meet emergent business needs by experimentations on new IT applications [24,56]. Both of the dimensions are measured with three items adapted from Jansen et al. [56]. In addition, prior literature suggested two ways to operationalize ambidexterity: the combined approach and the balanced approach [83]. The combined approach operationalizes ambidexterity as the product or sum of exploitation and exploration [55]. It implies that exploitation and exploration can be supportive of each other; thus, scoring high in both exploitation and exploration is positively related to performance. The balanced approach operationalizes ambidexterity as the absolute difference of exploitation and exploration. This implies that a closer match in the magnitude of exploitation and exploration enables a firm to avoid either the risk to obsolesce or the risk of failure to appropriate. This study adopts the combined approach to operationalize the simultaneousness of IS exploitation and IS exploration, which is most prevalent in prior IS-related ambidexterity studies [24,84,85]. Accordingly, this study creates product indicators based on the items of IS exploration and IS exploitation, which serve as the measures of IS ambidexterity.

Understanding business situations is defined as the extent to which IS personnel understand business operations and business environments. Acquiring new technology skills is defined as the extent to which IT personnel learn new technology skills. These two constructs are adapted from the concept of human asset [67]. Both constructs are measured with three items adapted from Ross et al. [67] and Bharadwaj [66]. Interacting with users is defined as the extent to which IT personnel work closely and cooperatively with users. It is adapted from the concept of relationship asset and is measured with three items adapted from Ross et al. [67]. Flexible technology asset is defined as the extent to which sharable IT hardware components and software service platforms can be utilized or reused to develop new IT applications. It is adapted from the concept of technology asset [67] and is measured with three items adapted from Ravichandran and Lertwongsatien [86].

All the research constructs are measured on a five-point Likert scale. The measurement items and their sources are provided in Appendix A.

5. Analysis

Data were analyzed using partial least squares (PLS), a structural equation modeling technique that uses a component-based approach for estimation. Similar to other structural modeling techniques, PLS can simultaneously assess the reli ability and validity of the measures of theoretical latent constructs (the measurement model) and estimate the relationships among these constructs (the structural model). Unlike covariance-based approaches, PLS places minimal demands on measurement scales, sample size, and distributional assumption [87]. We chose to use PLS for three reasons. First, our study is primarily intended for causal analysis, a condition for PLS suggested by Wold [88]. Second, PLS requires fewer statistical specifications and constraints on the data than covariance-based approaches such as LISREL. Finally, PLS is considered robust for small-to-moderate sample sizes [89].

5.1. Measurement model validation

The means and standard deviations of the constructs are reported in Table 3. This study adopted SmartPLS v.3.2.1 to assess the measurement model [90]. Although PLS does not require data to be normally distributed, it is suggested that extremely nonnormal data could inflate standard errors obtained from bootstrapping and thus decrease the likelihood of finding significant relationships [91,92]. Hence, we checked the normality of the constructs by distribution kurtosis and skewness [93]. The analysis showed that the kurtosis values ranged from −0.284 to 0.809, which were considered to be not too peaked (> 1) or too flat (< −1) [93]. The skewness values were between −0.568 and 0.121; this indicates that data distributions were not too skewed (< −1 or > 1) [93]. These results indicated that possible estimation bias caused by nonnormal data should not be a problem in this study [93].

The parameters of the measurement model were estimated with a factor-weighting scheme [93]. Internal consistency reliability, convergent validity, and discriminant validity tests were used to evaluate the measurement model. Because the true reliability lies between Cronbach's α (the lower bound) and composite reliability (the upper bound), it was suggested that both the measures need to be reported when evaluating internal consistency reliability [93]. As shown in Table 3, all the values of Cronbach's α and composite reliability exceeded 0.721, thus indicating that our measurement scales exhibited acceptable internal consistency reliability. Convergent validity was assessed by examining the outer loadings of the indicators and the average variance extracted (AVE) [93]. As shown in Appendix B, the estimated outer loadings for all the observed variables (i.e., items) to the respective latent variables were significant at 1% level. All the loadings were also greater than 0.7, indicating that at least 50% of each indicator's variance was explained by (and thus converged on) the corresponding latent variable [93]. In addition, AVE is the grand mean value of the squared loadings of the indicators associated with the construct [93]. An AVE value greater than 0.50 indicates that, on average, the construct explains more than half of the variance of its indicators. As shown in Table 3, all the AVE values were greater than 0.640. From these assessments, we believed that the measurement scales of all research constructs exhibited an acceptable convergent validity.

Discriminant validity was assessed by two criteria [93]: (1) items should load more highly on the construct that they intend to measure than on other constructs and (2) the square root of the AVE should be larger than the inter-construct correlations (the Fornell-Larcker criterion). Cross-loadings were computed by calculating the correlations between latent variable component scores and the manifest indicators of other latent constructs [84]. Appendix B indicates that all items loaded more highly on their own construct than on other constructs. Table 3 also shows that the square root of the AVE for each construct was greater than 0.70 (i.e., AVE > 0.50) as well as the correlations between the construct and other constructs. Therefore, all the constructs shared more variances with their indicators than with other constructs, thus exhibiting sufficient discriminant validity. Nevertheless, recent research pointed out that neither the cross-loadings approach nor the Fornell-Larcker criterion could reliably detect discriminant validity issues under certain conditions [94]. Specifically, cross-loadings fail to indicate a lack of discriminant validity when two constructs are perfectly correlated. Furthermore, the Fornell-Larcker criterion performs very poorly when indicator loadings of the constructs under consideration differ only slightly (e.g., all indicator loadings vary between 0.60 and 0.80) [95]. As a remedy, Henseler et al. [94] proposed assessing the heterotrait-monotrait ratio (HTMT) of the correlations. HTMT is the mean of all correlations of indicators across constructs measuring different constructs (i.e., the heterotrait-heteromethod correlations) relative to the geometric mean of the average correlations of indicators measuring the same construct (i.e., the monotrait-heteromethod correlations) [94]. A HTMT value above 0.90 suggests a lack of discriminant validity [94]. In addition, it is suggested that HTMT can serve as the basis of a statistical discriminant validity test [93]. Researchers can rely on the bootstrapping procedure to derive

Table 3
Correlation Matrix and Composite Reliability Scores.

Construct	Mean	Standard Deviation	Composite Reliability	Cronbach's α	Average Variance Extracted	UBS	ATS	IU	FTA	ISXPL	ISXPR	OPS	SDS
UBS	4.309	0.531	0.842	0.721	0.640	(0.800)							
ATS	3.767	0.658	0.880	0.797	0.710	0.235	(0.843)						
IU	4.123	0.505	0.892	0.817	0.735	0.590	0.241	(0.857)					
FTA	3.372	0.656	0.873	0.783	0.695	0.315	0.449	0.327	(0.833)				
ISXPL	3.799	0.746	0.954	0.905	0.913	0.371	0.562	0.413	0.528	(0.955)			
ISXPR	3.496	0.632	0.853	0.744	0.661	0.354	0.609	0.300	0.553	0.740	(0.813)		
OPS	4.008	0.561	0.894	0.822	0.737	0.457	0.281	0.443	0.423	0.511	0.472	(0.858)	
SDS	3.586	0.652	0.903	0.830	0.756	0.368	0.291	0.333	0.473	0.419	0.415	0.671	(0.869)

Note: Numbers in the parentheses on the diagonal are the square root of AVE values.
UBS = Understanding business situations, ATS = Acquiring new technology skills, IU = Interacting with users, FTA = Flexible technology assets, ISXPL = IS exploitation, ISXPR = IS exploration, OPS = Operational support, SDS = Strategic decision support.

a distribution of HTMT and hence a bootstrap confidence interval (e.g., 95%) of HTMT. A confidence interval (C.I.) of HTMT that contains the value 1 indicates a lack of discriminant validity [93]. On the basis of these two criteria, we found that the discriminant validity between IS exploration and IS exploitation was not established (HTMT = 0.940; C.I. of HTMT = (0.837, 1.029)). According to Hair's et al. [93] suggestion, we fixed the problem by removing the item ISXPL-3 (HTMT = 0.892; C.I. of HTMT = (0.806, 0.964)). As a result, this study adopted ISXPL-1 and ISXPL-2 as the measures of ISXPL in subsequent analyses. To sum up, the above results suggested that the adjusted measurement items possess sufficient psychometric properties to support the subsequent structural model analysis.

In addition, IS ambidexterity was measured with product indicators created by multiplying the constituent items of IS exploration with those of IS exploitation [24,55]. According to Hair et al. [93, p.311], the product indicators do not have to be assessed in the measurement model evaluation step as long as the original items for creating product indicators satisfy the criteria of measurement model validation in their respective construct (i.e., IS exploration and IS exploitation). The reason is that the product indicators are created by multiplying indicators from two conceptual domains. The resulting indicators for measuring IS ambidexterity do not stem from one specific conceptual domain and thus do not necessarily correlate highly. Therefore, the internal consistency reliability, convergent validity, and discriminant validity that are utilized to validate reflective measurement models are not appropriate for assessing the product indicators of IS ambidexterity. Because IS exploration and IS exploitation already have demonstrated acceptable psychometric properties in the measurement model validation, following prior ambidexterity study in the IS field [24,84,85], we can utilize the created product indicators as the measures of IS ambidexterity in the subsequent structural model analysis.

5.2. Structural model validation

PLS adopts OLS technique to estimate path coefficients in the structural model, which may generate biased path coefficients if the estimation involves a significant level of collinearity among the predictor constructs [93]. Therefore, this study evaluated the construct collinearity of predictor constructs separately for each subpart of the structural model. The analyses showed that all VIF values were below the threshold of 5 (1.308–2.347); this indicates that construct collinearity should not be a significant problem in our study.

Then, a bootstrapping technique with a path weighting scheme and 300 resamples was performed to obtain the estimates of standard errors for testing the statistical significance of path coefficients using *t* test [93]. Table 4 presents the results of PLS analysis for the structural model. With one-tailed *t* test, six path coefficients (H_1, H_4, H_6, H_7, H_{13}, and H_{14}) in the structural model were significant at $p < 0.01$, three (H_5, H_8, and H_{11}) were significant at $p < 0.05$, one (H_3) was significant at $p < 0.1$, and four were insignificant (H_2, H_9, H_{10}, and H_{12}). With regard to the explained variances (R^2), the results showed that our model explained 41.9% and 31.9% of the variances in operational support and strategic decision support, respectively. Besides, 57.4% of the variances in IS ambidexterity were accounted for by its antecedents. These R^2 values indicated that our research model exhibited weak-to-moderate predictive power [91].

We also examined the Q^2 value to assess the model's predictive relevance [93]. The Q^2 measure applies a sample reuse technique that omits part of the data points and uses the model and its parameter estimates to reconstruct (and thus predict) the data points of indicators in endogenous constructs. A value of 0.02, 0.15, or 0.35 indicates that exogenous constructs have a small, medium, or large predictive relevance, respectively, for a selected endogenous construct [93]. By adopting the cross-validated redundancy approach with an omission distance of 7 [93], the Q^2 values of the endogenous constructs ranged from 0.202 to 0.299, thus indicating a medium-to-large predictive relevance of the exogenous constructs.

Besides, we also calculated the f^2 effect size to assess the impact of each predictor construct on its own endogenous construct. The f^2 effect size measures the change in the R^2 value when a specified predictor construct is omitted from the model. As shown in Table 4, ten out of fourteen predictor constructs have small-to-medium effects on the R^2 values of their corresponding endogenous constructs. The results indicate that these predictor constructs are sufficiently relevant in explaining their respective endogenous constructs.

Our model also includes both IT department size and firm size as control variables for IS ambidexterity, operational support, and strategic decision support. Table 4 shows that the effect of IT department size on IS ambidexterity is significant at $p < 0.05$. This reveals that after ruling out the impact of IT department size on IS ambidexterity, the four proposed antecedents still have significant effects on IS ambidexterity. Table 4 also shows that the effects of firm size on operational support and strategic decision support are significant at $p < 0.05$ and $p < 0.1$, respectively. The results similarly indicate that IS ambidexterity has significant influences on IS alignment constructs despite the fact that the latter are also affected by firm size.

In addition to PLS, this study conducted an additional analysis to see whether pursuing IS ambidexterity outperforms pursuing only IS exploration or only IS exploitation. We followed Lee et al. [24] and compared the mean values of the two aspects of IS alignment (i.e., OPS and SDS) for different combinations of IS exploitation and IS exploration. The samples were categorized into four different combinations of IS exploration and IS exploitation on the basis of their mean values. Then, one-way ANOVA test was adopted to examine whether the HH (high IS exploration and high IS exploitation), the HL (high IS exploration and low IS exploitation), and the LH (low IS exploration and high IS exploitation) groups are different in the scores of OPS and SDS. As shown in Fig. 3a, the HH group has the highest OPS mean value than the other two groups. The post hoc analysis showed that the mean value of OPS in the HH group is significantly greater than those in the HL and

Table 4
Summary of PLS Results.

	Endogenous Construct								
	IS Ambidexterity			Operational Support			Strategic Decision Support		
	Hypothesis	β	f^2	Hypothesis	β	f^2	Hypothesis	β	f^2
Understanding Business Situations	H_3	0.122^{*}	0.022	H_7	0.202^{***}	0.043	H_8	0.168^{**}	0.025
Acquiring New Technology Skills	H_4	0.396^{***}	0.281	H_9	−0.099	0.010	H_{10}	−0.013	0.000
Interacting with Users	H_5	0.147^{**}	0.031	H_{11}	0.156^{**}	0.025	H_{12}	0.068	0.004
Flexible Technology Assets	H_6	0.305^{***}	0.162	H_{13}	0.172^{***}	0.032	H_{14}	0.320^{***}	0.096
IS Ambidexterity				H_1	0.296^{***}	0.064	H_2	0.135	0.011
Firm Size		0.047	0.003		0.131^{**}	0.020		0.109^{*}	0.012
IT Dept. Size		0.126^{**}	0.025		0.091^{*}	0.009		0.014	0.002
R^2	0.574			0.419			0.319		
Q^2	0.299			0.276			0.202		

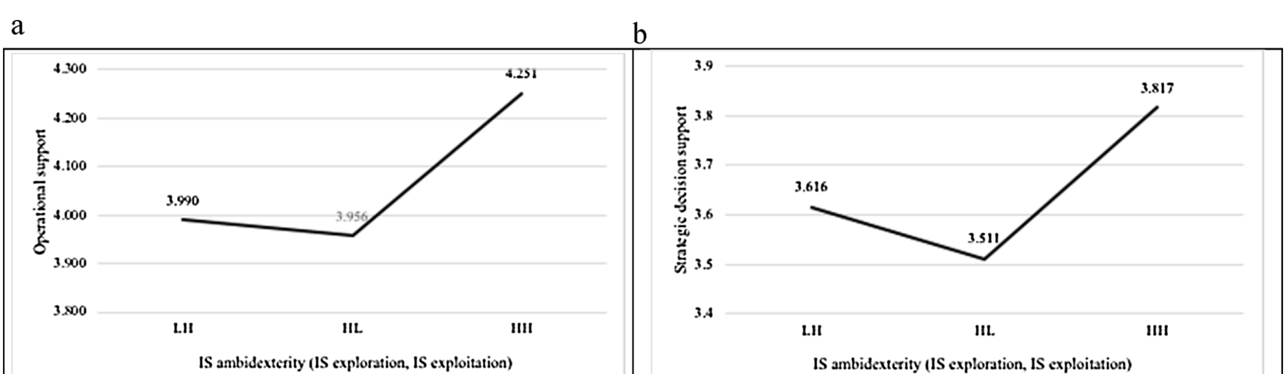
1.*, **, and *** indicate significance at $p < 0.1$, $p < 0.05$, and $p < 0.01$, respectively (one-tailed test).
2. The thresholds for small, medium, and large f^2 and Q^2 value are 0.02, 0.15, and 0.35, respectively.
3.The effect size of f^2 can be calculated as $(R^2_{included} - R^2_{excluded})/(1–R^2_{included})$. $R^2_{included}$ and $R^2_{excluded}$ represent the R^2 values of endogenous construct when the specified predictor construct is used and omitted in the structural model, respectively.

the LH groups. These results support H_1 that, in terms of operational support, simultaneously pursuing IS exploration and IS exploitation is superior to pursuing only IS exploration or only IS exploitation. Fig. 3b shows that the HH group also has the highest mean value of SDS than the other two groups. However, the post hoc analysis showed that the mean value of SDS in the HH group is significantly greater than that of only the HL group. The results indicate that simultaneously pursuing IS exploration and IS exploitation is only better than pursuing just IS exploration, which does not lend sufficient evidence for supporting H_2. In sum, the one-way ANOVA tests exhibited consistent findings with the previous PLS analysis.

Finally, we performed an exploratory analysis to examine the indirect effects of the four IS assets on both the aspects of IS alignment. As depicted in Table 5, all the four IS assets have significant indirect effects (through IS ambidexterity) on operational support. Because IS ambidexterity does not have a significant effect on strategic decision support, the indirect effects (through IS ambidexterity) of the four IS assets on strategic decision support are also insignificant.

5.3. Findings

Both the PLS and the one-way ANOVA analysis offered evidence that IS ambidexterity facilitates IS alignment, especially in the operational support aspect (H_1). The finding implies that pursuing IS exploitation and IS exploration simultaneously can enhance the alignment between information systems and required operational supports. IS exploitation and IS exploration, hence, are synergistic to maintain the extent to which information systems meet daily operational requirements [83]. This finding also indicates that IS alignment, as a dynamic managerial capability, is helpful to IS alignment in terms of operational support. On the contrary, the PLS and one-way ANOVA analysis did not support H_2 that IS ambidexterity enhances IS alignment in the strategic



Source	SS	df	MS	F	Sig.	Post hoc
Between groups	2.154	2	1.077	4.264	0.016	HH > LH, HH > HL
Within groups	29.807	118	0.253			
Total	31.961	120				

Source	SS	df	MS	F	Sig.	Post hoc
Between groups	1.700	2	0.850	2.362	0.099	HH > HL
Within groups	42.451	118	0.360			
Total	44.151	120				

Note 1: LH = Low IS exploration and High IS exploitation (n=33) HL = High IS exploration and Low IS exploitation (n=15)
HH = High IS exploration and High IS exploitation (n=73)

Note 2: LH and HL represent firms that pursue either IS exploration or IS exploitation, respectively.
HH represent firms that pursue IS exploration and IS exploitation simultaneously (i.e., IS ambidexterity).

Fig. 3. a) One-way ANOVA test of OPS for different combinations of IS exploration and IS exploitation. b) One-way ANOVA test of SDS for different combinations of IS exploration and IS exploitation.

Table 5
Direct and Indirect Effects of the Four IS assets on IS alignment.

Path	Direct Effect	Indirect Effect
Understanding Business Situations → Operational Support	0.202***	0.036*
Acquiring New Technology Skills → Operational Support	−0.099	0.117**
Interacting with Users → Operational Support	0.156**	0.043**
Flexible Technology Assets → Operational Support	0.172***	0.090***
Understanding Business Situations → Strategic Decision Support	0.168**	0.016
Acquiring New Technology Skills → Strategic Decision Support	−0.013	0.053
Interacting with Users → Strategic Decision Support	0.068	0.020
Flexible Technology Assets → Strategic Decision Support	0.320***	0.041

Notes: *, **, and *** indicates significance at $p < 0.1$, $p < 0.05$, and $p < 0.01$, respectively (one-tailed test).

decision support aspect.

Our research findings also indicate that IS ambidexterity can be facilitated by two aspects of IS assets. In terms of IS human assets, it is shown that understanding business situations (H_3), acquiring new technology skills (H_4), and interacting with users (H_5) can increase IS ambidexterity. These findings imply that, first, IS personnel who understand business situations well would possess higher levels of knowledge and cognitive capability about business units' IS requirements. Hence, they can conceive more possible IT applications regardless of whether the applications are conceived through exploitation or exploration. Second, IS personnel characterized by acquiring new technology skills would possess updated and proficient IT leveraging ability. Thereby, they can engage in more exploitative and exploratory IS activities. Finally, IS personnel who have close interactions with users are more likely to develop partnerships with users. They thus would not only try to improve current IS solutions but also be more willing to experiment with new technologies for possible new requirements, thus leading to higher levels of both exploitative and exploratory IS activities. As mentioned before, understanding business situations, acquiring new technology skills, and interacting with users capture the managerial cognition, human resource, and social capital of IS personnel. Because the three IS human assets undergird IS personnel's dynamic managerial capability, the empirical support of H_3–H_5 corroborates our conjecture that IS ambidexterity (i.e., IT department's dynamic managerial capability) can be improved by enhancing the three IS human assets.

Further, our research findings reveal that flexible technology assets can enhance IS ambidexterity (H_6). Despite the importance of the abovementioned three IS human-related assets, the empirical support of H_6 suggests that the flexibility in deploying technology assets also can influence IS ambidexterity. One plausible mechanism is that flexible technology assets enhance or constrain IS personnel's dynamic managerial capability [43], thus affecting IS ambidexterity. This is consistent with Wang et al.'s [96] capability-building view, which finds that IT infrastructure influences a firm's capability to mobilize IT resources for realizing strategic goals.

Although the above findings imply that understanding business situations, acquiring new technology skills, interacting with users, and flexible technology assets can indirectly improve the operational support aspect of IS alignment through facilitating IS ambidexterity (as shown in Table 5), our results showed that the four IS assets also can directly influence IS alignment. With regard to operational support, the positive effects from understanding business situations (H_7), interacting with users (H_{11}), and flexible technology assets (H_{13}) were empirically supported, but the positive influence from acquiring new technology skills (H_9) was not. With regard to strategic decision support, understanding business situations (H_8) and flexible technology assets (H_{14}) were found to have significant influences, while acquiring new technology skills (H_{10}) and interacting with users (H_{12}) were not. Taking all the research findings together, this research finds that the four IS assets can lead IT departments to IS alignment directly or indirectly.

6. Discussion

Some studies have suggested that IT-business alignment be examined more dynamically. Although there has been some progress in this endeavor, most studies nevertheless addressed the issue conceptually [21,22], while others focused on reconceptualizing alignment as a dynamic competence construct [48]. Neither of the research streams empirically showed how IT-business alignment may be achieved and possibly sustained. This study makes contribution in this direction by taking on IT departments' stance, investigating how and why IT departments with IS assets influence IS alignment. Specifically, we conceive IS alignment as reflecting IT departments' ordinary capability to deploying information systems such that the systems are aligned with the required strategic decision supports and operational supports of the organization. However, to have such an ordinary capability of sustaining IS alignment, we hold that dynamic managerial capability is required to continuously refine and renew the ordinary capability through ambidextrous IS activities. This conjecture is partially corroborated, indicating that the simultaneous pursuit of IS exploration and IS exploitation helps to realign information systems with environmental changes more dynamically and thus makes the operational support aspect of IS alignment sustainable. In addition, this study identifies four IS assets as the antecedents of IS ambidexterity on the basis of the DCV and the IS literature. Our findings indicate that (1) IT departments that possess more IS assets of understanding business situations, acquiring new technological skills, interacting with users, and flexible technology assets exhibit greater IS ambidexterity, allowing them to sustain the operational support aspect of IS alignment; (2) IT departments can achieve higher IS alignment in terms of operational support when they possess the IS assets of understanding business situations, interacting with users, and flexible technology assets; (3) IT departments can achieve higher IS alignment in terms of strategic decision support when they possess the IS assets of understanding business situations and flexible technology assets. This research hence corroborates that the four IS assets facilitate IS ambidexterity, while enhancing a certain aspect of IS alignment. The implications are discussed below.

6.1. Theoretical implications

First, this study draws upon the DCV to address the "atheoretic" criticism of IT-business alignment research. The findings indicate that IT departments with IS ambidexterity (i.e., dynamic managerial capability) can facilitate the operational support aspect of IS alignment by conducting both exploitative and explorative IS activities to modify its ordinary capability of deploying information systems. This research offers preliminary evidence that dynamic managerial capability is beneficial to IT-business alignment. However, because managerial capability is the only source of dynamic capabilities, we encourage future research to explore alternative sets of dynamic capabilities from the viewpoint of organizational process (e.g., learning, integration, and coordination) [29]. By doing so, our understanding regarding how to achieve IT-business alignment from the viewpoint of DCV could be improved.

Second, this study finds that achieving IS alignment dynamically requires both exploitative and exploratory IS activities that are inherently contradictory. Hence, ambidexterity serves as a kind of dynamic capability that contains the tension between exploitation and exploration. To understand whether ambidexterity is generally required for managing IT-business alignment, we suggest future research to identify more instances of contradictory activities that are simultaneously required for sustaining IT-business alignment. For example, this study focuses on only exploitative and exploratory IS activities, which are simultaneously required for achieving IS alignment. However, there are other types of IT-business alignments (e.g., intellectual, structural, business, IT, and cross-domain alignments), which involve different foci of alignment. Specifically, strategy is the focus of intellectual alignment. Because IS strategy may lead or lag business strategy [17], IT departments need to develop IS strategy based on both the predetermined business strategy (i.e., IT strategy lags business strategy) and opportunities presented by the external environment (i.e., IT strategy leads business strategy) in order to achieve intellectual alignment [23]. Accordingly, being ambidextrous in the IS strategy process is pivotal for sustaining IT-business alignment. When more and more research identifies contradictory needs for achieving alignment in a similar vein and corroborates the impact of associated ambidexterity on IT-business alignment, we can gain greater confidence about the thesis that ambidexterity serves as a pivotal dynamic capability for achieving and sustaining IT-business alignment.

Third, O'Reilly and Tushman [57, p.332] asserted that "the appropriate lens through which to view ambidexterity remains that of dynamic capabilities". In response to this call, this study draws upon the lens of dynamic managerial capability to identify the antecedents of IS ambidexterity. This study also empirically demonstrates that understanding business situations, acquiring new technological skills, and interacting with users serve as effective managerial cognition, human resource, and social capitals that can enhance dynamic managerial capabilities for handling and balancing ambidextrous IS activities. Such findings corroborate that the DCV, in addition to the structural, contextual, and leadership-based solutions that are predominant in the ambidexterity literature, is another useful lens for studying ambidexterity [91]. Therefore, we encourage future research to contrast or synthesize the two research streams in order to increase our theoretical understanding of ambidexterity.

Fourth, this research indicates that IS assets, beyond dynamic managerial capability, have a significant impact on IS alignment. This echoes the RBV-based alignment research stressing that organizational resources also serve as the pivotal antecedents of IT-business alignment [16,18,19,97,98]. Specifically, our research reveals that operational support and strategic decision support seem to be facilitated by different sets of IS assets but understanding business situations and flexible technology assets nevertheless appear to constantly affect both dimensions of the alignment directly. Given that adjusting information systems both exploitatively and exploratively can enhance only the operational support aspect of IS alignment (i.e., H_1), understanding business situations and flexible technology assets, as the common antecedents of both aspects of IS alignment, deserve more attention by scholars. One possible reason for this result is that the two IS assets can make it easier to mobilize business units to adapt to new ways of operations and strategic decision-making better supported by information systems [16,18]. Hence, the two IS assets still can have a direct effect on both aspects of IS alignment by inducing the necessary business adaptations. Consequently, this study encourages researchers to explore the nature of business adaptive capability and its impact on IT-business alignment in the future.

6.2. Managerial implications

This study offers several managerial implications. First, our research finds that adapting information systems both exploitatively and exploratively can facilitate IS alignment in terms of operational support. Accordingly, IT departments need to carry out activities to enhance or refine existing IT applications. IT departments also need to experiment on new IT applications that may meet future business demands. With such endeavors, IT departments would possess greater capacity to adjust information systems in response to both incremental and radical environmental changes and thus improve the IS support for business operations. Second, this study reports that IT departments need to nurture human and technological IS assets in order to improve their dynamic managerial capability for achieving IS alignment. Specifically, we suggest that IT departments recruit or promote IT personnel who are characterized by understanding business situations, acquiring new technology skills, and interacting with users. These practices could enhance IT departments' capacity in managing the tension between exploitative and explorative IS activities. Furthermore, we suggest that IT departments develop flexible technology assets such as shareable hardware/software platforms and reusable IS modules. Such technological IS assets would relieve IT departments from the inflexibility of reconfiguring existing information systems for IS exploitation and IS exploration. Third, we also suggest that IT departments leverage the four IS assets to improve IS alignment. It is particularly advised to focus on understanding business situations and flexible technology assets because our research shows that the two IS assets are the major means that IT departments can draw upon to enhance the strategic decision support aspect of IS alignment.

7. Conclusion

This study is only a preliminary step toward an understanding of IS assets, IS ambidexterity, and their relationships with IS alignment. Similar to other studies, this study also has some limitations. First, all data were collected from a single respondent with perceptual measures. Although our findings may help in explaining the relationships between the variables, we are aware that responses from multiple respondents would be better for understanding the real relationships. Second, PLS was used to analyze the data because it allows for smaller sample sizes without loss of power. However, a larger sample size would make it possible to adopt a covariance-based method for testing the overall model fit. Third, as pointed out by one of the reviewers, the mean values of UBS, IU, and OPS (4.309, 4.123, and 4.008), as shown in Table 3, appear to be high, given that the five-point Likert scales were adopted. A possible interpretation is that our sample did not include responding firms that held less positive stances on UBS, IU, and OPS. This might cause the problem of "restriction of range" of the studied variables, which could make correlation and beta coefficients biased downward [99]. In addition, this study adopted random sampling to collect survey data. It is thus also possible that the high mean values reported by the respondents reflected that the companies in the population tend to exhibit higher levels of UBS, IU, and OPS in the real world. Because both these cases are possible, we suggest that our findings should be interpreted with caution. Fourth, as shown in Fig. 3a and b, the post hoc analysis showed that firms pursing IS ambidexterity achieve greater IS alignment only in terms of the operational support aspect (not in terms of the strategic decision support aspect) than firms pursuing only either IS exploration or IS exploitation. Future research should try to seek stronger evidence that can explicitly and statistically show that pursuing IS ambidexterity would outperform pursuing either IS exploration or IS exploitation.

This study also points out avenues for future research. For example, this study focuses on examining whether dynamic managerial capabilities of the functional unit (i.e., IT department) influence IS alignment (i.e., IT-business alignment from the viewpoint of IT department). Future research may broaden the scope by studying whether the dynamic capabilities of the organization influence IT-business alignment. Besides, this study examines only the combined dimension of IS ambidexterity, which operationalizes ambidexterity as the product of exploitation and exploration [55]. Future research may examine the balanced dimension of IS ambidexterity, which is more meaningful to smaller firms or firms that operate in less munificent environments [58]. Prior research also has suggested several solutions (e.g., structural, contextual, and leadership) for attaining ambidexterity. Future research might want to draw upon these solutions to identify different sets of antecedents for IS ambidexterity. In addition, using a single respondent (such as IT managers) to answer both departmental and organizational questions might introduce bias. Future studies may have business managers to assess the questions related to IS alignment. Finally, because our study demonstrates only the effects of dynamic capabilities on IT-related achievements, future research may explore how the dynamic capabilities of IT departments will contribute to other strategic factors in firms.

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Appendix A. Measurement Items and Sources

Construct	Dimensions	Measurement items	Sources
	Understanding Business Situations	(UBS1) IT staff understand the business environment they support. (UBS2) IT staff understand the primary operations in the firm. (UBS3) IT staff understand the business problems within the firm.	Ross et al. [63]; Bharadwaj [56]
	Acquiring New Technology Skills	(ATS1) IT staff closely follow the trends in current technology. (ATS2) There is a plan for acquiring skills in new technology. (ATS3) IT staff regularly invest in technical training.	
	Interacting with Users	(IU1) IT staff have the ability to work closely with IS users. (IU2) IT staff work well in cross-functional teams. (IU3) IT staff have the ability to work cooperatively in a cross-functional team.	
	Flexible Technology Assets	(FTA1) Our technology platform can add new applications rapidly. (FTA2) We can easily develop new applications through reusable components. (FTA3) Our IS modules can be easily applied to other applications.	Ravichandran and Lertwongsatien [62]
IS Ambidexterity	IS Exploitation	(ISXPL1) We regularly adjust existing IT applications. (ISXPL2) We frequently refine the provision of existing IT applications.	Jansen et al. [86]
	IS Exploration	(ISXPR1) Our IT supports demands that go beyond existing needs. (ISXPR2) We have the specific plans in extending IT applications. (ISXPR3) We regularly search for new IT applications in business operations.	
IS Alignment	Operational Support	(OPS1) Our information systems improve the efficiency of our day-to-day business operations. (OPS2) Our information systems support the coordination across functions and product lines effectively. (OPS3) Our information systems enable the users to perform detailed analyses of present business situations.	Chan et al. [8]
	Strategic Decision Support	(SDS1) Our information systems support detailed analyses of major business decisions. (SDS2) Our information systems facilitate strategic business planning. (SDS3) Our information systems help the users in modeling possible courses of action.	

Appendix B. Outer Model Loadings and Cross-Loadings

	1	2	3	4	5	6	7	8
1. Understanding Business Situations (UBS)								
UBS1	**0.754**	0.288	0.411	0.142	0.250	0.238	0.361	0.214
UBS2	**0.843**	0.159	0.510	0.243	0.345	0.293	0.388	0.290
UBS3	**0.803**	0.140	0.486	0.355	0.287	0.315	0.350	0.369
2. Acquiring New Technology Skills (ATS)								
ATS1	0.202	**0.774**	0.243	0.270	0.352	0.408	0.149	0.208
ATS2	0.158	**0.893**	0.205	0.382	0.546	0.555	0.267	0.287
ATS3	0.240	**0.857**	0.176	0.459	0.495	0.557	0.273	0.232
3. Interacting with Users (IU)								
IU1	0.576	0.267	**0.752**	0.218	0.272	0.228	0.376	0.250
IU2	0.513	0.207	**0.919**	0.321	0.391	0.295	0.432	0.312
IU3	0.453	0.163	**0.891**	0.292	0.386	0.245	0.336	0.292
4. Flexible Technology Assets (FTA)								
FTA1	0.272	0.452	0.318	**0.815**	0.506	0.496	0.366	0.387
FTA2	0.305	0.304	0.308	**0.837**	0.413	0.421	0.383	0.375
FTA3	0.208	0.350	0.182	**0.851**	0.381	0.459	0.305	0.422

5. IS Exploitation (ISXPL)								
ISXPL1	0.366	0.498	0.431	0.510	**0.958**	0.711	0.537	0.440
ISXPL2	0.341	0.578	0.356	0.499	**0.952**	0.704	0.436	0.357
6. IS Exploration (ISXPR)								
ISXPR1	0.280	0.282	0.231	0.387	0.492	**0.721**	0.346	0.287
ISXPR2	0.316	0.539	0.189	0.472	0.589	**0.841**	0.378	0.377
ISXPR3	0.274	0.616	0.310	0.483	0.706	**0.870**	0.425	0.343
7. Operational Support (OPS)								
OPS1	0.392	0.271	0.394	0.381	0.506	0.443	**0.889**	0.511
OPS2	0.416	0.263	0.432	0.327	0.413	0.401	**0.862**	0.551
OPS3	0.366	0.177	0.304	0.387	0.381	0.363	**0.822**	0.700
8. Strategic Decision Support (SDS)								
SDS1	0.372	0.249	0.365	0.435	0.400	0.361	0.724	**0.859**
SDS2	0.343	0.241	0.247	0.385	0.348	0.373	0.504	**0.899**
SDS3	0.242	0.269	0.251	0.411	0.341	0.348	0.510	**0.850**

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Jeffrey C.F. Tai is an assistant professor in the Department of Management Information Systems at National Chiayi University, Taiwan. He received his MBA and Ph.D. in Information Management from National Central University, Taiwan, Republic of China. His research interests include enterprise resource planning, supply chain management, electronic commerce, and organizational impacts of information technology. His research has appeared in Information & Management, MIS Quarterly, Journal of Management Information Systems, International Journal of Information Management, and others.

Eric T.G. Wang is Chaired Professor in the Department of Information Management at National Central University, Taiwan (R.O.C.). He received his Ph.D. degree in Business Administration, with a specialization in computer and information systems, from the William E. Simon Graduate School of Business Administration, University of Rochester. His research interests include electronic commerce, supply chain management, outsourcing, organizational economics, and organizational impact of information technology. His research has appeared in Information & Management, MIS Quarterly, Information Systems Research, Management Science, Journal of Management Information Systems, Decision Sciences, European Journal of Information Systems, Information Systems Journal, Decision Support Systems, Omega, European Journal of Operational Research, and others.

Hsi-Yin Yeh received her Ph.D. degree from National Central University, Taoyuan, Taiwan, in 2011. She is currently an assistant researcher at the STPI, National Applied Research Laboratories, Taipei, Taiwan (R.O.C.). Her current research interests include patent analysis, social network analysis, and organizational dynamic capability. She has published the papers in the international journals, including Scientometrics, Psychology and Marketing, and Journal of Technology Management.