# Organizational Mindfulness Perspective on Driving Enterprise System Adaptation and Organizational Agility

Neil Chueh-An Lee and Gloria Hui Wen Liu

***Abstract*—Nowadays enterprise system(s) (ESs) have become a pervasive digital platform and are widely utilized by firms. However, uncertain environments require firms continuously adapt their ES. ES adaptation involves the postimplementation changes of an ES to meet changing business needs. How firms adapt their ES to facilitate organizational agility remains an understudied issue. Drawing from the literature of organizational mindfulness, this article holds that firms need to foster organizational mindfulness—a firm's willingness and capacity to capture and refine discriminatory details about its environments—to facilitate ES adaptation and organizational agility. We build and test a model based on 138 responses of Taiwanese manufacturing firms. Our findings demonstrate that organizational mindfulness can help firms to achieve better ES adaptation and organizational agility. Specifically, organizational mindfulness can facilitate not only ES adaptation but also entrepreneurial and adaptive agility that is the offensive and defensive dimensions of organizational agility. ES adaptation is mainly related to entrepreneurial agility. This article contributes to the agility literature by proposing and testing a model of how organizational mindfulness affects ES adaptation and organizational agility.**

***Index Terms*—Adaptive agility, enterprise system (ES) adaptation, entrepreneurial agility, organizational agility, organizational mindfulness.**

## I. Introduction

FIRMS are facing an increasingly uncertain business environment nowadays. Increasing firms have relied on information technology (IT) to collect and analyze data to sense the environment and to provide services to respond to market demands [1], [2], [3], [4], [5], [6]. The IT-enabled sensing and responding capability of firms forms the foundation of organizational agility [7].

Manuscript received 28 April 2022; revised 23 November 2022; accepted 22 December 2022. This work was supported in part by the Ministry of Science and Technology of the Republic of China (Taiwan) under Grant MOST 107-2410-H-130-021. Review of this manuscript was arranged by Department Editor T. Daim. *(Corresponding author: Gloria Hui Wen Liu.)*

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Color versions of one or more figures in this article are available at https://doi.org/10.1109/TEM.2023.3234174.

Digital Object Identifier 10.1109/TEM.2023.3234174

Enterprise system(s) (ESs) have become a pervasive digital platform and are widely utilized by firms to achieve organizational agility [8]. However, given the uncertainties in the environment, firms can never foresee all contingencies and design their ES for good and all [1], [9]. Firms that are capable of transforming anomalous events into useful business insights and action plans, and adapt their ES accordingly will be able to remain agile [7], [9], [10], [11]. ES adaptation, i.e., the postimplementation change of an ES to meet changing business demands [12], [13], [14], therefore, would be a critical driver of organizational agility [2], [3].

ES, however, cannot adapt or renew by themselves [10], [15], [16]. This raises a question: What factor will drive ES adaptation? We argue that a collective mindful mindset, that is, organizational mindfulness, will facilitate ES adaptation. Organizational mindfulness refers to a firm's willingness and capacity to capture and refine discriminatory details about its environments [17]. Firms with a mindful mindset are likely to discover insights, cues, or opportunities from data, reality details, and unintended or unexpected situations [17]. We argue organizational mindfulness will help firms adapt ES proactively, thereby enabling organizational agility.

This article draws upon the perspectives of organizational mindfulness to develop a research model to examine how organizational mindfulness helps firms adapt their ES to achieve agility. Our result demonstrates that organizational mindfulness enables organizational agility directly and indirectly through facilitating ES adaptation. This article contributes to the literature in two respects. First, we demonstrate the importance of organizational mindfulness in enabling ES adaptation and agility. Past literature emphasizes the role of IT in driving agility [1]. There is a general negligence that IT by itself cannot deal with any unforeseeable contingencies. It is people in the firm (i.e., managers and employees) who must be mindful of what is happening and respond accordingly. This article thus empirically demonstrates that organizational mindfulness is an important antecedent of ES adaptation and organizational agility.

Second, IT such as ES can become outdated. Adapting IT to fulfill emergent demands is thus critical to achieve organizational agility. Prior agility research in the information systems field often emphasizes the importance of various IT capabilities in driving agility based on the perspectives of resources-based view and dynamic capabilities view [1], [18]; it is generally

ignored that IT applications (e.g., ES) can create inertia and require adaptation. In this article, we introduce ES adaptation as an important driver and uncover its effect on agility.

The remainder of this article is organized as follows. We review literature in organizational agility, ES adaptation, and organizational mindfulness. We next develop the research hypotheses and model. The research methods and measurements are described, followed by the data analysis. Then, the managerial and research implications, future research directions, and limitations are discussed. Finally, conclusions are presented.

## II. Theoretical Background

### A. Organizational Agility

Organizational agility refers to a firm's capability to sense and respond to shifting market forces in a timely manner [19]. It is widely found to help firms seize opportunities and handle threats effectively and efficiently [1]. Researchers recently identify two dimensions of organizational agility, including the offensive and defensive one [20]. Entrepreneurial agility, i.e., the offensive organizational agility, refers to the firm's ability to anticipate and seize market opportunities proactively [20]. Entrepreneurial agility thus allows a firm to modify its positioning and strategies and organize new business approaches to gain early advantages in changing conditions [20]. For example, Dell sensed its limitation on creating new products and services. Anticipating increasing client engagement in product design, Dell established IdeaStorm in 2007, a crowdsourcing community, that allows a new strategy to engage consumers in suggesting, discussing, and voting for new ideas. Dell thus was able to obtain and implement hundreds of new ideas to improve and innovate their products and services [21].

In contrast, adaptive agility, i.e., the defensive organizational agility, refers to the firm's ability to detect and respond to market dynamics or adversaries to protect itself and remain resilient [20]. Adaptive agility allows firms to recover from disruptions in market forces, without any fundamental change in the internal structure or organization [20]. Take FreightX as an example [20]. FreightX, an electronic marketplace, connects shippers and carriers in an increasingly fragmented transportation industry. FreightX sensed that the transportation industry began moving away from electronic marketplaces and toward long-term, prenegotiated contracts, which would hurt its revenues. In response, FreightX cooperated with clients to develop customized electronic trading communities that allowed shippers to manage multiple preselected carriers. The system helped shippers evaluate and select optimizer freight options based on their prespecified criteria. The system optimized FreightX's existing practices and processes without fundamentally changing its strategy. FreightX thus could avoid adverse impacts that could have brought forth by such disruptions in its industry [20]. Prior articles generally demonstrate that organizational agility can facilitate firm performance [1], [22], [23], [24].

### B. Effects of IT on Organizational Agility in the Literature

Prior articles have demonstrated that IT can enhance a firm's sensing and responding capabilities, thereby driving organizational agility [1], [5], [6]. Two streams of research are found in the literature. The first stream emphasizes the deployment of advanced IT infrastructure to drive organizational agility. For example, firms can detect, process, and communicate information in a flexible and timely manner via the use of shareable/cloud platforms, IoT, business analytics, artificial intelligence, communication services, or application portfolio and services [2], [3], [4], [6], [25], [26], [27], [28], [29], [30]. This is because such IT infrastructure is developed on the basis of shared data and information [1]. With such IT infrastructure, firms can quickly sense market needs and trends, and flexibly deploy possible applications in response to market opportunities, resulting in greater agility [1].

The second stream focuses on the adoption of appropriate IT management approaches to enhance firms' sensing and responding capabilities, including the IT-business alignment approach [9], [19], [31], the IT department identity approach [32], the IT governance approach [33], the IT ambidexterity approach [34], [35], or the IT/digital skills [23]. For example, Lee et al. [34] demonstrated that using existing IT resources and practices while experimenting with new IT resources and practices (i.e., the IT ambidexterity approach) enables firms to maintain operational efficiency and produce innovative response, thereby resulting in organizational agility. Also, Liang et al. [9] and Hu et al. [36] demonstrate that IT's and business executives' mutual understanding of and joint commitment to each other's mission, objectives, and plans can help firms to realize informal communication, information exchange, and orchestrated collaboration (i.e., the IT-business alignment approach), achieving organizational agility in dynamic environments. Likewise, Rozak et al. [23] suggested that managers and employees alike must have sufficient digital skills to harness digital technology for improving organizational agility (i.e., the IT/digital skills approach).

However, given the changing business environment, IT such as ES can become obsolete quickly [37] and prevent firms from adapting to their environment [9], [35], [38], compromising organizational agility. While the ES relies on people for effective adaptation [10], [15], [16], how people adapt ES remains understudied in the literature.

### C. ES Adaptation and Organizational Mindfulness

The ES[1] is designed to automate and integrate processes, collect data, support information flows, and analyze business information [11]. The ES is often a major IT investment and has become pervasive [8]. Firms heavily rely on their ES to enable agile operation [8].

Th ES that standardizes the formats of data and information and modularizes the subparts of a functionality to attend to departmental demands [39] can serve as a common platform across a firm [39], [40]. Different departments thus can use the same ES to achieve their distinct task demands, and at the same

[1]In this article, enterprise system(s) refer to organization-wide applications, including enterprise resource planning (ERP), customer relationship management (CRM), supply chain management (SCM), business intelligent (BI), data warehousing, and any application components of the software platforms on which these applications are built, such as SAP's NetWeaver.

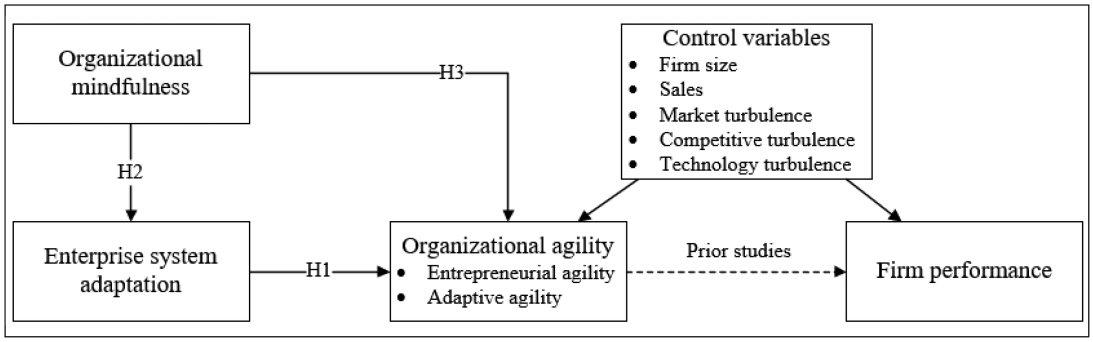


Fig. 1. Research model.

time, maintain their interconnections [40], and share information and knowledge.

However, as the ES becomes a common platform, it also reinforces operation stability and can run the risk of incurring rigidity [11], [40]. This creates inertia that forces firms to stick with existing ES and attendant resource investments [35], [38]. Organizational change thus can be impeded.

Facing an increasingly uncertain business environment, firms need to adapt their strategies, tactics, and operations across functional departments [35], [41]. This thus can cause the failure of existing ES [38]. Accordingly, an ES needs to be adapted quickly to support new organizational activities and to meet functional departments' emergent demands [9], [35].

Yet, there is insufficient attention on how ES actually adapt and what has driven the adaptation in prior articles [1]. Based on the perspective of organizational mindfulness, we argue firms rely on people to detect anomalies and opportunities to adapt ES so as to come up with digital innovations to deal with their changing environment [1], [7]. Wang et al. [32] indicated that how people in the firm collectively make sense of their world is important for the firm to achieve organizational agility. Indeed, according to the Capgemini CIO survey [16], 49.5% of surveyed CIOs worldwide agreed people are the most important organizational element than information systems (23.8%) and business processes (26.7%) for achieving agility. Likewise, Seo and La Paz [42] mentioned that *Organizations can be agile if managers and individuals are agile, because the collection of individual mindful agility becomes part of organizational agility.* Management thus needs to foster the right mindset for individuals to explore possibilities that may contribute to organizational agility [16], [32]. A mindful organization thus can extract useful cues and insight from data, reality, and unintended or unexpected situations to better integrate business processes and develop appropriate strategies and actions to respond to their environment. We contend that organizational mindfulness can enable both ES adaptation and organizational agility. Prior articles have suggested the positive relationship between organizational agility and firm performance because agility can help a firm to expand its repertoire of competitive actions and the nature of its feasible responses to environmental change [1], [2], [3], [19], [20], [31]. We thus also examine such positive relationship. Our research model is proposed as shown in Fig. 1 and explained below.

## III. Hypothesis Development

### A. Enterprise System (ES) Adaptation and its Effects on Organizational Agility

ES adaptation refers to the postimplementation change of an ES to meet changing business demands, including functional upgrades or continual enhancement of said ES [12], [13], [14]. ES adaptation thus can 1) bring new features and/or 2) improve existing features to make an ES meet changed business demands [13], [14]. ES adaptation excludes infrastructure upgrade that migrates an implemented system to a new platform, without implementing new functionality to change user behavior or business processes [11], [14].

ES adaptation prevents ES from becoming core rigidities in the firm [8]. An adapted ES thus can be deployed continuously to meet emergent information and business needs of a firm and its individual functional departments [1]. Failure to adapt an ES, in contrast, impedes coordination and cooperation and thereby organizational agility.

ES adaptation can facilitate organizational agility via two means, namely via enhancing entrepreneurial agility and adaptive agility. Entrepreneurial agility involves a firm's reconfiguring its business processes and positioning to seize potential opportunities [20]. Adapting ES ensures system functionalities synchronize with new strategies, positioning, and processes [2]. For example, in order to absorb changing customer demands, the marketing department of Danisco, a Danish bio-based company, developed a new CRM to support its new growth-by-acquisition strategy [43]. That is, ES adaptation ensures that Danisco's ES meets their new marketing needs. New functionalities brought by ES adaptation, such as business analytics [29] and cloud computing [30], thus provide required information and service to support proactive marketing initiatives [8], thereby enhancing entrepreneurial agility.

*Hypothesis 1a: ES adaptation is positively related to entrepreneurial agility.*

In contrast, adaptive agility involves a firm's recovery and bounce-back from disruptions caused by market forces (e.g., new market trends, disasters, and government policies). ES adaptation can provide better system functionalities to help a firm handle a wide range of foreseeable scenarios, and quickly recover from its market mistakes and faults [20], [44]. Through

continuously satisfying information and business needs of functional departments, ES adaptation helps motivate better assimilation of ES use across the firm [44]. As a result, this improves the firm's ability to better serve its clients and prospects [7], [8], [11]. This facilitates the firm to quickly and easily mobilize organizational resources/capabilities for disruption recovery [8], increasing adaptive agility. Therefore, we propose

*Hypothesis 1b: ES adaptation is positively related to adaptive agility.*

### B. Organizational Mindfulness and Its Effects on Enterprise System Adaptation

Organizational mindfulness refers to a firm's willingness and capacity to attend and capture discriminatory details about its environments, to continuously refine and differentiate the details based on newer experiences, and to make sense of those details [17], [45]. That is, mindful firms can capture more subtle cues from data, information, and reality, and interpret them as being associated with underlying significant phenomena. Organizational mindfulness thus may help firms comprehend and realize potential opportunities, and respond appropriately.

Weick and Sutcliffe [17] specified five interrelated processes that make up organizational mindfulness, namely processes associated with a firm's preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise. First, preoccupation with failure captures the need for continuous attention to anomalies that could be symptoms of larger problems in a system. Preoccupation with failure involves the organization's sensitivity to the possibility of failures, attention to small failures, willingness to encourage the reporting of mistakes, and openness to the discussion of problems [46]. Thus, when minor glitches happen, mindful firms consider them as potential symptoms of a larger problem or opportunities rather than as isolated, local events. For example, a firm provides venues for employees to openly exchange and discuss personal experiences with business process failures and how ES can be adapted to support them.

Second, *reluctance to simplify* means refusing to use simplified worldviews or previously established informational categories to filter and organize new information [46]; it involves developing a nuanced and current understanding of the context by frequently questioning the adequacy of existing assumptions and considering reliable alternatives [47]. Mindful firms thus tend to attend to anomalies or surprises and strive to understand them [46]. For example, employees in a firm constantly challenge existing business activities and ES functionalities.

Third, *sensitivity to operations* involves maintaining situational awareness and a vivid sense of details [46]. It is a focus on actuality rather than intentions. This means that mindful firms pay more attention to what is actually happening in organizations, not what is supposed to be happening [17]. For example, employees as well as management are constantly asked to act based on factual evidence, rather than their gut feelings.

Fourth, *commitment to resilience* involves the ability to correct errors quickly and accurately before they have a chance to worsen and cause more serious harm. Resilience involves recognizing the inevitability of setbacks, and coping with and learning from errors [46], [47]. Resilient firms thus are capable of improvising and bouncing back from setbacks quickly. For example, shop floor workers in a factory are empowered to take any measures to solve production problems as they see appropriate [48].

Finally, *deference to expertise* is the tendency to utilize individuals with particular knowledge regardless of their status, tenure, or rank. It recognizes that authority does not equate to expertise [17], [46], [47]. Deferring to expertise thus pushes decisions down to the lowest levels possible. For example, provided with a map of individuals' talents and skills, employees and management alike are encouraged to seek help from experts whenever problems arise, regardless of their positions.

We argue that organizational mindfulness can lead firms to discover opportunities to further improve their ES. Mindful firms are willing to face possible problems and shortcomings of, and misalignments in ES that can compromise system performance and organizational activities [49]. They mindfully consider functional departments' emergent needs with regard to ES functionalities without being constrained by authority [17] or past experiences or existing knowledge [46]. Mindful organizations are open to innovations and surprises, continuous learning, and unanticipated complications [49]. Therefore, mindful firms are more willing to implement new systems or modules to respond to their business needs and opportunities [44]. Mindful firms also encourage their decision-makers to evaluate the state of preparedness and scan the whole environment before ES improvement and enhancement projects, reducing the risk of project failure [45]. Consequently, mindful firms are more likely to take reasonable action to adapt their ES [44]. Hence, we propose

*Hypothesis 2: Organizational mindfulness is positively related to ES adaptation.*

### C. Effects of Organizational Mindfulness on Organizational Agility

Achieving organizational agility requires firms to scan business events that manifest significant market changes. Significant market changes are those changes that may cause changes to firms' strategy, competitive action, and performance [26]. Firms thus need to acquire and interpret relevant information to redefine their opportunities and threats [20], [26].

Mindful firms can capture reality details and interpret them as being associated with potentially significant benefits or losses [17]. They can discover emerging market changes from routine business events because significant phenomena often begin with small symptoms that are difficult to notice. Mindful firms do not fall prey to established knowledge [46]. They thus can avoid filtering possible cues and details, correctly interpret potential important information, and take actions swiftly and proactively, leading to entrepreneurial agility.

*Hypothesis 3a: Organizational mindfulness is positively related to entrepreneurial agility.*

Organizational agility also requires firms to quickly and correctly take a set of activities to recover from disruptions (i.e., adaptive agility) [20]. With the sensitivity to actual situations, business activities, and disruptions [17], [46], [47], mindful firms can respond quickly. This could minimize adverse impacts of disruptions quickly before the disruptions have a chance to cause significant failure. By effectively utilizing employees' knowledge, mindful firms can enlarge their knowledge base and response repertoires to disruptions [45]. Mindful firms with loosening hierarchical constraints can also handle new disruptions and problems via easy access to diverse expertise of employees. The migration of decision-making along with problems down the hierarchical echelon thus increases the success of responding activities, and benefits firms' adaptive agility. Accordingly, we propose

*Hypothesis 3b: Organizational mindfulness is positively related to adaptive agility.*

## IV. Research Methodology

### A. Instrument Development

Our data were collected with a carefully developed self-report survey instrument. We developed and validated our measures using the guidelines in the IS literature [50]. We first reviewed prior articles to develop measures that were suitable for the current article to ensure a minimal overlap between constructs and their face validity. In order to establish content validity, the measurement items were independently evaluated by each of the researchers. The researchers then jointly discussed each construct and its items until they agreed on the appropriateness of all the measures. After compiling an English version of the questionnaire, the survey items were first translated into Chinese by a bilingual researcher, and then verified and refined for translation accuracy by two MIS professors. The Chinese version of the draft was pretested with two senior business executives for ensuring face and content validity again, resulting in wording modifications of some survey items. We operationalized the constructs using multi-item reflective measures with a seven-point Likert scale. The measures are provided in Appendix A and discussed below.

*Firm performance* is operationalized as a subjective measure of the extent to which the profits, return on investment, sales, growth, return on assets, equity, and market share have been achieved [51], [52], [53]. Past articles have measured firm performance using either archival measures such as return on equity and return on assets or subjective measures based on respondents' perception of performance relative to competitors [54]. While archival performance data of listed Taiwanese firms can be retrieved from public sources, performance data of private companies cannot be retrieved [54].[2] We adopted subjective performance measures due to the inclusion of private companies in our sample frame. This is consistent with prior articles in which subjective performance measures are administered to top management [2], [3], [24], [51], [55]. Further, we collected archival performance data to cross-validate the subjective measures of firm performance. Our findings demonstrate significant correlation between the subjective performance measures and archival performance data (see Appendix D for details).

*ES adaptation* items were developed based on our definition and previous articles of ES upgrade and enhancement [12], [13], [14]. The respondents were asked to assess the degree to which a recent ES adaptation (such as an ERP) has been implemented to meet their business demands in three types of activities [44], namely strategic activities, primary, and supportive activities on the firm's value chain. However, firms may not adapt ES functionalities for all business activities because some business activities may not exist. For example, raw materials manufacturers may not engage in many branding activities, whereas such activities can be essential for consumer product manufacturers (e.g., Unilever). Thus, we followed the approach of Mu et al. [44] in which respondents were also asked to indicate whether a specific business activity was critical to the firm (coded as 1 or 0, respectively). Only the activities identified as critical were used to create the measure of ES adaptation for each firm. The critical activities of a specific type (e.g., strategic activities) were averaged to obtain a single value to reflect ES adaptation of that type. Consequently, ES adaptation was measured by items of the three activity types (i.e., strategic, primary, and supportive activities) and an overall ES adaptation rating.

The measures of *entrepreneurial agility* and *adaptive agility* are adopted from Chakravarty et al. [20]. Four items were used to measure entrepreneurial agility, that is, the degree to which a firm proactively capitalizes on impending market change. Similar to entrepreneurial agility, four items were utilized to measure adaptive agility, that is, the degree to which a firm reacts to an eventuality by buffering itself and correcting for disruptions without requiring major strategic changes.

*Organizational mindfulness* measures the extent to which a firm has characteristics of the five interrelated mindfulness processes [56]. Six items were adopted from Nwankpa and Roumani [49].

We include five control variables about organizational and environmental characteristics in our model. They are firm size, sales revenues, competitive turbulence, market turbulence, and technology turbulence [57], [58]. Firm size and sales are related to a firm's resources and may affect organizational agility and firm performance. Prior articles have suggested that organizational agility is more relevant when a firm operates under turbulent environments [24], [26]. Thus, competitive, market, and technology turbulences are controlled.

### B. Data Collection

A cross-sectional mail survey was administrated for collecting data from the top 1000 manufacturing firms based on the Year 2017 Directory of the Top 5000 Largest Firms in Taiwan. We surveyed Taiwanese manufacturing firms for four reasons. First,

[2]Prior articles have demonstrated that subjective measures are also valid and reasonable [54]. Wall et al. [54] found supportive evidence by comparing performance data collected using subjective measures with that of archival data. They argue that subjective measures are generally directed at respondents at top management level, "for whom financial considerations of the kind captured by objective measures are likely to dominate their view of company performance" [54].

TABLE I
PROFILE OF THE RESPONDENTS ($N = 138$)

| Industry | No. | % | Number of employees | No. | % |
|---|---|---|---|---|---|
| Automobile | 4 | 3 | 1–250 | 38 | 28 |
| Chemical | 23 | 17 | 251–500 | 37 | 27 |
| Computer and electronics | 44 | 32 | 501–1,000 | 30 | 22 |
| Food | 6 | 4 | 1,001–2,000 | 24 | 17 |
| Machine and tool | 13 | 9 | >2,000 | 9 | 7 |
| Metals and materials | 32 | 23 | | | |
| Textile | 6 | 4 | | | |
| Others | 10 | 7 | | | |

the origins of agility concepts emerge from studies that examine manufacturing industries [5], [6]. Second, Taiwan has been well known for its manufacturing prowess and plays a critical role in global supply chains [59], [60], [61], especially in the sectors of electronics, IT products, metals, chemicals, textiles, and industrial machinery. It is home to some of the largest manufacturers in the world, such as TSMC, Acer, Formosa Plastics, and Giant [60]. Third, Taiwanese manufacturing firms face changing geopolitical and geoeconomic environments [59]. With China's rise, many Taiwanese manufacturing firms migrated their factories to mainland Chain and delivered products to global customers [61]. However, since 2018, the Sino-U.S. trade wars and tensions between Washington and Beijing put Taiwanese manufacturing firms in a dilemma position [59], [60]. Competition from neighbors, such as South Korea, has also spurred on the development of agility of Taiwanese manufacturing firms [60]. These factors make organizational agility important for the survival of Taiwanese manufacturing firms. Finally, Taiwan, a collectivism country, has different management cultures and styles from Western countries (i.e., individualism) [62]. This may compromise the generalization of organizational research conducted in Western countries [63]. While prior articles on organizational agility have mainly been conducted in various contexts of Western countries [1], [5], [18], it is worthwhile to extend to different cultural contexts [22]. Taiwan, thus, provides a good research site for studying organizational agility.

We distributed our survey to business executives due to their critical role in responding to market demands. After accounting for undelivered and invalid mails, the effective mailing was 947 firms. After one follow-up mailing, 138 valid surveys were returned in total, yielding a response rate of 14.57%. Although the response rate is not high, it is still acceptable to examine our model using partial least squares (PLS) [64]. Table I exhibits the characteristics of the sample. As the production value of the computer and electronics industries has contributed one-third of Taiwan's GDP and these firms are more advanced in utilizing information and communication technologies, 32% of the respondents are from these industries. Chemical, machine, metals, and materials account to around 10% to 20% in the sample.

Nonresponse bias was assessed using the procedure recommended by Armstrong and Overton [65]. Considering the last group of respondents as most likely to be similar to nonrespondents, a comparison of the first and last quartile of the respondents provides a test of response bias. No significant differences between the first and last quartile of all samples were found on our key research variables based on the $t$ test. Accordingly, nonresponse bias should not be a serious concern in this article.

Common method variance (CMV) was tackled by two approaches. First, we used Harmon's single-factor test to detect CMV [66]. Eight factors with an eigenvalue >1 were extracted and collectively accounted for 77.6% of the variances in the data, with the first factor accounting for 19.3% of the variances, which indicates that CVM was not a serious problem. Second, we incorporated the measured latent marker variable (MLMV) in our survey to detect and correct for CMV while using PLS [67]. This approach requires collecting multiple items that have no nomological relationship with the research items. We followed Chin et al. [67] and carefully selected MLMV indicators. We adopted the items used to measure "trying new features" in Microsoft Office and slightly modified the targeted software to Microsoft Word, which has more widespread use in companies [68]. We then conducted the construct level correction approach to partial out the CMV effects at the structural model in our data analysis. Therefore, the more accurate estimates of the structural paths can be obtained. By using this method, we also did not observe any significant path coefficient that turned insignificant after further analyses. This informed that CMV has less influence on our research model.

### C. Data Analysis and Results

A PLS structural equation model using SmartPLS Version 3.3.2 was constructed for measurement assessment and hypotheses testing. We estimate the outer model through PLS algorithm with the path weighting scheme, and the inner model through consistent PLS (PLSc) algorithm. According to Dijkstra and Henseler [69], PLSc avoids the excessive amount of Type I and Type II errors that can occur if traditional PLS is applied to estimate structural equation models with reflective measurement models. Thus, we adopted PLSc algorithm in hypothesis testing.

### D. Measurement Validation

We assessed the validity and reliability of the items and constructs according to the guidelines from Hair et al. [64]. Outer loadings for all items were higher than 0.7 and significant at 1% level. The rho_A, composite reliability, and Cronbach's alpha estimates, reported in Appendix B, were above 0.7 for all constructs, indicating good internal consistency and the reliability of the scales [64]. We further assessed the convergent validity of our constructs based on average variance extracted (AVE). The AVE of each construct exceeded the minimum threshold value of 0.5 [64]. The combined results demonstrated convergent validity of the constructs.

Discriminant validity is established when 1) items load more highly on the construct that they are intended to measure than on other constructs, 2) the square root of the AVE by each construct is larger than the interconstruct correlations [64], and

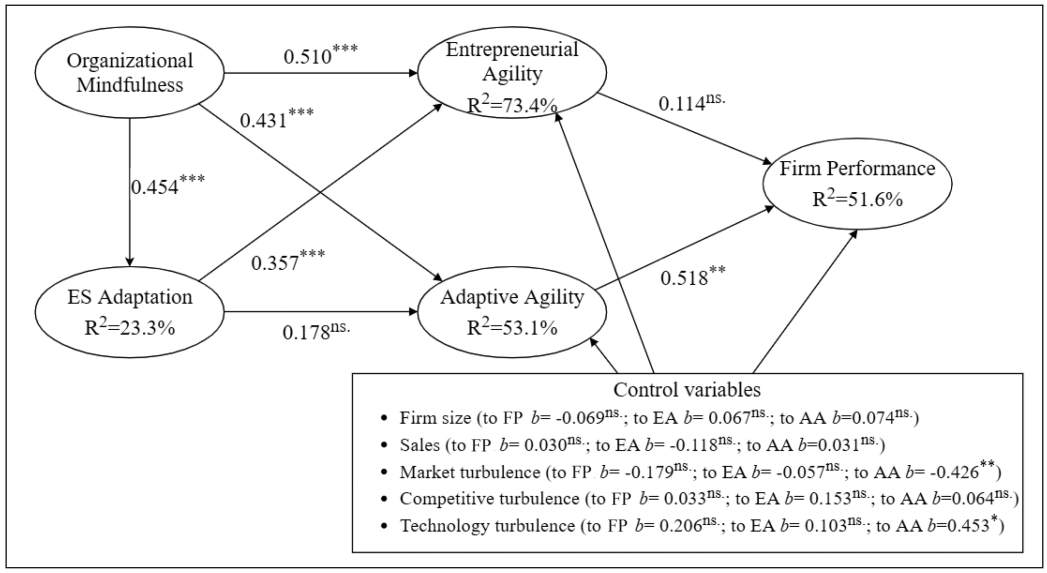


Fig. 2. Structural model. Note that $p < 0.05*$; $p < 0.01**$; $p < 0.001***$; $p > 0.05$ ns. We hide the MLMV constructs in order to simplify the figure.

3) the Heterotrait–Monotrait ratio of correlation (HTMT) is significantly smaller than 1. Cross-loadings were computed by calculating the correlations between a latent variable's component scores and the manifest indicators of other latent constructs [64]. Without exception, all items loaded more highly on their own construct than on other constructs. As shown in Appendix B, the square root of the AVE for each construct was greater than the correlations between the construct and other constructs, indicating that all the constructs shared more variances with their indicators than with other constructs. All HTMT values, shown in Appendix C, were significantly smaller than 1 with 95% confidence interval (CI), indicating clear discriminant between two constructs. Thus, our measures exhibited sufficient discriminant validity.

### *E. Structural Model*

We first assessed multicollinearity by examining each set of predictor constructs separately for each subpart of the research model [64]. In our model, all the variance inflation factors of endogenous constructs are less than two which is well below the five threshold [64], indicating no multicollinearity problem in our model.

To assess the significance of the path coefficients in the inner model, SmartPLS was applied to generate 10 000 samples using a bootstrapping technique with the settings of PLSc, no sign changes, a path weighting scheme, percentile bootstrap CI, connecting all latent variables for initial calculation, and two-tailed test [64], [69], [70]. The full model has an $R^2$ of 51.6% for firm performance, 53.1% for adaptive agility, 73.4% for entrepreneurial agility, and 23.3% for ES adaptation. With omission distance equaling 5, all the cross-validated redundancy $Q^2$ values of endogenous constructs are larger than zero, indicating predictive relevance [64]. Fig. 2 shows the result of structural model estimation.

Our results demonstrate that while adaptive agility has a significant positive effect on firm performance ($\beta = 0.518$; $p < 0.01$), entrepreneurial agility shows an insignificant effect ($\beta = 0.114$; $p > 0.05$). ES adaptation positively affects entrepreneurial agility (support H1a; $\beta = 0.357$; $p < 0.01$) but fails to affect adaptive agility (not support H1b; $\beta = 0.178$; $p > 0.05$). Our analysis also reveals that organizational mindfulness is significantly associated with ES adaptation (support H2; $\beta = 0.454$; $p < 0.01$). Finally, organizational mindfulness has a positive effect on both entrepreneurial agility (support H3a; $\beta = 0.510$; $p < 0.01$) and adaptive agility (support H3b; $\beta = 0.431$; $p < 0.01$). For the control variables, market turbulence negatively affects adaptive agility ($\beta = -0.426$; $p < 0.01$); technology turbulence positively affects adaptive agility ($\beta = 0.453$; $p < 0.05$); other relationships are insignificant. Overall, we found support for four of five hypotheses in the research model.

### *F. Post Hoc Analyses*

Because the high-technology manufacturing sector (e.g., computer and electronics) and the traditional one (e.g., food, machine, and tool) can have different competition dynamics [71], we regrouped our sample and separately tested them. The *traditional sector* included manufacturers from automobile, chemical, food, machine and tool, metals and materials, and textile ($n = 84$) and the high-tech sector included those from computer and electronics ($n = 44$). The results of the *high-tech sector* are consistent with those of the full dataset.[3] However, the traditional sector sample demonstrates that ES adaptation is

[3]In the post hoc analyses, we dropped control variables to simplify research model because of the minimal sample size requirement of PLS. We generated 10 000 samples using a bootstrapping technique with the PLS algorithm, a path weighting scheme, BCa bootstrap CI, and two-tailed tests. The results of the high-technology manufacturing sector show that all path coefficients are significant at $p < 0.05$ except for the effect of entrepreneurial agility on firm

effective to achieve adaptive agility ($\beta = 0.238$; $p < 0.05$).[4] We discuss these results in detail in the following section.

### G. Discussion of Results

Although prior articles generally demonstrate that organizational agility improves firm performance [1], our data show a different picture, inconsistent with Chakravarty et al. [20] who demonstrated that while entrepreneurial agility improves firm performance, adaptive agility does not. Instead, our results indicate that while adaptive agility facilitates firm performance, no such effect exists for entrepreneurial agility. There are two possible explanations. First, the research sample in Chakravarty et al. [20] focuses on the B2B (i.e., business to business) electronic marketplace players, including independent electronic marketplaces, infrastructure providers, and industry-sponsored markets. Due to its high digitalization level and low searching cost for customers, the B2B electronic marketplace is characterized with low switching cost and high customer churn rate. Facing such situations, e-marketplace providers thus have to continuously (re)configure their strategies and positionings to retain their customers and maintain competitive advantage. That is, it requires better entrepreneurial agility to survive in the B2B electronic marketplace. In contrast, our research sample mainly consists of manufacturing firms. Their main strategic objective is to maintain production efficiency and stable product quality. Adaptive agility thus is factored in significantly, with the ability to recover from disruptions in market forces (i.e., adaptive agility) playing a more relevant role.

Second, entrepreneurial agility allows firms to modify its positioning and strategies and organize new business approaches. However, according to prior articles [24], [52], these modifications require time to transform into performance, especially financial performance. For example, Clauss et al. [24] found that business model innovation is a key mediator between strategic agility and firm performance. Ganguly et al. [72] also demonstrated that disruptive innovation is a key outcome of organizational agility. This means that the firm with entrepreneurial agility may obtain greater performance through modifying its business model or implementing disruptive innovation, which takes time to translate into financial performance in the future rather than at present. Given the cross-sectional nature of our research design, our data may not be able to capture the real effect of entrepreneurial agility on firm performance. Future article may collect longitudinal data to explore if and how such factors as business model innovation and disruptive innovation mediate the relationship between organizational agility and organizational performance over time.

Our research results further show that ES adaptation enables entrepreneurial agility (H1a) but not adaptive agility (H1b). One possible reason may be that we conceptualize ES adaptation mainly to include new features and improvement of existing features to meet business demands. These demands may be raised by new opportunities, strategies, and processes the firm anticipated or implemented. That is, ES adaptation may be essentially a better match for firms' exploration strategy [33], [35]. Thus, an adapted ES can better support entrepreneurial agility as our results have demonstrated. Our results may also shed some light to the research stream of IT ambidexterity in which prior articles do not deliberate on how IT exploration and exploitation influence offensive and defensive agilities separately and jointly [33], [35]. This article differentiates the effects of ES adaptation on different types of organizational agility and suggests that ES adaptation under our conceptualization is more related to offensive agility. These findings somehow imply that while IT exploration may contribute to offensive agility, IT exploitation may facilitate defensive agility. Future article may further explore different types of IT adaptation and their effects on offensive and defensive agilities.

Our second reason is that due to inertia, firms tend to rely on workarounds (e.g., manual information processing or usage of other shadow software) to cope with misalignment between ES functionalities and changing business needs [35] until crises occur or new business needs suddenly arise. This means that ES adaptation tends not to be consciously implemented to support adaptive agility. For firms to consciously adopt ES adaptation for developing adaptive agility, it requires mechanisms to overcome such inertia. As prior articles suggested, firms may need to foster employees' ability to leverage ES functionalities and amplify ES effectiveness [33]. Relational governance, one of IT governance mechanisms, may be an example approach. It encourages interaction, shared learning, collaboration, and communication between business and IT units [33]. Employees from business units can thus improve their digital skills through formal and informal interaction with IT personnel [23], leading to better use of ES functionalities in response to emergent business needs.

Our post hoc analyses, showing that ES adaptation is effective to achieving adaptive agility for traditional manufacturers rather than high-tech ones, may provide the third reason. The traditional manufacturing firms often have longer product life cycles [71]. Thus, they have more time to adapt and inscribe possible contingencies into ES, which makes ES resilient enough to help firm respond to disruptions. Longer product life cycle also buys more time for firms to train their employees [23], making employees better utilize ES to handle changing business needs. In contrast, high-tech manufacturing firms often face shorter product life cycles [23]. They, thus, need to stay alert on the life stage of their products and make their manufacturing configurations meet the needs of specific product life stage, resulting in less time to adapt their ES and utilize ES to respond to disruptions. Under such circumstances, adopting workarounds may seem to be a more efficient way to achieve adaptive agility, instead of relying on ES adaptation.

Our analysis demonstrates that ES adaptation is significantly driven by organizational mindfulness. This result confirms our argument that the five interrelated processes of organizational mindfulness can help firms discover insights, cues, and opportunities to better adapt ES [10], [15], [16]. Indeed, many new

performance ($\beta = 0.270$; $p > 0.05$) and the effect of ES adaptation on adaptive agility ($\beta = 0.150$; $p > 0.05$).

[4]We tested two models here. One is the same as the research model (path coefficient from ES adaptation to adaptive agility $= 0.238$; $p < 0.05$), and the other is a simplified model without control variables (path coefficient from ES adaptation to adaptive agility $= 0.243$; $p < 0.05$). Both results show significant path coefficient from ES adaptation to adaptive agility.

functional demands of ES are often discovered and proposed by the members of functional departments [73]. The five processes (e.g., sensitivity to operations and deference to expertise) allow low-ranking employees to pass on information to the upper echelon. It is helpful in overcoming the inertia created by existing ES investments [9] and realizing ES adaptation. This result also concurs with Liang et al. [9] and Hu et al. [36]. They find that the alignment between business and IT executives can help firms to align business and IT strategy, which in turn results in better organizational agility. This article extends the foci from the alignment at the management level to the inclusion of low-ranking employees for achieving organizational agility through their mindful engagement. Future article may further examine how alignment or interaction at different organizational levels contributes to organizational agility.

Next, we find organizational mindfulness directly and positively affects both entrepreneurial agility (H3a) and adaptive agility (H3b). This suggests that organizational mindfulness can help firms better utilize employee expertise to realize business benefits, such as via identifying inconspicuous symptoms and coming up with more feasible solutions. As a result, firms can better define emerging opportunities and threats, and react to the environment more efficiently and effectively. These results also complement prior articles on a similar concept of entrepreneurial alertness, that is, a firm's ability to recognize and respond to opportunities and identify appropriate actions that result in improved competitive actions [7], [74]. However, those articles are conceptual or qualitative studies [7], [74]. This article provides more empirical evidence to further corroborate the positive effect of organizational mindfulness on organizational agility.

Further, our findings suggest that organizational mindfulness can enable entrepreneurial agility directly and indirectly through ES adaptation. We thus further conducted a mediation test to examine the indirect effect of organizational mindfulness on entrepreneurial agility through ES adaptation by the bootstrapping approach with SmartPLS. The test shows a significant mediation result ($\beta = 0.162$; $p < 0.01$), meaning that ES remains an important tool to realize new strategies and processes. Adapting ES to bring new features and improve existing features can help firms to shift or transform extant routines, overcoming inertia that could impede entrepreneurial agility.

Finally, our analysis reveals that organizational mindfulness has stronger effects on both entrepreneurial agility ($\beta = 0.510$) and adaptive agility ($\beta = 0.431$) than ES adaptation on entrepreneurial agility ($\beta = 0.357$). This result concurs with prior articles that emphasize that the importance of the human factor in achieving organizational agility [16], [32]. We do not suggest that IT is less important while abundant research has demonstrated various IT playing a key role in achieving organizational agility [1], [5], [6], [18]. Rather, this article cautions the dominant role firms tend to designate to IT, which may result in mindless adoption of IT or IT doing more harm than good to firms (e.g., generating inertia). We, therefore, encourage future article to examine how the human factor interacts with IT, such as artificial intelligence, in achieving organizational agility.

## V. Implications and Limitations

### A. Implications for Research

This article applies the perspective of organizational mindfulness to studying ES adaptation and organizational agility. Specifically, we propose organizational mindfulness drives ES adaptation, which in turn enables organizational agility, including entrepreneurial agility and adaptive agility. Prior articles have been largely focused on the resource-based view, dynamic capabilities view, and theories of alignment [1], [5]. The organizational mindfulness perspective provides a new angle for firms to detect and transform anomalous events and details into insights and opportunities.

Specifically, the resource-based view generally argues that organizational agility is attributable to a resource that is valuable, rare, inimitable, or nonsubstitutable. Likewise, the dynamic capabilities view focuses on whether the firm has ability to sense, respond, and reconfigure resources/capabilities according to the changing needs of the market [1], [5]. These article often consider organizational agility as a dynamic capability, and IT resources, competences, and capabilities are viewed as distinctive resources or operational capabilities to enable agility [1], [2], [5], [26]. This approach, however, lacks a clear understanding of how to detect opportunities for developing IT resources, competences, and capabilities for supporting organizational agility over time. In contrast, the organizational mindfulness perspective and its five processes can help firms to detect opportunities for evolving IT and thereby agility. Thus, our approach may mitigate the ambiguity of the antecedents of IT resources, competences, and capabilities.

Further, theories of alignment or fit between IT and business strategy are another theoretical perspective largely adopted in agility-related studies [1], [19]. This perspective argues that since changing environments can disrupt the fit between IT and business strategy, IT will be unable to support a change in business strategy and create inertia in doing business, impeding agility [1]. Thus, IT strategy/managers need to align with business strategy/managers (i.e., vertical alignment) [9], [19], [36]. However, these perspectives neglect the role of low-ranking employees in improving organizational agility. Instead, the organizational mindfulness perspective emphasizes the role of employees and experts over that of management and hierarchy. Thus, the processes to facilitate alignment between executives and low-ranking employees (e.g., via preoccupation with failure, reluctance to simplify, and deference to expertise) would be a key to evolving IT, thereby improving organizational agility.

Finally, while ES inevitably becomes legacy and impedes organizational agility, this issue of ES adaptation is understudied [1]. Prior articles mainly examine the effects of adopting new information technologies and systems (e.g., cloud computing, IoT, artificial intelligence, big data analytics, and communication tools) on agility [2], [3], [4], [6], [25], [26], [27], [28], but not the adaptation of existing IT or ES. This article conceptualizes the concept of ES adaptation and empirically examine its effect on organizational agility. Indeed, nowadays firms are digitalized to various degrees, and ES adaptation will be a recurring issue.

### B. Implications for Practice

We suggest managers to foster mindful mindset in their firms for enabling ES adaptation and organizational agility. Specifically, managers can help foster the five interrelated processes of organizational mindfulness [17]. First, managers should not resort to immediate punishment when any mistakes or lapses in business processes or procedures occur. Instead, they could create a safe environment for employees to figure out what is going wrong and why, so that they can learn from the mistakes. Managers could further encourage open discussion among employees to encourage knowledge sharing and vicarious learning. This helps expand the knowledge base of individual employees and shared understanding of departmental interconnection. Most importantly, managers should respect expertise and empower frontline employees to devise and implement solutions, such as adjustment of business processes or ES adaptation. Although the bottom-up problem-solving process can sometimes be time-consuming, the overall process prevents firms from forming an oversimplistic view of their environment and wrong solutions.

Further, firms should be cautious of the encroachment of IT investment, and give sufficient attention to the development of their employees' skills [23]. Indeed, prior articles have found that IT spending alone does not have a significant effect on agility [6]. This article further corroborates this. Thus, managers should provide training for employees when new or changed ES features are implemented. Managers also need to be patient as performance takes time to realize after ES adaptation.

### C. Research Limitations

We should note that this article has several limitations. First, we used cross-sectional data to assess our model. Although the proposed research hypotheses were derived theoretically, the results still reflect associations rather than causality. Second, this article relies on perceptual measures of firm performance which may not accurately reflect the theoretical construct we examined. But, because we collected data from top managers who largely make their decisions and actions based on their perceptions, such a limitation may not be so severe. To further address this issue, we compared our data (i.e., subjective firm performance) with public data. The result demonstrates high consistency between these two data sources, thereby mitigating this limitation (see Appendix D for details). Future article may seek to test and extend our research model using archival and longitudinal data. Third, the response rate of the survey appears relatively low. This could be because of the large number of measurement items in our questionnaire. We also checked the nonresponse bias and found no bias statistically. However, given the small sample size, the generalizability of the results could still be a limitation. Finally, industrial sectors may be an important contextual factor. Thus, we regrouped our sample into two subgroups, namely the high-tech sector and traditional sector. Our post hoc analyses demonstrate some difference, that is ES adaptation is positively related to adaptive agility in the traditional sector. Future article may collect data from different sectors to test and extend our model.

## VI. Conclusion

In this article, we developed and tested a research model that links organizational mindfulness, ES adaptation, entrepreneurial agility, adaptive agility, and firm performance based on the perspective of organizational mindfulness. The empirical results support most hypotheses in the model and the findings provide guidance for practitioners to enhance organizational agility. First, firms should foster organizational mindfulness to achieve greater organizational agility via the processes of preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise. Second, ES adaptation mainly enables entrepreneurial rather than adaptive agility. Third, organizational mindfulness is key to helping firms adapt their ES and thus overcome inertia. Accordingly, this article contributes to the existing theoretical and practical knowledge in the following ways. First, this article applies the perspective of organizational mindfulness to emphasize the important aspects of people and organization. Second, IT can become outdated. This article conceptualizes and empirically tests the concept of ES adaptation. Third, our post hoc analyses provide a nuanced understanding that the industrial sector matters for organizational mindfulness and ES adaptation to drive agility. That is, ES adaptation is positively related to adaptive agility in the traditional sector, but not in the high-tech sector. Finally, this article provides practical insights for managers to cultivate a mindful environment conducive to organizational agility. Overall, we provide a better understanding about the roles of organizational mindfulness and ES adaptation in enabling entrepreneurial agility and adaptive agility.

## Appendix D
## Cross-Validation of Firm Performance With Archival Data

We aimed to cross-validate our subjective measure of firm performance with archival firm performance collected from publicly available data sources. Specifically, we collected data on net profit margin, return on assets, and return on equity from Taiwan Stock Exchange for the publicly traded firms in our sample ($N = 103$). The remaining firms are private and do not disclose financial data. We thus use such subset of the firms in the sample to perform validation checks. We collected data for a 3-year period, 2017–2019 (the year of the survey), and computed average scores in order to reduce the effects of variations over this period. Following, we created a summated scale with the archival performance measures and compared it with the subjective measure of performance (note that we mainly draw upon the items of 3, 4, and 7 to create the summated scale of subjective measures because these three items match the archival performance measures). The result of a correlation analysis shows a significant correlation between the subjective performance measure and archival performance data (0.195, $p < 0.05$).

## APPENDIX A
## CONSTRUCTS AND MEASUREMENT ITEMS

| Construct and scale indicators | Loadings | Mean | S.D. |
|---|---|---|---|
| **Firm performance** | | | |
| The extent to which your firm's financial performance during the last 2 or 3 years, relative to all other competitors (1: much below the average, 7: much above the average) | | | |
| ● Our profitability has been substantially better. | 0.91 | 4.42 | 1.64 |
| ● Our return on investment has been substantially better. | 0.94 | 4.39 | 1.54 |
| ● Our return on assets has been substantially better. | 0.92 | 4.46 | 1.52 |
| ● Our return on equity has been substantially better. | 0.91 | 4.48 | 1.54 |
| ● Our growth in market share has been substantially better. | 0.84 | 4.33 | 1.47 |
| ● Our sales growth has been substantially better. | 0.84 | 4.42 | 1.48 |
| ● Our return on sales has been substantially better. | 0.93 | 4.40 | 1.53 |
| ● Our financial performance has been substantially better. | 0.93 | 4.43 | 1.53 |
| **Organizational mindfulness** | | | |
| How well does each of the following statements describe the working environment in your firm? | | | |
| ● People are encouraged to question the way things are usually done here. | 0.85 | 4.85 | 1.24 |
| ● Personnel here are willing to challenge the status quo. | 0.92 | 4.90 | 1.26 |
| ● We appreciate skepticism here. | 0.83 | 5.03 | 1.16 |
| ● People feel free to prolong their analysis to better grasp nature of problems. | 0.89 | 5.14 | 1.12 |
| ● We have a good map of each other's talents and skills. | 0.85 | 5.04 | 1.10 |
| ● People are committed to solving any problem that arises. | 0.79 | 5.16 | 1.23 |
| **Adaptive agility** | | | |
| ● Our firm is pliable, in that we can adjust to abnormal conditions and then bounce right back when conditions come back to normal. | 0.93 | 5.37 | 1.27 |
| ● Our firm emphasizes building capabilities to defend against a wide range of scenarios. | 0.92 | 5.14 | 1.24 |
| ● Our firm can be characterized as resilient. | 0.94 | 5.17 | 1.24 |
| ● Our firm has the ability to absorb environmental shocks. | 0.90 | 5.14 | 1.25 |
| **Entrepreneurial agility** | | | |
| ● Our strategy emphasizes building capabilities to foresee a wide range of scenarios. | 0.91 | 4.87 | 1.31 |
| ● We believe in rapidly taking advantage of opportunities. | 0.88 | 5.01 | 1.27 |
| ● Our strategic assets can easily be converted to alternate forms. | 0.91 | 4.49 | 1.21 |
| ● We can easily modify our positioning strategy. | 0.87 | 4.54 | 1.31 |
| **Market turbulence** | | | |
| ● Customer preferences change rapidly in our industry. | 0.86 | 4.34 | 1.44 |
| ● It is very difficult to predict any changes in our industry. | 0.91 | 4.29 | 1.37 |
| ● Forecasting demand in our industry is very difficult. | 0.89 | 4.35 | 1.41 |
| **Competitor turbulence** | | | |
| ● There is intense competition for market share in our industry. | 0.82 | 5.81 | 1.09 |
| ● Competition in our industry is cutthroat. | 0.80 | 6.02 | 1.02 |
| ● Price competition is a hallmark of our industry. | 0.69 | 5.76 | 1.12 |
| ● One hears of a new competitive move almost every day | 0.88 | 4.85 | 1.22 |
| **Technological turbulence** | | | |
| ● Technological innovations have brought many new product ideas in the recent past. | 0.91 | 5.01 | 1.31 |
| ● The technology in our industry is changing rapidly. | 0.94 | 5.02 | 1.39 |
| ● It is very difficult to forecast where the technology in our industry will be in the next 2 to 3 years. | 0.55 | 4.42 | 1.34 |
| **Measured latent marker variable (MLMV)** | | | |
| ● I played around with features in Microsoft Word. | 0.84 | 4.73 | 1.34 |
| ● I used some Microsoft Word features by trial and error. | 0.91 | 4.53 | 1.46 |
| ● I tried new features in Microsoft Word. | 0.93 | 4.82 | 1.38 |
| ● I figured out how to use certain Microsoft Word features. | 0.92 | 4.64 | 1.31 |

| Construct and scale indicators | Loadings | Mean | S.D. | Construct and scale indicators | Loadings | Mean | S.D. |
|---|---|---|---|---|---|---|---|
| **ES adaptation**<br>Please rate the degree to which after recent ES (such as ERP) implemented in your firm, the system have been upgraded or enhanced to provide new features or to improve initial features in order to meet demands of following business activities. | | | | *Primary activities (value chain)*<br>● Inbound logistics (e.g., purchasing)<br>Outbound logistics (e.g., warehousing)<br>● Manufacturing/operations<br>● Marketing<br>● Sales<br>● Customer services | 0.94 | 7.80 | 1.17 |
| *Strategic activities*<br>● Being a low-cost producer<br>● Having manufacturing/operations flexibility<br>● Enhancing supplier linkages<br>● Enhancing customer linkages<br>● Providing value-added services<br>● Enhancing existing products/services<br>● Entering new markets | 0.92 | 4.61 | 1.16 | *Support activities (value chain)*<br>● Procurement<br>● Technology development<br>● Human resource management<br>● Firm infrastructure<br>● Linkages among key support activities<br>*Overall support*<br>● Overall, our ES and relevant systems have been upgraded or enhanced to meet demands of business activities. | 0.89<br><br>0.80 | 4.75<br><br>5.12 | 1.24<br><br>1.31 |

## APPENDIX B
## INTERCONSTRUCT CORRELATIONS AND RELIABILITY MEASURES ($N = 138$)

| Construct | $\rho$_A | Cron. α | CR. | AVE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Firm perfor. | 0.97 | 0.97 | 0.97 | 0.82 | **0.90** | | | | | | | |
| 2. Adap. | 0.94 | 0.94 | 0.96 | 0.85 | 0.66 | **0.92** | | | | | | |
| 3. Entre. | 0.92 | 0.92 | 0.94 | 0.80 | 0.52 | 0.65 | **0.89** | | | | | |
| 4. ES adapt. | 0.92 | 0.84 | 0.88 | 0.64 | 0.48 | 0.41 | 0.58 | **0.89** | | | | |
| 5. Org. mindful. | 0.94 | 0.93 | 0.94 | 0.73 | 0.52 | 0.58 | 0.71 | 0.44 | **0.85** | | | |
| 6. Comp. turb. | 0.92 | 0.91 | 0.94 | 0.79 | 0.16 | 0.15 | 0.27 | 0.05 | 0.18 | **0.80** | | |
| 7. Market turb. | 0.88 | 0.87 | 0.92 | 0.79 | 0.08 | 0.12 | 0.34 | 0.25 | 0.32 | 0.45 | **0.89** | |
| 8. Tech. turb. | 0.85 | 0.74 | 0.85 | 0.67 | 0.37 | 0.41 | 0.46 | 0.27 | 0.42 | 0.38 | 0.55 | **0.82** |

## APPENDIX C
## HETEROTRAIT–MONOTRAIT RATIO OF CORRELATION (HTMT) AND THEIR 95% CI ($N = 138$)

| Construct | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Firm perfor. | | | | | | | | |
| 2. Adap. | 0.69 [0.56, 0.79] | | | | | | | |
| 3. Entre. | 0.55 [0.40, 0.66] | 0.70 [0.56, 0.81] | | | | | | |
| 4. ES adapt. | 0.51 [0.37, 0.63] | 0.44 [0.26, 0.59] | 0.64 [0.47, 0.75] | | | | | |
| 5. Org. mindful. | 0.54 [0.37, 0.66] | 0.61 [0.46, 0.72] | 0.76 [0.64, 0.86] | 0.47 [0.30, 0.63] | | | | |
| 6. Comp. turb. | 0.14 [0.06, 0.21] | 0.14 [0.05, 0.28] | 0.25 [0.11, 0.44] | 0.06 [0.04, 0.06] | 0.16 [0.08, 0.28] | | | |
| 7. Marke turb. | 0.09 [0.04, 0.15] | 0.13 [0.05, 0.27] | 0.38 [0.20, 0.55] | 0.28 [0.11, 0.44] | 0.35 [0.18,0.50] | 0.46 [0.29, 0.61] | | |
| 8. Tech. turb. | 0.41 [0.20, 0.59] | 0.47 [0.25,0.65] | 0.54 [0.32, 0.71] | 0.36 [0.14, 0.55] | 0.51 [0.30,0.67] | 0.41 [0.25, 0.58] | 0.72 [0.53, 0.85] | |

*Note:* The 95% CI of HTMT are estimated by 4999 bias-corrected and accelerated bootstrapping with confidence intervals bias corrected [68].

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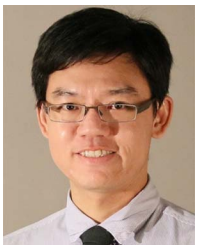

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