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Technology Evaluation and Imitation: Do They Have Differential or Dichotomous Effects on ERP Adoption and Assimilation in China?

ABSTRACT

Enterprise resource planning (ERP) software is a platform for innovation with high failure rates due to its complexity. In China, failure rates of ERP are also high due to key differences between China and Western countries in terms of development, cultural, and organizational structure. Even when Chinese firms successfully *adopt* ERP, many fail to *assimilate* ERP and consequently never experience the full benefits of the innovation. The purpose of this study is to examine the predictors of adoption versus assimilation in Chinese firms so that ERP can provide more innovation than mere automation. However, the literature largely assumes a dichotomy of choices when implementing organizational innovations in business: technological evaluation and imitation. We argue that this dichotomy does not apply well to a Chinese ERP context. China has achieved tremendous success in manufacturing and industrial processes through technological leapfrogging offered by imitation. At the same time, Chinese firms are under increasing pressure to innovate because of government and market pressures. Therefore, we argue that forces of imitation and evaluation are likely both at play when Chinese firms adopt and assimilate innovations—including ERP. Accordingly, we examined how two behaviors, inter-organizational social technology imitation and rational technology evaluation, influence Chinese organizations in adopting and assimilating ERP systems. Our findings suggest that both social technology imitation and rational technology evaluation are determinants of Chinese ERP adoption and assimilation. Hence, this study offers new ways for IT and innovation researchers to explore social behavior (i.e., imitation) in IT diffusion processes and to consider the merits or risks of such behavior alongside the conventional rational approach (i.e., evaluation).

KEYWORDS

Enterprise resource planning system (ERP), ERP assimilation, technology evaluation, technology imitation, diffusion of innovation (DOI) theory, China, adoption, assimilation

INTRODUCTION

Enterprise resource planning (ERP) software offers a standardized platform for innovation that integrates financial and human resources, supply chain, and manufacturing functionality, but can be enhanced with customer relationship management, business intelligence, e-Commerce, and more [37, 49]. Such functionality, if properly implemented, can significantly innovate firms not just through technical integration of IT infrastructure but also through business integration of cross-functional and inter-organizational business processes [66]. Though ERP has been shown to be essential to the success of medium-to-large business organizations, it's sheer complexity has resulted in a high failure rate [30, 52]. Accordingly, innovation is never achieved by an off-the-shelf installation of ERP; rather, innovation with ERP requires integration and implementation that provides unique insights and competitive advantage.

In China, ERP is particularly critical for strategic competitive advantage in its manufacturing firms and important for driving business intelligence and improving supply chain capabilities [30, 36]. However, effective ERP implementation is exceedingly difficult because it typically requires organizational transformation (e.g., business process engineering, change management) and strategic repositioning [78, 86]. Unfortunately, the failure rates of ERP in China have been higher than in Western countries [30, 101], leaving many opportunities for improvement.

These high failure rates are largely due to the unique cultural and environmental context of Chinese. Compared to Western firms, Chinese firms have different styles of management, business models, and even data formats [10]. Other unique Chinese characteristics that influence ERP adoption are the strong role of government, the prominence of state-owned-enterprises (SOEs) [10], and the variety of ownership structures—including SOEs [30]. Likewise, China has unique forms of corporate governance with a focus on *guanxi*, a term referring to a "strong emphasis on the relationships between business partners for achieving mutual benefits" (p. 502). Differences in language, customer support practices, lack of professional personnel, organizational resistance, price expectations, and even reporting practices have also acted as barriers to Chinese ERP implementation. Chinese corporate culture can make it difficult to openly and honestly address organizational issues that need to be resolved so that proper re-engineering

of an organization can occur to achieve ERP implementation success [95, 98, 101].

Thus, it is clear that not all of the lessons learned from Western-based ERP implementations can simply be applied to a China context [10, 30]. Some lessons may even be detrimental for Chinese firms because of poor cultural fit. Despite these issues, understanding and improving Chinese ERP implementation is compelling because of China's economic size and technological position in the world. "More than any other country, China is being transformed by its application of IT, from a poor and isolated society to a major force in the global economy" [59, p. 46]. Therefore, China-specific ERP implementation knowledge is crucial to develop to foster's China's impressive economic trajectory.

Even successful ERP implementations in China have room for improvement: Many Chinese firms have implemented ERP but have not done so fully and thus have not achieved the promised benefits of the innovation [36, 104]. This issue demonstrates the differences between mere adoption of ERP versus assimilation of ERP. "One of the major hurdles to successful ERP implementation is that many Chinese SMEs regard implementing ERP as a means to achieve modernization rather than to replace legacy systems and realize organizational change," which requires process re-engineering and assimilation of ERP [62, p. 406]. ERP assimilation is key to study because it is a better indicator of post-adoption success than mere implementation [52]. Lack of assimilation has been tied to organizations eventually failing, and sometimes removing, ERP implementations they initially thought to be successful [52]. Hence, one of our research goals is to understand the key factors that determine adoption and assimilation of ERP in China.

In considering factors that predict adoption and assimilation in the literature, we found two potentially conflicting views regarding how this happens. One of these two methods of IT adoption and assimilation, *technology evaluation*, focuses on the rational evaluation of the objective characteristics of IT innovations that facilitate users' beliefs, attitudes, and behavior. For example, diffusion of innovation (DOI)'s evaluation of innovation characteristics along with the technology acceptance model (TAM)'s evaluation of innovation's perceived ease of use and usefulness offer crucial insights into the rational decisions of IT adoption and assimilation. But in reality, humans—including business executives and employees deploying ERP—demonstrate *bounded rationality*, which suggests that despite their intention

to be rational, they simply cannot include all potential factors in decision making because of either the intrinsic constraints of the human brain or the extrinsic constraints of incomplete information [25].

To challenge the limitations of bounded rationality, humans observe how others behave and infer information from such behaviors. This leads to a set of literature on adoption and assimilation that focuses on imitation. Social imitation, a learning behavior of observing others facing similar decision scenarios, offers decision-makers opportunities to transform, classify, organize, and draw inferences from observing the actions of others, thus conserving their resources and enhancing their chances of survival [63]. Organizations may be able to obtain new information from imitating other organizations [13, 41]. However, imitation comes in many forms, each of which affects the impact of decisions made in different organizational settings [12, 22]. Technology imitation is the investigation of different social mimetic forms that affect managerial perception and beliefs when adopting and assimilating IT innovations.

These potentially conflicting views (i.e., evaluation versus imitation) of the drivers of adoption and assimilation are particularly meaningful in the context of implementing ERP in Chinese firms. To achieve world-leading growth in manufacturing and related industries, many Chinese companies adopted an imitation strategy [89]—including the use of ERP [10]. However, increasing national and industrial pressure has shifted companies' methods toward evaluation, innovation, and external competition [15, 89]. Because of bounded rationality and its unique development trajectory and traditions, a typical Chinese company likely considers both imitation and evaluation to facilitate ERP implementation. We thus argue that the unique dynamics involved in ERP implementation require a carefully contextualized model that assumes imitation and evaluation as concurrent processes —not a dichotomous choice.

Given this motivation, our study compares the approaches of technology evaluation and imitation to adoption and assimilation of ERP, as influenced by internal and external environments, in the China context. Specifically, we address two major research questions:

1. How do rational technology evaluation and social technology imitation influence the degree of ERP adoption and assimilation of Chinese firms implementing ERP?
2. How do external and internal forces (i.e., technological, organizational, and environmental

characteristics) moderate the effects of technology imitation and evaluation on ERP adoption and assimilation of Chinese firms?

BACKGROUND ON THE UNIQUE CHINA ERP CONTEXT

Before we present our research model and propose hypotheses, we first explain the unique context of ERP in China and why it is important. Notably, this is not a cross-cultural study. Thus, our aim is not to propose hypotheses that explain how China is different from other national contexts. Instead, the hypotheses are developed in terms of ERP use in China and the general literature.

Most major ERP systems are software products developed in Western countries. These products have built-in business practices that represent established Western business procedures. These practices may not fit general Chinese culture or business models. The reason is that culture can differentiate people's general behavior and organizations' functioning [38, 100]. Although China is notably different from Western cultures in terms of norms regarding power distance, uncertainty avoidance, individualism/collectivism, and masculinity/femininity [38, 99], there are certain aspects of Chinese culture that differentially influence the adoption and assimilation of ERP products that originate from the West. These key factors include language, business practices and guanxi, Confucianism, and localization.

Language

The languages adopted for ERP systems are mostly based on alphabetic symbols, but the Chinese language is pictographic [100]. Each of the Chinese characters is a pictographic symbol that represents an object or concept. These characters do not translate well to equivalent alphabetic symbols. For example, the homonyms (different symbols that sound the same, but have different meanings) and synonyms in Chinese characters can create translation and connotation problems while using ERP.[i] In addition, most Chinese are still not well-versed in English; however, using leading ERP systems requires using English. Adopting or assimilating a vastly expensive ERP program that requires the use of a language of which a small percentage of Chinese executives and managers are fluent in produces unique challenges in China.

Business practices and guanxi

Western countries are market-based economies whereas China is a state-controlled economy.

Market-based economies are governed by a universal set of formal rules and are regulated by free markets. In contrast, a state-controlled economy is a system in which the state makes economic decisions, which largely describes China [60], although there has been much privatization and sale of SOEs to private economic entities in recent decades [61]. Due to a lack of rule-based business practices (i.e., rule of law), Chinese companies have to rely on guanxi to conduct their business. Guanxi refers to a personal network or special relationship with mutual benefits [94] and determines how the Chinese do business and how their interpersonal and professional relationships work. For example, rigidly embedded ERP rules can conflict with the flexibility to override rules or procedures available in guanxi.

Confucianism

Chinese executives' management styles are heavily influenced by the philosophy of Confucius— a prominent scholar in China around 500 BC [100]. Two principles of Confucianism have had long-lasting effects on business operations in China: centralized monarchy and family-based production [43]. In business settings, centralized monarchy suggests employment inequality and consolidated decision-making, whereas family-based production suggests entrepreneurship. These two philosophies drive organizations toward centralized and personal management rather than a decentralized and shared management style, which is an approach promoted by ERP. A key strategic goal of ERP use is to enhance communication, collaboration, and information sharing. When ERP objectives misalign with Confucianism, the uncertainties associated with the market become more erratic.

Localization

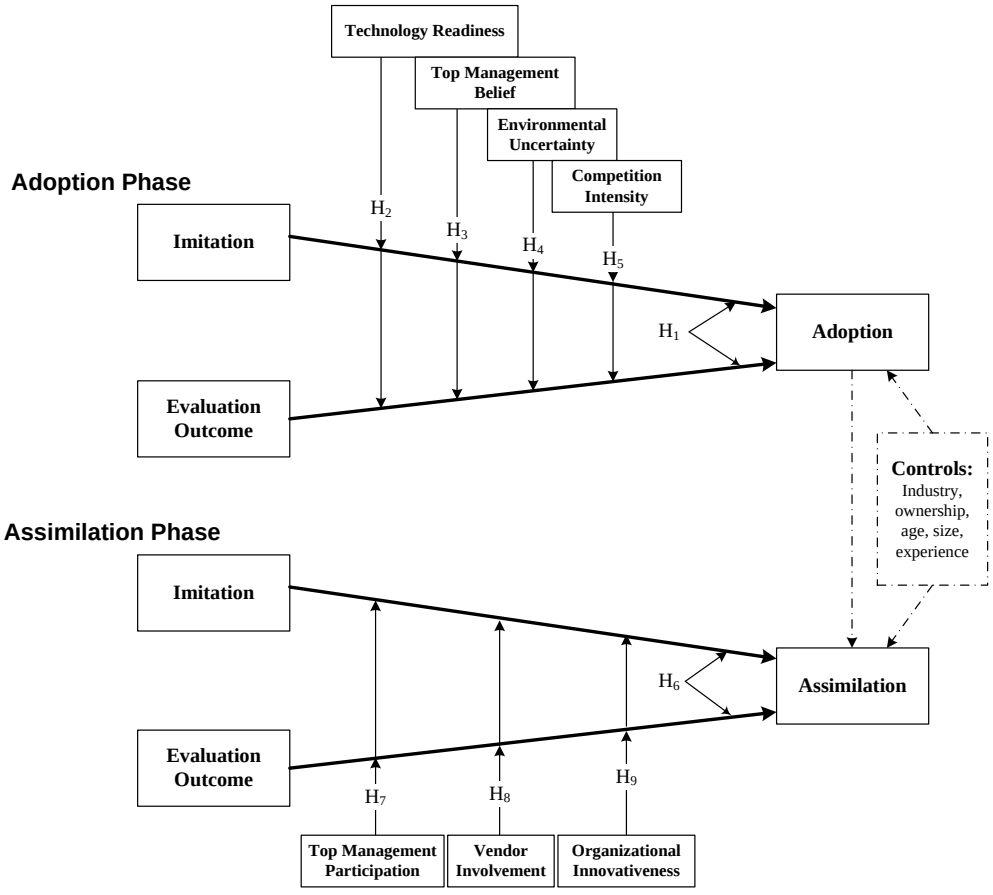
Chinese prefer name-brand consumer products from the West; yet, they prefer local technology products and services [46]. Chinese technology companies have developed world-class capabilities and yet have localized to China. These include software development (e.g., Kingdee, Kingsoft) and hardware manufacturing (e.g., Huawei, Xiaomi) to e-commerce (e.g,. Alibaba, Baidu, Tencent). Consequently, the success of ERP vendors' move into China, to a great extent, depends on how much their products and services have been intentionally localized to meet unique Chinese needs. In fact, localization of a product or service is challenging and many foreign IT companies (e.g., Amazon, eBay, Google) have failed in the

Chinese market because they failed to follow local needs and requirements. In contrast, domestic Chinese ERP vendors took a major share of the market because they successfully integrated unique Chinese characteristics into their development of ERP systems [95].

RESEARCH MODEL

Figure 1 depicts our research model, which is composed of two dependent, two independent, and seven moderating variables (the relationships between controls and outcomes are depicted with dotted lines). The dependent variables evaluate ERP adoption and assimilation. The selection of ERP adoption and assimilation as dependent variables allows us to evaluate and differentiate the longitudinal effects of technology *evaluation* and *imitation* strategies. We apply our evaluation from the pre-implementation stage of ERP adoption decisions to the post-implementation stage of ERP assimilation, thereby determining the degrees of ERP success.

Figure 1: The Research Model



Our model is contextualized to large Chinese firms that have adopted or assimilated ERP. This contextualization is crucial because of the multiple characteristics of the Chinese context that uniquely affect imitation, evaluation, adoption, and assimilation. Many have argued that the best theory development in management fields [e.g., 24, 90, 91] and IS [e.g., 8, 21] is heavily contextualized as opposed to theory intended to apply to all situations. Aside from the boundary condition of being contextualized to China, our model is guided by a couple of other key assumptions. First, we expect that in typical Chinese firms, evaluation and imitation are both used to some degree and do not reflect a dichotomy of choices. Second, the practices of technology evaluation and imitation tend to extend from individuals to organizations, and these behaviors affect critical IT investments such as ERP systems. Third, a firm's behavior in terms of technology evaluation and imitation can be moderated by both its internal technological and organizational characteristics and its external environmental characteristics.

Explaining Choice of Moderators of Adoption and Assimilation

In terms of this last assumption, we consider the additional factors that need to be incorporated into our research model to reflect the influence of external and internal forces on both social imitation and technology evaluation in the process of ERP adoption and assimilation in China. These are factors that we have gleaned from the general literature that also have unique application when considering Chinese ERP implementation. Incorporating such factors in this study further enriches and contextualizes our model meaningfully to China. To do so on a systematic basis, we apply the technology–organization–environment (TOE) framework, which has been widely used in innovation diffusion research to elaborate on the three aspects of a firm's context that are critical to IT diffusion. Crucially, TOE has also been applied in a China context successfully. These factors are represented as moderation hypotheses (H2–H5 & H7–H9) in our model. To determine these factors, we scoured the literature for TOE considerations that could likely have differential effects on imitation versus evaluation and adoption versus assimilation. These are detailed and supported in Appendix A.

Distinguishing Adoption and Assimilation

Our research model is segmented into conceptual differences between ERP adoption and ERP

assimilation. Per seminal research by Rogers, *adoption* refers to the acquisition, implementation, or purchase of an innovation [71]. According to Rogers, adoption is more about management authorizing purchase of technology or overseeing its basic implementation rather than more fully capturing strategic value for the firm by routinizing the technology for everyday use. The latter loosely refers to assimilation and is greatly preferred to adoption. Although there are several formal definitions of assimilation in the literature [27, 88, 102], all agree that assimilation essentially refers to the extent to which a firm has progressed through the stages of innovation deployment—from initial awareness to routinization (i.e., where the innovation has become an integral part of operation).

Moreover, ERP is an especially complex technology to implement. Wei et al. [88] note that for such technologies with high implementation complexity, little or no actual assimilation occurs after technology adoption (i.e., the *assimilation gap* [28]). Many Chinese firms have implemented ERP but have not done so fully and thus have not achieved the innovation's promised benefits. However, if assimilation is successful, the ERP innovation is infused and routinized into the work routines of an organization—providing its expected benefits [73]. These distinctions indicate why it is particularly important to compare and contrast adoption versus assimilation in an ERP context and why we provide contextualized and moderated hypotheses concerning both.

How Imitation Fosters Adoption and Evaluation (i.e., DOI) Fosters Assimilation

Our model also considers both *imitation* and *evaluation*, which are expected to have differential effects. We argue that a key reason Chinese firms find themselves stuck in the post-adoption phase or with suboptimal implementation is that they followed the processes of imitation too strongly and evaluation too weakly. Therefore, such firms could not achieve strategic assimilation, which requires in-depth rational evaluation, planning, and strategy (i.e., *evaluation*). Chinese firms can be especially prone to imitation when adopting ERP that is highly Westernized (i.e., not localized enough), which conflicts with language, business practices and guanxi, and Confucianism. Hence, an underlying assumption in our model is that these contextual factors are better addressed with evaluation than with imitation.

However, another core assumption in our model is that imitation and evaluation are not

dichotomous, and both are used in Chinese ERP implementations; however, imitation tends to lead to mere adoption, whereas evaluation is more likely to produce assimilation. We first provide evidence for treating imitation and evaluation as non-dichotomous. The importance of technology imitation and evaluation vary according to the innovations under consideration. However, research has found that the effects of such behaviors can be simultaneous and tend to converge over time [87, 97]. Thus, social imitation can complement rather than compete against rational behavior, thereby leading to better ERP decisions [87].[ii] In fact, the extension of the TAM model to include social influence is an attempt by rational information systems (IS) theorists to examine a wider range of factors drawn from both the social and rational perspectives. Similarly, theorists of imitation do not exclude objective rationality [22].

How Organizational Imitation Works

Interdisciplinary researchers have applied various theories to explain imitative behavior.[iii] In IS, most organizational imitation studies have taken an institutional perspective. Here, organizations are compelled to respond to the constraints within their respective environments for the sake of survival, which results in the elimination of less optimal organizational and in a high level of resemblance among the remaining organizations [34]. With this perspective, IS researchers have investigated the effect of institutional pressures on ERP adoption [52, 73], and others examined the effects of DOI and imitation on the organizational beliefs involved in the adoption of ERP systems. Regardless, we argue that when imitation is the primary driver for ERP implementation, projects are more likely to involve less strategic thinking and lack deep stakeholder involvement in implementing ERP itself. Such an approach fosters adoption but blunts the ability of a firm to truly assimilate ERP because it does not understand itself, its supply chain, its competitors, and the technology itself to achieve strategic assimilation. Likewise, imitation used in conjunction with evaluation is more likely to lead to ERP implementation success.

How Organizational Evaluation Works

In contrast to pure imitation, we assert that when Chinese firms carefully evaluate and plan implementation of innovations (e.g., ERP) and do so for strategic reasons, they are more likely to achieve assimilation. Here, our assumptions rely on the rich DOI literature, and we use DOI itself as a strong

proxy for a firm engaging in technology *evaluation*. DOI has been used for this approach several times in the literature including with an ERP study that contrasted it to imitation [49]. DOI research is especially useful in our context because it considers a firm's innovation characteristics and success in either adoption or diffusion (e.g., assimilation) of a technology innovation. The adoption perspective evaluates the organizational characteristics that make the IT receptive to innovation and change and thus for initial adoption of an innovation, whereas the diffusion perspective investigates the innovation characteristics that lead to the IT's widespread acceptance and assimilation [65].

According to DOI theory, technological characteristics are critical for successful innovation adoption and ultimate diffusion. Among all of the innovation characteristics investigated thus far, compatibility, relative advantage, complexity, trialability, and observability have been found to be the most important. Our investigation, however, only focuses on relative advantage, complexity, and compatibility because these three characteristics have been consistently found to be significant for innovation assimilation in a meta-analysis of previous work on innovation characteristics [82].[iv] Firms that use a logical evaluation perspective, as manifested in these three DOI constructs, are much more likely to end up with successful ERP assimilation rather than mere adoption. But again, we believe most Chinese firms combine the social influence of imitation with the bounded rationality of evaluation.

RESEARCH HYPOTHESES

ERP Adoption in Terms of Imitation and Evaluation

The Direct Effects of Imitation and Evaluation Behavior

Studies of rational DOI and TAM [e.g., 20, 71, 84] have confirmed the importance of technology evaluation in effecting an innovation's consequential adoption. This is also evident in the context of Chinese businesses [47]. A wide range of characteristics including relative advantage, complexity, compatibility, perceived ease of use, and perceived usefulness is influential in the decision-making process of innovation adoption. Yet, these technology characteristics have to be localized to Chinese business operations and culture. Institutional and herding theorists [e.g., 5, 7, 22, 70] have also shown that a critical mass of users can, over time, create positive bandwagon effects for others to follow including

the decision to adopt ERP. This phenomenon is prominent in China, where large and successful organizations are highly influential, thus creating a potentially strong bandwagon effect [49].

In comparing the behavior of evaluators and social imitators, theories of evaluation (such as DOI and TAM) have confirmed that organizations that perform technology evaluation are much larger (e.g., more resources, employees, or revenue), more innovative, and industry leaders have better technological capability; this holds in China [47]. Thus, these organizations are more aware of ERP benefits and its strategic values. In contrast, imitating organizations, as suggested by theorists of organizational sociology, are generally less prestigious, less successful, less resourceful, and smaller, thus constraining their scale of ERP adoption. When imitators are unaware of their ERP needs and are restricted in their resources, their adoption scale tends to be more conservative to avoid the risks and uncertainties associated with uncertain outcomes [37]. Such trade-offs between evaluation and imitation have long been a key controversy in the Chinese context. In a rapidly developing country, many Chinese companies have adopted an imitation strategy to attain superiority in manufacturing and related industries [89] including the use of ERP [10]. Imitation gave these companies a jumpstart in ERP use but did not guarantee strategic ERP benefits. Again, one likely cause of this hurdle is not localizing the ERP to the unique cultural needs of Chinese companies especially in terms of language, business practices and guanxi, and Confucianism. Hence, when ERP progresses to maturity, organizations are increasingly pressured toward evaluation, innovation, and external competition [15, 89] for organizational performance. Thus, in China:

> *H1: Technology imitation and evaluation both have a positive effect on ERP adoption (a), but the effect of technology evaluation is stronger than that of technology imitation (b).*

The Moderating Effect of Technology Readiness

Organizations with greater technology readiness are in a better position to adopt advanced IT innovations [103] primarily through embeddedness mechanisms [83]; such organizations have better technologies and more competent IT professionals to deal with the issues associated with ERP decisions. Research has shown that Chinese firms with stronger technology readiness tend to achieve greater post-implementation success with ERP [104]. Such readiness in our context is not just about technological know-how but also

cultural fit with the ERP product and vendor such that the innovation can be more readily assimilated.

However, with less technology readiness, organizations cannot make decisions about ERP and need to follow their competitors' practices. A unique way that Chinese firms have dealt with this lack of readiness is through imitation. Imitating their competitors gives firms a second-mover advantage of unexpected or unsought unique benefits including the accrual of an external referent of prestige [49]. These unexpected benefits, along with the expected benefits of lower adoption risks and costs, could favorably compensate IT inadequacy in ERP evaluation. This kind of imitation was largely necessary for Chinese firms to catch up with (and eventually surpass) the manufacturing and industrial capabilities of Western firms [10, 15]—often creating a technological "leapfrogging effect." Thus, in China:

> *H2: When technology readiness is high, the effect of technology evaluation on ERP adoption is stronger than that of technology imitation (a); however, when technology readiness is low, the effect of technology imitation on ERP adoption is stronger than that of technology evaluation (b).*

The Moderating Effect of Top Management's ERP Belief

Belief has been an underlying theme among many popular rational IT models (such as TAM and TPB) with a general consensus that it has a critical impact on IT adoption and intention to use [14, 20]. Belief about an ERP is the subjective psychological state of evaluation regarding its potential to benefit the organization. This belief is developed after the collection, processing, and synthesis of information [51]. In China, ERP implementations are normally initiated by top management [58] ostensibly because of their belief in ERP. These senior executives—as influenced by the privatization and joint-venture policies in modernizing Chinese businesses [61, 76]—are less susceptible to principles of Confucianism but more inclined to make their business decisions decentralized, formalized, and transparent. ERP's capability and capacity in supporting collaboration, formalism, and best business practices are effective in enhancing belief in the innovation. As such, the extent of ERP belief of top management will determine the level of their determination to move the project forward. These findings are particularly applicable to ERP adoption and assimilation in China [52] especially as ERP failures are an embarrassment that can undermine organizations' hierarchical authoritarianism. ERP must also not be seen as a threat to time-honored business practices and guanxi. Hence, when top Chinese managers believe strongly in ERP,

they are more likely to commitment and to ensure success of ERP initiatives. Although social influence theorists have observed a positive correlation between social imitation and beliefs, little research has explored the relationship between management belief, social imitation, and IT adoption. Through imitation, private information is gained from the actions of others [7]. Thus, social imitation can translate the practices of others into terms that are meaningful and useful to management's internal ERP decisions as seen in China [49]. Thus, we suggest that in China when top management's belief in ERP is low, technology imitation affects ERP adoption decisions more than technology evaluation does. We propose:

> *H3: When top management's ERP belief is high, the effect of technology evaluation on ERP adoption is stronger than that of technology imitation (a); however, when top management's ERP belief is low, the effect of technology imitation on ERP adoption is stronger than that of technology evaluation (b).*

The Moderating Effect of Environmental Uncertainty

Environmental uncertainty often encourages organizations to imitate others instead of using technical rules to evaluate alternatives [35, 53]. Environmental uncertainty also slows the rational decision-making process and has a negative impact on performance, thus having little influence on ERP decisions. When uncertainty is high, organizations' leaders are persuaded to model themselves on others and to base their ERP adoption decisions on social comparison. This correlation between uncertainty and imitation may promote organizations to adopt ERP systems while changing few of the ERP parameters that need to be altered to fit their organization's needs. Liang et al. [52] aptly explain that mimetic forces or pressure "results as organizations respond to uncertainty by mimicking actions of other organizations. When technologies are poorly understood, when goals are ambiguous, or when the environment creates uncertainty, organizations may model themselves after other organizations perceived to be legitimate or successful" (p.62). Crucially, they confirm this relationship in a Chinese ERP assimilation context.

Further research shows that Chinese firms are especially prone to mimetic pressure with increased environmental uncertainty or instability [96]. If this holds, it then follows that when environmental uncertainty is low, Chinese organizations are more assured of the effective application of ERP in implementing their chosen strategies. They will tend to sense the means–ends relationship

between ERP initiatives and ERP assimilation. The managers are also more certain of the outcomes of ERP initiatives, which motivates them to adopt more ERP modules for effective ERP implementation. Thus, at times of low uncertainty, technology evaluation, rather than technology imitation, is a more effective approach to the design of appropriate strategies for ERP adoption. Such an approach helps to ensure more ERP adoption and more capacity to reap the benefits of ERP systems. Thus, in China:

> *H4: When environmental uncertainty is high, the effect of technology imitation on ERP adoption is stronger than that of technology evaluation (a); however, when environmental uncertainty is low, the effect of technology evaluation on ERP adoption is stronger than that of technology imitation (b).*

The Moderating Effect of Competition Intensity

Competition intensity is the degree of competitive strength among players within an industry. In China, Confucianism encourages competition for organizational social status, resources, and performance [6]. However, intense competition can lead to the use of homogeneous strategies in an effort to neutralize the aggressive actions of rivals [53] by matching the behavior of their competitors. Moreover, when competition is intense, organizations have more pressure and less time to evaluate ERP in response to current challenges. This coercive competitive pressure within an industry forces organizations to imitate leading competitors, making them less likely to execute evaluation decisions [22]. Thus, technology imitation may become more influential in ERP adoption at times of intense competition, and it may reverse when competition intensity is low. These general principles should apply in a Chinese context to the extent that a given industry faces intense competition. As evidenced in the highly competitive market of electronic commerce in China, online companies are very responsive to their competitors' strategies as they imitate successful methods immediately to avoid falling behind. This phenomenon is not as obvious in less competitive industries such as manufacturing. In China, most large firms are not exposed to high levels of intense industry competition especially SOEs that are shielded from internal and external competition [36, 89]. They have less pressure and more time for evaluating their competitors' strategic moves prior to their decision making for counteracting strategies. Thus, in China:

> *H5: When industry competition is high, the effect of technology imitation on ERP adoption is stronger than that of technology evaluation (a); however, when industry competition is low, the*

effect of technology evaluation on ERP adoption is stronger than that of technology imitation (b).

ERP Assimilation in Terms of Imitation and Evaluation

The Direct Effects of Imitation and Evaluation Behavior

Technology evaluation and imitation may have differential effects on the lengthy process of ERP assimilation. Technology evaluation gives organizations a better understanding of ERP and its fit to business operations thereby directing learning and adaptation processes toward successful institutionalization. Technology evaluation also enables organizations to effectively chart an assimilation strategy to capitalize on ERP's potential contributions to streamlined business practices and the integration of organizational data [79]. These effects of technology evaluation are particularly crucial in China as popular ERP systems are mostly developed in the West. During the ERP adoption stage, Chinese organizations may be more constrained by ERP in their business activities. However, as ERP is assimilated over time, Chinese organizations' ERP knowledge accumulated from adoption and assimilation evaluation allows them to develop useful ERP integration solutions, thus localizing ERP to their business practice, local culture, and language needs. Imitation, by contrast, may be influential in the initial ERP decision after which the organization learns from its own and others' experience [53]. Thus, organizations may not only imitate adoption decisions but also when learning to build their own capacity for ERP utilization. Yet, time lags and relative learning rates may affect the learning dynamics of imitators thereby resulting in low-quality ERP assimilation. These effects of learning and performance have already been demonstrated by empirical findings in other contexts [e.g., 17]. We propose this as especially true in an ERP context because the "best practices" embedded in an off-the-shelf implementation of ERP are unlikely to satisfy all users [52]. The fit of these "best practices," in both management mindset and organizational behaviors, to Chinese firms justifies thorough evaluation. Such assessment is important because China has very unique technological, organizational, cultural, industrial, and legal requirements, which makes standard implementation of Western-based ERP technologies especially challenging [10]. Implementing most off-the-shelf ERP "best practices" based on Western industries will clash with language, culture, and established business practices in China. Thus, in China:

H6: Technology evaluation and imitation both have a positive effect on ERP assimilation (a), but the effect of technology evaluation is stronger than that of technology imitation (b).

The Moderating Effect of Top Management Participation

Top management belief and participation are not the same; belief leads to participation, but does not guarantee it [52]. Hence, participation is more crucial, and this is especially true in China where management has outsized influence in contrast to Western firms. The reason for this is that respect for seniors and authority has always been a core belief in Confucianism [11]. Accordingly, organizational employees are expected to comply with the instructions of senior management without question. Top management participation refers to senior executives' behavior related to institutional planning, development, and implementation [44]. This participative behavior is essential in the assimilation stage because it is needed to plan efficient IT processes and strategically assimilate the targeted IT [4]. Top management participation can also help to coordinate and resolve conflicts among individuals and functions in the assimilation process [39]. In China, when top management is actively involved in ERP assimilation, organizations become more conscious of ERP's goals, thus enabling more organizational alignment [52]. Given the unique challenges of China ERP implementation, research has shown that top management support is crucial throughout an ERP project and for successful implementation of the innovation [30, 36, 104].

Likewise, a reduction in top management participation should lead to less effective ERP leadership. Subsequently, organizations may be less able to integrate an ERP infrastructure that is beneficial to long-term competitiveness, or they may invest in ERP as an act of faith [52], leading to resistance or devising workarounds such as the use of shadow systems [78]. Without top management participation, organizations are likely to be less visionary, less coordinated, and less committed to ERP assimilation; they are thus more likely to imitate or be influenced by their trading partners or competitors to institutionalize their ERP. Previous Chinese ERP implementation studies have shown that when top managers delegate their ERP involvement to lower-level managers, it sends negative signals about the implementation that undermine long-term post-implementation success [62, 67]. Thus, in China:

H7: When top management participation is high, the effect of technology evaluation on ERP assimilation is stronger than that of technology imitation (a); however, when top management participation is low, the effect of technology imitation is stronger than that of technology evaluation (b).

The Moderating Effect of Vendor Involvement

In China, having an implementation partner is just as crucial as top management participation [10]. The effectiveness of vendor involvement in transferring knowledge is essential to the success of ERP assimilation, especially because extra challenges are introduced when implementing Western-developed ERP packages in the unique cultural environment of China [10, 30]. When vendors assume more responsibilities and become more involved in planning and strategic tasks, their influence on assimilation is more extensive and effective [80]. Such vendors are especially helpful in China with resolving internal conflicts and improving the internal communication necessary for implementation success [85]. Vendors are also helpful in reconciling the differences in China's and ERP's built-in business practices along with the variations of language use in ERP and business operation. Thus, with a high level of vendor involvement, organizations are more motivated and able to rationally evaluate ERP systems and practices, which leads to more effective ERP assimilation. However, the literature is not clear about how vendor involvement moderates the impact of social imitation on ERP assimilation. Nonetheless, agency theory suggests that when the involvement of a vendor (as an agent) is low, knowledge asymmetry between vendor and organization in ERP assimilation continues, thus forcing Chinese organizations to exploit ERP by engaging in learning-by-imitating for an optimal assimilation solution [49]. Thus, we propose that in China weak vendor involvement encourages technology imitation and discourages technology evaluation:

H8: When vendor involvement is high, the effect of technology evaluation on ERP assimilation is stronger than that of technology imitation (a); however, when vendor involvement is low, the effect of technology imitation is stronger than that of technology evaluation (b).

The Moderating Effect of Organizational Innovativeness

In the last few decades, China has been active in joint ventures with multinational corporations, privatizing SOEs, and establishing innovative high-tech regions. These national strategies offer opportunities for Chinese organizations to be exposed to leading technologies and modern management,

thus allowing for more innovation. Innovative organizations are, in general, larger and more open with norms that encourage change [71]. They also have more slack resources and absorptive capacity and thus more time and resources for the scanning, experimenting, and learning involved in adopting ERP systems [73]. The better learning capabilities of innovative organizations avow them more opportunity to achieve the organizational transformations facilitated by ERP. These transformations include alignment of the much-touted best practices of the respective ERP systems with an organization's existing practices and the transformation of an organization's existing IT infrastructure and data architecture to the ERP platform. Innovative organizations are also more likely to implement a centralized support unit to guide and coordinate their ERP initiatives [64]. Thus, we propose that the most innovative organizations are more proactive and have more resources to create effective evaluation strategies for ERP adoption.

However, there are Chinese organizations that are more traditional and more susceptible to the influence of Confucianism. These organizations place a greater emphasis on social and cosmic harmony which leads to more social conformity and less innovation [19]. When organizations are less innovative, they are more likely to follow an imitation route, as shown extensively in China [10, 15, 47]. Such firms also tend to have fewer resources for adopting innovations and have less information on innovative offerings [74]. As such, these organizations have fewer strategic reasons for adopting ERP systems other than to follow their competitors. Innovative firms in China can best be represented by joint ventures while less innovative firms are often conservative SOEs. Joint ventures tend to set up a cross-functional steering committee to achieve a consensus on strategies for ERP assimilation. In contrast, SOEs' assimilation strategies are designated to individuals' responsibility [58]. Thus, with more organizational innovation, the effects of evaluation are more expected, whereas with less organizational innovativeness, the effects of imitation on ERP adoption are probably more consequential. Thus, we propose:

> *H9: When organizational innovation is high, the effect of technology evaluation on ERP assimilation is stronger than that of technology imitation (a); when organizational innovation is low, the effect of technology imitation is stronger than that of technology evaluation (b).*

METHODOLOGY

Sample

The sample for our study were randomly selected from the company database maintained by the Ministry of Commerce in the People's Republic of China. A total of 379 companies were randomly chosen from 1,800 companies that have implemented ERP (out of 10,000 registered companies). The selected companies were contacted for information related to their ERP adoption and assimilation. Whenever possible, the highest ranking member of the committee that oversaw the company's ERP adoption was contacted for an on-site interview and to answer our questionnaire. This person was considered to have good knowledge of the company's ERP adoption and assimilation processes. Because the ERP committee members were responsible for making ERP adoption decisions and devising strategies for its implementation, they could also describe their organization's perspective on IT innovation. In addition, they had access to the minutes of the ERP committee meetings and other relevant documents if they were in doubt about their company's ERP adoption decision-making process or assimilation status.[v]

Questionnaire Development

We used a number of measures to ensure the validity and reliability of the questionnaire. In addition to using previously validated questions, each of the questionnaire items was pre-tested by two business professors with expertise in survey research and eight IT professionals with significant ERP experience. After the questionnaire was finalized, it was pilot tested by 52 graduate management information system (MIS) students who had work experience and ERP knowledge. Finally, following leading literature on developing scales for Chinese participants, the revised questionnaire was translated into Chinese using the back-translation method by a bilingual professor. The translated Chinese questionnaire was then translated back into English by another bilingual professor and checked by a native English speaker for semantic equivalency with the original English version. This process continued until the back-translated English version corresponded closely to the original English version.

Data Collection

We adopted a cross-sectional approach for data collection. This approach is less costly and time-consuming than a longitudinal approach but introduces potential validity concerns of common method variance (CMV) and causal inference (CI) [92]. Furthermore, Rindfleisch et al. [69] suggested

that a longitudinal approach is not necessarily required if a study's key constructs are concrete and externally oriented; the responses are from key informants and their response bias is low; the measurement format and scales are heterogeneous; the end dates of predictor variables are unclear the theoretical foundation is well developed; the likelihood of an intervening event is high; the likelihood of alternative explanations is low; and the nature of argument is between organizations. Our study fulfills all of these eight criteria, thus justifying our cross-sectional data collection.

Sixteen graduate MIS students from a top university in Beijing were the interviewers in this study. These students, who were already familiar with ERP concepts and had experience in conducting academic surveys, were provided with one day's training in ERP, interview techniques, and the project's background. The students also reviewed the questionnaire items and participated in mock interviews with the trainers. To maximize consistency and standardization in interviewing, the students were given a standardized script including opening and closing remarks and were asked to read the questions exactly as they were worded in the questionnaire.

We followed several processes to minimize the effects of interviewer error on the collected data[vi]. We also followed several procedures to minimize the adverse effects associated with cross-sectional data collection.[vii]

Measures

All constructs (except assimilation) were measured using five-point Likert-type scales, with one indicating "strongly disagree" and five indicating "strongly agree" (see Appendix B). The interviewees were asked to relate their responses to the time of their company's ERP adoption (for the adoption items) and to their company's current ERP use (for the assimilation items).

The data on ERP adoption were captured by the modules on supply chain activities and the total number of adopted ERP modules. The former is consistent with previous studies that applied the extent of IT use to business activities in e-business, open systems, and software practice technologies [26]. The measure based on the number of ERP modules adopted was developed by [37] and adapted by [66]. ERP adoption in the present study is classified into four levels according to its use in value-chain modules

(materials management, operations, sales and distribution, supply chain management, and customer services) and enterprise-support modules (finance, human resources, and data warehouse).

An organization was classified as a level-1 implementer if it had adopted only enterprise-support modules, a level-2 implementer if it had adopted one value-chain module (with or without enterprise-support modules), a level-3 implementer if it had adopted two or three value-chain modules (with or without enterprise-support modules), and a level-4 implementer if it had adopted a full suite or a selected suite of four value-chain modules. Non-adopters were assigned a zero. This classification is a comprehensive measure because it captures two essential characteristics of ERP adoption—*width* (coverage of supply chain activities) and *depth* (the total number of modules). The interviewees were instructed to indicate if their company's ERP modules had been adopted at the initial implementation stage or were the same as those they were using at the time of our survey regardless of whether the modules were routinized after adoption.

The scale of ERP assimilation, which was adapted from [52] and was composed of three items to measure volume, diversity, and depth of assimilation. The volume dimension was measured by the percentage of the firm's business processes that used the ERP system. The diversity dimension was assessed by the number of the firm's business functions that were automated by the ERP system. The depth dimension was measured by the vertical effect of the ERP system on the firm's business activities, ranging from ongoing planning to strategic decision-making. The interviewees were asked to respond to those survey questions based on the situation at the time of the survey.

Specified as a second-order formative construct, the measure of ERP imitation, developed by, was subdivided into three organizational modes designed to measure frequency-, trait-, and outcomes-based imitation. Accordingly, it was specified as a second-order formative construct with these three modes as its sub-dimensions. The ERP evaluation measure was based on the evaluation results of the three DOI dimensions—relative advantage, compatibility, and complexity. It was treated as a second-order formative construct composed of these three components.[viii]

The measures of technology readiness were adapted from [103]. Top management belief and

management participation were measured by top management's perceived value of ERP in business activities and their participation in managing the ERP initiative. The measurement involved three items adapted from [52] and used in [49]. Environmental uncertainty was assessed using two proxies: market and technological turbulence, which were adapted from [33]. Competition intensity was assessed by a three-item scale adapted from [45]. Organizational innovation was assessed by a four-item scale adopted in [77]. Vendor involvement was the extent of a vendor's investment in the relationship with the organization, the business process restructuring that was undertaken to fit the relationship requirements, and the establishment of an implementation team [18, 72].

To help test counter-explanations to our model, we used five control variables: *industry type*, *ownership type*, *firm age*, *firm size*, and *time since ERP adoption*. *Industry type* was classified by sector (e.g., finance, manufacturing, IT, insurance, and health). These industries face different sets of circumstances and industry competition; thus, they likely have differential effects on ERP assimilation [93]. *Ownership type* was categorized as SOE, domestic-private-owned, joint-venture, or solely foreign-invested. In China, ownership type is likely to differ in innovativeness. For example, SOE are more prone to maintaining bureaucratic procedures, whereas joint-ventures are more inclined to innovation. A domestic enterprise may lack the necessary skills to conduct systematic reviews of its ERP system, whereas a foreign enterprise may be more likely to acquire the skill set through their mother company. Firm age was measured by the natural logarithm of the number of years of business operation, and the natural log transformation was used to account for the diminishing effects of firm age. In general, new organizations tend to be more flexible in introducing new technologies; thus, the organization's age can also affect technology assimilation [34]. Firm size, as a formative variable, was measured by the affiliate's annual sales and number of employees. This variable has been validated in prior studies to have differential effects on ERP business process outcomes in process efficiency, effectiveness, and flexibility, thus resulting in ERP implementation benefits in different ways [57]. Finally, time since ERP adoption was the number of years from ERP adoption to the date of the survey. Research suggests that time since ERP adoption not only influences cumulative organizational learning but also mediates ERP assimilation.

DATA ANALYSIS AND RESULTS

Interviewee Profiles

Two hundred and eight subjects completed the questionnaire— a response rate of 54.9%. Details about the responding companies are shown in Table 1. The interviewees were mostly top managers including chief executive officers (13.5%), chief information officers (20.2%), chief financial officers (18.8%), and chief operations officers (9.6%). The remaining responses came from middle managers including senior IT managers (9.6%), senior sales managers (5.8%), and senior finance managers (2.4%). The seniority of our interviewees indicated the reliability and quality of the collected data.

Table 1: Interviewee Profiles

	Frequency	Percentage
Interviewee Title		
Senior management	162	77.9
Middle management	46	22.1
Industry Type		
Manufacturing	148	71.2
Service	50	24.0
Retailing	10	4.8
Ownership Type		
State-owned	52	25.0
Private-owned	59	28.4
Joint-venture	28	13.5
Foreign	64	30.7
Other	5	2.4
Employee Number		
Less than 100	23	11.1
100–499	45	21.6
500–999	30	14.4
1000–4999	56	26.9
5000 and more	54	26.0
Total Fixed Assets (in million RMB)		
Less than 4.99	25	12.0
5–9.99	12	5.8
10–49.99	22	10.6
50–99.99	31	14.9
100–299.99	26	12.5
300 and higher	92	44.2

Non-response bias was assessed using the extrapolation procedure suggested by [3] to compare the first quartile with the last quartile of interviewees. For this comparison, we used two-tailed *t*-tests on the scale variables of company profile characteristics and all indicators of key constructs. For the categorical variables of company characteristics (industry type and ownership type), we performed

chi-square tests to compare the first quartile with the last quartile of responses. The comparisons revealed no significant differences, suggesting that non-response bias was unlikely to be present in our data.

Measurement Model Analysis

The measurement models for formative constructs (ERP assimilation, relative advantage, compatibility, and complexity, and firm size) and reflective constructs (all others) were analyzed separately, because formative and reflective constructs require different analysis procedures. These validity analyses were performed in accordance with the latest guidelines in [31, 56]. Full details are in Appendix C.

To check if our cross-sectional data introduced a major challenge to our two-stage model, we conducted a series of comparison analyses. First, we split the data into two groups in terms of years of ERP adoption. To be consistent with [49] and [71], we created the "early stage" group for those who had adopted ERP less than 4 years and the "later stage" group for those who had adopted ERP more than 7 years. We ran the adoption model with the "early stage" group and the assimilation model with the "later stage" group. The results from these sub-groups were then compared with results from the whole dataset. The comparisons did not reveal any significant differences, indicating our model could be appropriately tested using our cross-sectional data. Analysis details are found in Appendix D.

Structural Model Analysis

We followed the moderated regression analysis (MRA) procedure recommended by [75] to validate our research model. With this approach, a series of regression analyses were run in a specific order, each with one or more variable(s) than the previous regression analysis. In the first step, only the control variables were regressed against the dependent variable (Model 0). Next, the two main antecedent variables, imitation and DOI, were added into the model (Model 1). Third, each moderator for adoption (technology readiness, top management belief, environmental uncertainty, and competition intensity) and assimilation (top management participation, vendor involvement, and organizational innovativeness) was added into Model 1, creating Models 2, 4, 6, and 8 for adoption and Models 2, 4 and 6 for assimilation, respectively. Finally, the interaction terms (independent * moderating variables) were added into Models 2, 4, 6, and 8 and Models 2, 4 and 6 to create Models 3, 5, 7, and 9 for adoption and Models 3, 5, and 7 for assimilation,

respectively. Following, all non-dichotomous independent variables were mean centered before the formation of the interaction terms. In addition, we examined whether the moderations were sensitive to the nonlinear effects of the predictors on each criterion by controlling for the squared effects of the predictors (imitation and DOI). The results are shown in Tables 2a and 2b.

To confirm the hypotheses, we split the sample into a series of two sub-samples by the proposed moderator's mean value. We used the approach in [2] to define a moderator's high and low level as one standard deviation above or below the mean. Regressions were run on the sub-samples. Then, *t*-tests and Smith-Satterthwaite (S-S) tests [23] were applied to compare the path coefficients of the two sub-samples. The results of these two tests are reported in Tables 3a and 3b.

ERP Adoption

The MRA models were assessed using various indexes (see Table 2a). The Cohen's f^2 values of 0.047 and 0.059 for technology readiness and environmental uncertainty, respectively, suggested that these moderation effects were of medium size. We also conducted an *F*-test for the significance of the incremental R^2. The resultant *F*-values for these two moderation effects were significant (F = 6.513 and 8.145; p =0.02 and p<0.001, respectively), indicating that the incremental R^2 (ΔR^2) explained by these two moderation effects on ERP adoption was significant. The ΔR^2 for the moderation effects of top management belief (F = 0.341, *n.s.*) and competitive intensity (F = 0.341, *n.s.*) were not significant.

The main effects of both imitation and DOI were significant for ERP adoption (β = 0.135 and 0.112; p < 0.05), but these effects showed no significant difference in magnitude (t = 1.086, *n.s*; see Table 3a). Thus, H1 is only partially supported.

For the moderation effect of technology readiness, our results (shown in Table 2a) suggested that it was a significant moderator for the effects of both DOI and imitation on ERP adoption (β = -0.182 and 0.268, respectively; p < 0.01). Further analysis of these relationships showed that when the levels of technology readiness varied, the effects of imitation and DOI on adoption exhibited very different patterns. As shown in Table 3a, when the level of technology readiness was low, imitation had a stronger effect than DOI on ERP adoption (t = 8.153; p < 0.01) and the effect of DOI on adoption was not

significant (β = 0.069, *n.s.*). By contrast, when the level of technology readiness was high, DOI had a stronger effect than imitation (t = -2.681; $p < 0.05$). Thus, H2 is supported.

Top management belief did not show any significant variation in its moderating effect between imitation and DOI for ERP adoption (β = 0.017 and 0.049, *n.s.* See Table 2a, Model 5; t =1.213, *s-s* = 1.322, *n.s.* and t = -1.154, *s-s* = -1.306, *n.s.* for imitation and DOI, respectively; see Table 3a). Regardless of whether top management belief is high or low, the effects of imitation and DOI on adoption showed no significant difference (t = 0.561 and 1.091, *n.s.*; see Table 3a). These findings suggest H3 is not supported.

Environmental uncertainty did change the relative positions of imitation and DOI in adoption. Although imitation had the same effect on adoption at different levels of environmental uncertainty (t = -0.088, *s-s* = -0.137, *n.s.*), the effect of DOI was significantly higher when uncertainty was low (t = 8.663, *s-s* = 9,712, $p < 0.01$). When uncertainty was low, DOI had a significantly stronger impact on adoption than imitation (β = 0.276, $p < 0.01$ and 0.144, $p < 0.05$, respectively; t = -4.541, $p < 0.01$). By contrast, when uncertainty was high, imitation had a stronger impact (β = 0.149, $p < 0.05$) than DOI (t = 2.892, $p < 0.05$) and the effect of DOI was not significant (β = 0.051, *n.s.*). Thus, H4 is supported.

Competitive intensity demonstrated the same moderating patterns as top management belief. It did not change the effects of imitation and DOI on adoption (β = -0.018 and 0.052, *n.s.*; see Table 2a, Model 9; t = 0.091, *s-s* = 1.004, *n.s.* and t = -0.082, *s-s* = -1.076, *n.s.* for imitation and DOI, respectively; see Table 3a). Similarly, the differences of effects between imitation and DOI on adoption were not significant regardless of whether competitive intensity was high or low (t = 0.891 and -0.091, *n.s.*; see Table 3a). These results suggest that H5 is not supported.

ERP Assimilation

The results for the MRA models are reported in Table 2b. The F-test for ΔR^2 indicated that the top management participation moderation effect was not significant (F = 1.665, p = 0.191), while the moderation effects of vendor involvement and organizational innovativeness on assimilation were significant (F = 12.636 and 9.424, p = 0.000 and 0.000, respectively). The Cohen f^2 of 0.091 and 0.058

suggested a small effect size for the moderation effects of vendor involvement moderation and organizational innovativeness. However, in dealing with such complex interaction terms, a small effect is considered highly meaningful [16]. Similar to adoption, both imitation and DOI had significant effects on ERP assimilation (β = 0.121 and 0.117, $p < 0.05$), but these effects showed no significant difference in magnitude (t = 0.122, *n.s.*; see Table 3b). Thus, H6 is only partially supported.

Top management participation did not influence the effects of imitation and DOI on assimilation (t = -0.915, s-s = -0.996, *n.s.* and t = 0.082, s-s = 0.103, *n.s.* for imitation and DOI, respectively; see Table 3b). In addition, regardless of whether top management participation was high or low, the effects of imitation and DOI on assimilation showed no significant difference in magnitude (t = 0.051 and 0.203, *n.s.*; see Table 3b). These findings suggest that H7 is not supported.

By contrast, vendor involvement significantly changed the patterns of the effects of imitation and DOI on assimilation. Although the effect of imitation on assimilation did not significantly change when vendor involvement shifted from low to high (t = -0.093, s-s = -0.106, *n.s.*), the effect of DOI on assimilation was significantly augmented (t = -9.763, s-s = 10.152, $p < 0.01$). In addition, when vendor involvement varied, so did the relative strength of imitation and DOI. When vendor involvement was low, imitation had a stronger effect on assimilation than DOI (t = 2.185, $p < 0.05$). However, when vendor involvement was high, DOI had a stronger effect than imitation (t = -3.165, $p < 0.05$; see Table 3b). These results suggest that H8 is supported.

A comparison of the moderating effects of innovativeness on the relationships between DOI, imitation, and ERP assimilation (as shown in Table 2b, Model 7) confirmed that the effects of DOI and imitation were not significantly different for less innovative companies (t = -1.056, *n.s.*; see Table 3b). However, for highly innovative companies, the effect of DOI was significantly higher than that of imitation for ERP adoption (t = -4.363, $p < 0.01$). Thus, H9 is partially supported.

DISCUSSION AND IMPLICATIONS

Summary of Results

In a China context, the results show that technology imitation and evaluation *both* have a positive

Table 2a: The Results of Hierarchical Regression Analysis—Adoption

DV = Adoption	Base Model 0	Main Model 1	Moderators: Technology readiness		Top management belief		Environmental uncertainty		Competition intensity	
			Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Industry	-.021^{ns}	-.035^{ns}	-.055^{ns}	-.052^{ns}	-.061^{ns}	-.047^{ns}	-.088^{ns}	-.069^{ns}	-.061^{ns}	-.061^{ns}
Ownership	.183*	.117*	.175*	.174*	.180*	.168*	.181*	.168*	.180*	.182*
Age	-.019^{ns}	-.014^{ns}	-.008^{ns}	-.051^{ns}	-.008^{ns}	-.058^{ns}	-.016^{ns}	-.028^{ns}	-.029^{ns}	-.038^{ns}
Size	.192**	.187**	.172**	.160**	.181**	.178**	.166*	.158*	.159*	.170*
Imitation		.135*	.121*	.132*	.137*	.135*	.131*	.131*	.131*	.130*
DOI		.112*	.105*	.096*	.112*	.112*	.106*	.142*	.113*	.108*
Imitation × Imitation				.007^{ns}.		.008^{ns}.		.009^{ns}.		.007^{ns}.
DOI × DOI				.013^{ns}		.018^{ns}		.015^{ns}		.019^{ns}
Technology readiness			.305**	.215**						
Imitation × Tech. readiness				-.182**						
DOI × Technology readiness				.268**						
Top management belief					.050^{ns}	.031^{ns}				
Imitation × Top mgt. belief						.017^{ns}				
DOI × Top mgt. belief						.049^{ns}				
Uncertainty							.005^{ns}	.013^{ns}		
Imitation × Uncertainty								-.037^{ns}		
DOI × Uncertainty								-.131**		
Competition									.032^{ns}	.051^{ns}
Imitation × Competition										-.018^{ns}
DOI × Competition										.052^{ns}
R^2	*0.141*	*0.181*	*0.218*	*0.253*	*0.183*	*0.185*	*0.187*	*0.232*	*0.183*	*0.185*
ΔR^2	--	0.040	0.037	0.035	0.002	0.002	0.006	0.045	0.002	0.002
F for ΔR^2	--	6.862	13.248	6.513	0.685	0.341	2.066	8.145	0.685	0.341
Sig. F	--	0.001	0.000	0.002	0.408	0.711	0.152	0.000	0.408	0.711
f^2	--	0.049	0.047	0.047	0.002	0.002	0.007	0.059	0.002	0.002

*Note: * p < 0.05; ** p < 0.01; *** p < 0.001; ns: not significant at p < 0.05; F, ΔR^2, and f^2 values of Models 3, 5, 7, and 9 are based on the comparisons with Models 2, 4, 6, and 8, respectively; F, ΔR^2, and f^2 values of Models 2, 4, 6, and 8 are based on the comparisons with Model 1; F, ΔR^2, and f^2 values of Model 1 are based on the comparison with Model 0.*

Table 2b: The Results of Hierarchical Regression Analysis—Assimilation

DV = Assimilation	Base Model 0	Main Model 1	Moderators: Top management participation		Moderators: Vendor involvement		Moderators: Organizational innovativeness	
			Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Industry	-.059^{ns}	-.068^{ns}	-.058^{ns}	-.054^{ns}	-.050^{ns}	-.076^{ns}	-.069^{ns}	-.064^{ns}
Ownership	.182*	.176*	.170*	.170*	.166*	.160*	.172*	.171*
Age	-.019^{ns}	-.039^{ns}	-.029^{ns}	-.018^{ns}	-.038^{ns}	-.039^{ns}	-.044^{ns}	-.041^{ns}
Size	.172**	.168**	.165**	.159**	.150*	.153*	.166*	.158*
Experience (time since ERP adoption)	.118*	.107*	.106*	.102*	.084*	.071^{ns}	.102*	.093*
Adoption	.521**	.506*	.505*	.505*	.501*	.499**	.505*	.498*
Imitation		.121*	.123*	.118*	.119*	.117*	.122*	.123*
DOI		.117*	.116*	.108*	.111*	.112*	.119*	.115*
Imitation × Imitation				.008^{ns}		.007^{ns}.		.010^{ns}
DOI × DOI				.015^{ns}		.011^{ns}		.013^{ns}
Top management participation			.049^{ns}	.051^{ns}				
Imitation ×Top management participation				.021^{ns}				
DOI × Top management participation				.019^{ns}				
Vendor involvement					.177*	.159*		
Imitation × Vendor involvement						.050^{ns}		
DOI × Vendor involvement						.141*		
Innovation							.019^{ns}	.015^{ns}
Imitation × Innovativeness								-.020^{ns}
DOI × Innovativeness								.127*
R^2	*0.409*	*0.491*	*0.493*	*0.499*	*0.532*	*0.571*	*0.496*	*0.528*
ΔR^2	--	0.082	0.002	0.006	0.041	0.039	0.005	0.032
F for ΔR^2	--	22.635	1.105	1.665	24.530	12.636	2.778	9.424
Sig. F	--	0.000	0.294	0.191	0.000	0.000	0.097	0.000
f^2	--	0.161	0.004	0.012	0.088	0.091	0.010	0.068

*Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ns: not significant at $p < 0.05$; F, ΔR^2, and f^2 values of Models 3, 5, and 7 are based on the comparisons with Models 2, 4, and 6, respectively; F, ΔR^2, and f^2 values of Models 2, 4, and 6 are based on the comparisons with Model 1; F, ΔR^2, and f^2 values of Model 1 are based on the comparison with Model 0.*

Table 3a: The Path Coefficient Comparisons for Adoption

IVs	Base Model 1	Moderated Models											
		Technology Readiness			Top Management Belief			Environmental Uncertainty			Competitive Intensity		
		Low	High	†T/S-S	Low	High	†T/S-S	Low	High	†T/S-S	Low	High	†T/S-S
Imitation	.135*	.228**	.113*	4.872**/ 5.012**	.138**	.121*	1.213ns/ 1.322ns	.144*	.149*	-.088ns/ -.137ns	.129*	.128*	.091ns/ 1.004ns
DOI	.112*	.069ns	.165**	-2.472*/ -2.833*	.125*	.110*	-1.154ns/ -1.306ns	.276**	.051ns	8.663**/ 9.712**	.119*	.129*	-.082ns/ -1.076ns
‡t Value	1.086ns	8.153**	-2.581*	--	.561ns	1.091ns		-4.541**	2.892*	--	.891ns	-.091ns	--

Note: ** $p < 0.01$; * $p < 0.05$; n.s. not significant; † T and S-S values for the difference in coefficients between sub-samples; ‡ conventional t statistics for the difference of coefficients between Imitation and DOI.

Table 3b: Path Coefficient Comparisons for Assimilation

IVs	Base Model 1	Moderated Models								
		Top Management Participation			Vendor Involvement			Organizational Innovativeness		
		Low	High	†T/S-S	Low	High	†T/S-S	Low	High	†T/S-S
Imitation	.121*	.122**	.128*	-.915ns/ -.996ns	.115*	.123*	-.093ns/ -.106ns	.108*	.128*	-.863ns/ -.982ns
DOI	.117*	.120*	.119**	.082ns/ .103ns	.044ns	.225**	-9.763**/ -10.152**	.114*	.276**	-4.486**/ -4.673**
‡t Value	.122ns	.051ns	.203ns	--	2.185*	-3.165*	--	-1.056ns	-4.363**	--

Note: ** $p < 0.01$; * $p < 0.05$; n.s. not significant; † T and S-S values for the difference in coefficients between sub-samples; ‡ conventional t statistics for the difference of coefficients between Imitation and DOI.

effect on ERP adoption ($H1_a$ supported); however, the effects of technology evaluation and technology imitation are similar ($H1_b$ not supported). When technology readiness is high, the effect of technology evaluation on ERP adoption is stronger than that of technology imitation ($H2_a$ supported); however, when technology readiness is low, the effect of technology imitation on ERP adoption is stronger than that of technology evaluation ($H2_b$ supported). H3 was not supported because it was based on the premise that top management belief was a positive moderator in the model; instead, top management belief has direct and mediating effects on adoption behavior. When environmental uncertainty is high, the effect of technology imitation on ERP adoption is stronger than that of technology evaluation ($H4_a$ supported); however, when environmental uncertainty is low, the effect of technology evaluation on ERP adoption is stronger than that of technology imitation ($H4_a$ supported). H5 was not supported, as we found no effects tying level of industry competition with differential effects of imitation or evaluation. Technology evaluation and imitation both have a positive effect on ERP assimilation ($H6_a$ supported), but there are no differences between technology evaluation and imitation in strength of effect on ERP assimilation ($H6_b$ not supported). H7 was not supported, as we found no effects tying level of management participation with differential effects of imitation or evaluation. When vendor involvement is high, the effect of technology evaluation on ERP assimilation is stronger than that of technology imitation ($H8_a$ supported); however, when vendor involvement is low, the effect of technology imitation is stronger than that of technology evaluation ($H8_b$ supported). Finally, when organizational innovation is high, the effect of technology evaluation on ERP assimilation is stronger than that of technology imitation ($H9_a$ supported); however, when organizational innovation is low, the effect of technology imitation is not significantly stronger than that of technology evaluation ($H9_b$ not supported).

Explaining Contributions of Contrary Results in a China Context

Despite most of our hypotheses being supported, several turned out contrary to our predictions. Certain factors of the China context may have affected these outcomes in ways we did not previously expect. First, to rapidly develop as a world power, China has commonly followed an imitation, “leap-frog” approach in manufacturing and industrial processes, which has resulted in late adoption of ERP. However, this

"leap-frog" approach has been challenging with ERP because of technological and cultural barriers, including with major Western providers such as SAP and Oracle [10], whose products are not fully localized to China. More recently, Chinese firms have experienced more ERP implementation success as Chinese firms have gained technological and external expertise [10, 52]. Hence, it is not entirely surprising to find that there is no statistical difference between imitation and evaluation drivers on adoption and assimilation ($H1_b$ not supported) because imitation has had a strong influence on ERP adoption and diffusion in China, and many of China's current industries continue to embrace this mindset.

Another likely explanation for several other contrary results is that a large portion of the firms we studied were SOEs or similarly protected firms, which have some unique, important characteristics that affect our context. First, these are often highly bureaucratic and inefficient firms that are largely protected not only by foreign but also domestic competition despite intense reforms over the years [36, 54, 89]. In fact, some SOEs have simply become larger by absorbing less successful SOEs that have failed in required reforms. Second, many of these firms are prone to practices of guanxi, favoritism, corruption, and even instances of management positions being given out or retained as favors [42]. As a result, some managers in SOEs often lack the competence, knowledge, and training of their Western counterparts [42] and tend to lack incentives for innovation [36] especially because sometimes the government does not favor improvement if jobs will be lost in their sectors [62]. Third, such firms tend to have worse innovation infrastructure and more poorly trained workers as compared to establishments in the private industry [10, 89]. Fourth, managers at SOEs tend to have an authoritarian, command-and-control decision-making style (and workers tend to have a duty and obedience style) [54], which conflicts with the management style typically needed for ERP implementation [62]. Research provides evidence that more Western types of management (e.g., consensus-building, empowerment) are critical for successful ERP implementation and that the common practice of delegating implementation of ERP to lower managers undermines implementation success [62, 67].

Juxtaposed to this added understanding of the China context, we found that top management's ERP belief and top management's ERP participation had no positive role in our model (H3 and H7 not

supported, respectively). Hence, because most of our respondents were either from SOEs or large firms that experience some form of protection, they most likely employed a hierarchical administration structure. Top managers in these companies tend to control rather than supervise ERP projects. They are commonly reluctant to be directly involved in their company's projects or in resolving ERP implementation issues [58, 67]. Management's relative inexperience with the automation and standardization that comes with ERP also restricts their ability to differentiate between the merits of evaluation and imitation approaches to ERP assimilation.

Likewise, the level of industry competitiveness had no bearing on the outcomes (H5 not supported). We attribute these findings to the general lack of competition found in SOEs and other large firms in China. To a certain extent, China's economy is still state-controlled, which probably reduces management incentive to deploy effective strategies to ease competition pressure. This finding coincides with the claim that competition can create implicit incentives to stimulate efficiency [55] suggesting that when competition is reduced owing to a state-controlled economy, organizations' incentives for efficiency are also reduced. As a consequence of this competition–incentive relationship, organizations may be less discriminative in the use of imitation or evaluation for their ERP adoption decisions.

Moreover, even highly trained and competent SOE managers naturally have little incentive to deploy strategic initiatives to improve their firms' performance [36] because they work in protected industries with monopolistic traits and virtually no competition.[ix]

In contrast, external vendor involvement had a positive influence on ERP implementation—further indicating that internal management does not have the resources or management knowledge to make ERP and assimilation successful in SOE firms without external help. (H8 supported). We expect our H3 and H7 predictions to be accurate for private Chinese firms in highly competitive industries.

Key Contributions and Implications for Research

Our research provides an important contextualized model of Chinese ERP implementation that predicts factors that lead to adoption or assimilation. Aside from examining both of these dependent variables, a compelling aspect of our study is that we do not treat technological imitation or evaluation as a

dichotomous choice that fosters either adoption or assimilation. Instead, we argue that in a China context, it makes sense to assume that both processes are at play (as China was a late entrant into ERP adoption) and therefore that it is crucial to empirically evaluate how technology imitation and evaluation complement each other and where these processes differ. Our results suggest that technology imitation and technology evaluation practices have crucial effects on the extent of ERP adoption and assimilation in China. Both imitation and evaluation act as direct effects, but they are also moderated by several key TOE factors. Although extant studies have addressed how imitation and evaluation influence ERP adoption and assimilation, they have only focused on either imitation or on evaluation [e.g., 20, 71] alone. Consequently, Tingling and Parent [81] asked, "Does imitation transcend judgment?" and pointed out that "Further research is warranted to investigate the presence and extent of these effects" (p. 113). Our study has also addressed this research need in the unique context of unique Chinese business.

As a result, uniting these perspectives contributes to our understanding of imitation's and evaluation's standalone and integrative effects—along with their subsequent effects as moderated by internal and external influences—on IT adoption and assimilation. The insights derived from this investigation should allow IT professionals to develop more effective strategies for infusing Chinese organizations with new innovations. This study also offers new ways for IT researchers to explore social behavior (i.e., imitation) in IT diffusion processes and to consider the merits or risks of such behavior alongside the conventional rational approach (i.e., evaluation).

We further explain these contributions using two criteria—their ability to predict ERP adoption and assimilation and the value of the information provided. Regarding predictability, technology imitation and evaluation are both useful in explaining ERP adoption and assimilation and the variance explained by technology evaluation is also similar to that explained by technology imitation. In terms of the value of information, technology evaluation supplies specific information on ERP's technological performance, whereas technology imitation offers general information on adopters' social behavior. Given the findings that technology imitation and evaluation are equally important in predicting ERP adoption and assimilation, the selection of an imitation or evaluation approach in ERP decisions is based on an

organization's internal technological and management characteristics and the external environment in which it operates.

Another implication of this study is related to the relative weights of technology imitation and evaluation approaches in influencing ERP adoption and assimilation. Tingling and Parent [81] called for further studies on how relative weights and values are assigned to each of the criteria for imitation and evaluation. In our study, we examine the relative weights of imitation and evaluation approaches under various contingencies such as uncertainty, competition, experience, and innovativeness — yielding important institutional insights and new explanations for IT innovation diffusion.

Finally, our findings contribute to both ERP and innovation research. Specific to ERP research, our study provides empirical evidence on how ERP is diffused in China. Our evaluation of the social force of imitation and rational force of evaluation provide support to their criticality in influencing ERP's adoption and assimilation extent among Chinese organizations. These findings may suggest to ERP vendors how to localize ERP implementation and marketing strategies in the China market taking into consideration the effect of technological, organizational, and environmental variations. In terms of innovation research, our study applies a dual perspective of social imitation and rational evaluation, which has seldom been applied in a single investigation, to evaluate their differential effects at different stages of IT diffusion. Our findings suggest that the past emphasis on one single perspective of rational evaluation may be biased toward formalism and rationalism. In reality, innovation adoption could be less rational and more socially oriented. Hence, innovation research should be more encompassing in its perspective to avoid overlooking any possibility that explains the variations of ERP adoption and assimilation. Moreover, this study represents one of the few innovation studies involving China ERP innovation, which provides sorely needed contextual contributions in the literature.

Managerial and Practice Implications

The findings of our research also have several important implications for managerial practice. First, this study provides strong evidence that both technology imitation and evaluation are important forces for ERP adoption and assimilation in China. Therefore, decisions regarding ERP implementation should

consider both imitation and evaluation—not just one factor. ERP vendors can promote their systems either by imitation- or value-based strategies—or a combination of the two. Using an imitation-based strategy, ERP vendors may encourage potential users to implement ERP because a large number of high-status organizations have done so with success. Using a value-based strategy, ERP vendors may promote their systems based on technical values such as task–technology fit, perceived ease of use, and perceived overall usefulness.

Moreover, our findings suggest that both technology imitation and evaluation are subject to environmental and organizational influences. Thus, ERP vendors should segment their markets by business environment and innovativeness, and different promotion strategies should be used for different market segments. For example, for potential users with low technology readiness, who solicit less vendor participation and/or who operate in highly uncertain environments, an imitation-based strategy may be more effective. By contrast, for potential users with high technology readiness, who are innovative, solicit more vendor participation and/or who operate in stable environments, a merit-based strategy may be more effective.

Another implication of our research stems from the strong support we found in vendor involvement and not in management participation for moderating the effects of imitation or evaluation approaches on ERP assimilation. One implication of this is that once ERP has been implemented and routinized, top management becomes less involved in key decisions (such as the use of an imitation or evaluation approach) because their participation can be replaced by external IT expertise. Although it is true that top management need not be actively involved throughout the ERP assimilation process, it is also true that relying on external expertise can be risky. This is not a strategically wise position to take even though it appears common in China. Thus, top management participation is still required for key decisions regarding ERP assimilation into business operations and conflict resolution involving cross-functional ERP infusion and routinization. Top management can also work with vendors to initiate strategies and practices for successful ERP assimilation. To move toward greater technological leapfrogging and worldwide economic leadership, it is imperative that executives in China become better

trained and involved in ERP deployment.

Finally, we argue that managers need to carefully consider key moderating variables into their strategic decisions on ERP adoption and assimilation. By considering environmental uncertainty and competitive pressures, managers can gain insights into how to devise best-fit strategies for their decisions on ERP adoption and assimilation. By being more aware of their organization's IT infrastructure, innovativeness, and management characteristics, managers can better decide on a technology adoption approach that fits their organizational culture. This is especially pertinent because of the wide variety of organizational forms in China. Whereas some firms are largely protected from competition, others operate in a highly competitive market. Thus, in China, "one size does not fit all." and will become especially true as SOEs further privatize and reform.

Limitations and Future Research Opportunities

Given our unique China context and attempt to propose a highly integrated model, our study exhibits several limitations that point to exciting lines of further research that we strongly encourage. First, we modeled imitation generally. However, different types of imitation (i.e., frequency-, trait-, and outcome-based) may have different effects on ERP adoption and assimilation. Because the moderation effects of environmental and organizational conditions on these different types of imitation may be complex, future research is needed to study this.

Second, we adopted a cross-sectional approach to data collection, which is excellent for maximizing external validity but suffers weaknesses in claiming internal or causal validity. In such an organizational context, experimentation is an unrealistic solution to this dilemma; however, longitudinal data can be very helpful although it can be difficult to successfully collect. For example, data collected at several time points, using two-phase data collection, where adoption-related data is collected in the first phase and assimilation-related data is collected in the second phase, may be more objective in analyzing how organizational and environmental factors affect ERP diffusion.

More work needs to be done to better understand further interactions between technology evaluation and imitation within a given organization and its industry. At the organization level, evaluation

and imitation may displace one another by degrees. But at the industry level, evaluation and imitation may complement each other to create an evolving landscape of supposition, hopeful belief, and qualified knowledge [78]. Further research is needed to empirically validate these two levels of imitation–evaluation interactions. In addition, the imitation–evaluation interaction pattern may not be linear and direct but subject to contingencies such as organizing visions, industry norms, diffusion processes, and organization characteristics. Future investigation into these interaction contingencies should yield valuable insights into what constitutes effective strategies for the implementation of technology evaluation and social imitation. Likewise, researchers may want to extend our model to include more mediating variables that can clarify the roles of imitation and evaluation in ERP assimilation. These mediators may include implementation strategy and assimilation processes [78].

Finally, we have provided compelling results that may be attributed to the unique business environment in China (e.g., a state-controlled economy with many SOEs), but this is just a starting point. Future studies are needed to differentiate between technology adoption and assimilation approaches in the context of different economic and organizational structures. Furthermore, more research with a strategic perspective is warranted given the prevalence of technology evaluation and social imitation and their potential consequences, not only regarding ERP but also other significant IT investments. For example, researchers could examine if an organization's imitation –evaluation strategies and responses to competition mitigate rivalry within an industry and affect the consequential adoption and assimilation of ERP. Research [53] has suggested that an organization's differentiation strategy can reduce imitation to insulate rival actions and a homogeneous strategy can promote imitation to ease the intensity of competition. Accordingly, such strategic selection may be deemed to have a consequential effect on the extent of ERP adoption and assimilation.

Conclusion

Drawing on previous imitation and innovation theories, this study examines how imitation and DOI evaluation combine to influence ERP adoption and assimilation in a China context. Our results reveal that both DOI imitation and evaluation are important forces for ERP diffusion and their influences on ERP

adoption and assimilation are roughly equal. However, the forces of imitation and evaluation on ERP diffusion vary according to different contingencies. The most unexpected findings are that management beliefs and participation have insignificant effects on the use of imitation or evaluation approaches to both ERP adoption and assimilation. We believe that these results may be attributable to China's state-controlled economy as SOEs constituted the majority of this study's sample. These findings provide a foundation for further research on adoption and assimilation of organizational innovations.

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ENDNOTES

[i] Chinese people also dislike certain characters that symbolize something undesirable. Typical examples are numbers such as "4" and "24," which are synonymous to "dead" and "easy to die." Not many Chinese like their phone numbers, employee identification numbers, or residence numbers to be associated with these numbers. Such factors are not considered in Western ERP design.

[ii] Similarly, Rice et al. [68] argued that the dichotomy between the rational and the social is artificial and perhaps unnecessary. Webster and Trevino [87] even suggested bringing the two approaches together by incorporating factors from both theories.

[iii] In the field of management, for example, imitation research has developed several theories to explain organizational and individual imitation. Organizational theorists have attempted to explain the unique behavior patterns associated with imitation by referring to the "bandwagon effect" [29], which is a diffusion process in which an organization's leaders feel pressured to adopt an innovation due to the sheer number of other organizations that have already adopted it in earlier stages [70].

[iv] In addition, many DOI studies [e.g., 1, 50] have used only these three variables.

[v] In situations where clarification was required, the interviewers contacted committee members them for confirmation after they had had a chance to review the relevant archives. In this way, we minimized the risks associated with response inaccuracy due to memory lapses.

[vi] The first completed survey instrument from each interviewer was carefully reviewed to assess the quality and reliability of the data collection. Any issue identified in this review process was discussed with the interviewer before they resumed their interviews. Then, 56 surveys were randomly chosen for validation. The interviewees were contacted by the project supervisor, who randomly selected a few items from the questionnaire for the interviewees to re-answer. This validation process ensured not only data reliability but also that the interviewees to whom responses were attributed had actually been interviewed. Although this measure was implemented on a small scale, we found little deviation between interviewees' first and second responses and no fault associated with the interviewers.

[vii] First, all student interviewers were briefed on the potential side effects of cross-sectional data. Thus, they were asked to mark on the questionnaire if an informant had been unsure or hesitant in their responses. These marked questionnaires, although limited, were followed up for validation. Second, the interviewees had to be senior executives, key ERP decision makers, or educated ERP professionals serving on an ERP steering committee to enhance response quality and minimize response bias [47, 75]. Third, the interviewees were asked to provide documentation of ERP adoption and assimilation, if possible, as a secondary data source. These documents were used in validating their survey responses. Last, we performed statistical analyses on CMV, and compared early and late adopters to ensure the validity of our cross-sectional data.

[viii] Although there are other potential aspects of DOI, these three dimensions are the most widely used. DOI research in the past few decades validated that a large number of innovation characteristics were critical to adoption and diffusion of innovations [71]. However, generalized the relationship between 25 innovation characteristics and adoption and diffusion from their meta-analysis of seventy-five research articles. They identified ten characteristics that were most frequently studied by researchers: compatibility, relative advantage, complexity, cost, communicability, divisibility, profitability, social approval, trialability, and observability. Of these ten characteristics, compatibility, relative advantage, and complexity were consistently found to be significant. Since this time, many DOI research studies in the IS field have employed these three variables in their innovation adoption and diffusion studies [9, 32, 48]. Therefore, in our study, only these three aspects were used to represent DOI. It is clear that these three aspects are distinct and can move in different directions theoretically; thus, based on leading guidelines on formative construct specification and measurement, we specified DOI as a formative construct with compatibility, relative advantage, and complexity as its sub-dimensions.

[ix] This is particularly true not just for SOEs but for firms are shielded from international competition such as in oil & gas, technology, steel production, and the like. In fact, collective and locally-government owned enterprises are shown to be even less efficient and less competitive than SOEs [40].

APPENDIX A. SUPPORT FOR CHOICE OF MODERATORS CHOSEN FOR THE MODEL

Moderators in Our Study (Definition)	**Previous Use as a Moderator (context)**	**Relationship(s) Moderated by the Moderator**	**Our Moderation Use; Justifications of its Use as a Moderator in Our Study**
Technology readiness (the extent of an organization's technology infrastructure and IT human resources, such as skills and knowledge, to implement information technologies or applications [44])	[1] (supply chain technologies), using technology turbulence and technology breath	Perceived ease of use → intention to use; perceived usefulness → intention to use; and intention to use→ implementation extent	We propose technology readiness as a moderator of adoption. The reason for this relationship is that technology readiness is a core, first-order consideration to where adoption itself cannot start without it. Hence, its effect on adoption is more critical than on assimilation. When implementation gets to the assimilation stage, technology readily is already taken for grant and should not be a concern for assimilation decisions. Readiness is normally used as an independent variable in the literature [e.g., 44] and seldom used as a moderator. Its related variables; however, have been investigated and validated as significant moderators. Hence, it is relevant to explore the effect of technology readiness as a moderator in IS research, especially with ERP adoption/assimilation.
	[13] (information security management), using IT capability	Institutional influences → Assimilation of information security management	
Top management belief (the degree to which top management views IT as critical or instrumental [18])	n/a	n/a	We propose top management belief to moderate adoption. We do so, first, because it is difficult to imagine a scenario in which a firm is willing to undergo the great expense of purchasing and adopting ERP without a general belief IT is valuable. Hence, top management belief is crucial when ERP is evaluated for adoption, because if they do not believe in it, it is not going to be purchased. However, once the adoption stage is over, it is more important that management demonstrates their support by actively participating in ERP assimilation. As such, top management belief is only critical to adoption in the earlier diffusion cycle. The IS discipline has only investigated this construct as an independent [25], mediating [14, 15, 40], and dependent variable [23]. However, the management discipline has researched the moderation effect of top management support [13] and top management capacity (such as skills and abilities) [17, 20, 21].
Environment uncertainty (the degree to which future states of the world cannot be anticipated and accurately	[12] (management)	Decision rationality → Decision quality	We propose environment uncertainty to moderate adoption. Environmental uncertainty could certainly have an influence on ERP adoption because ERP provides a mechanism by
	[13] (information	Institutional influences →	

Moderators in Our Study (Definition)	**Previous Use as a Moderator (context)**	**Relationship(s) Moderated by the Moderator**	**Our Moderation Use; Justifications of its Use as a Moderator in Our Study**
predicted [30, p. 67])	security)	Adoption of information security	which better and more certain information and supply chain flows can be achieved, and thus act as a counter-weight to general uncertainties associated with business operations. When ERP implementation is in assimilation stage, ERP adopters are already heavily committed to ERP. In other words, their assimilation processes have to continue disregarding the extent of uncertainties were out there in the environment. Hence, we would argue environmental uncertainty as a baseline that fosters adoption, not assimilation. A large number of studies use uncertainty as a moderator in factors such as decision quality to IT adoption. In general, these studies have validated this construct to be a crucial moderator of IT decision and firm performance. Hence, a re-evaluation of this moderator in our research context is important as it is a likely factor influencing ERP.
	[24] (management)	Managerial ties → Firm performance	
	[34] (management)	Coopetition alignment → Innovation and market performance	
	[43] (IT-business strategic alignment)	Strategic alignment → Firm performance	
Competition intensity (the degree of competition that a firm faces in its industry [24, p. 387])	[24] (management)	Managerial ties → Firm performance	We propose competition intensity to moderate adoption. The reason is that the more competitive an industry is, the more firm's will be aware of others' use of ERP and related herding effects, information cascades, and "bandwagon" effects. These will combine create imitation pressure that more likely fosters adoption over assimilation. A few studies were identified using this variable as a moderator. However, their research domain is in management and their research findings are inconsistent. Hence, it is essential to re-evaluate this variable in the IT context, especially for ERP adoption/assimilation where it logically fits.
	[27] (management)	Supply chain structure → Profitability	
	[34] (management)	Coopetition alignment → innovation and market performance	
Organization innovation (the extent to which an organization has the capacity to introduce new processes, products, or ideas [4])	n/a	n/a	We propose organization innovation to moderate assimilation. ERP is an innovation and the more it is implemented and integrated, the more likelihood it has in transforming an organization's information, processes and that it will help produce new ideas and insights. Accordingly, an organization must be innovative enough to devise strategic plans to ensure effective use and assimilation of ERP within their organizations. Although

Moderators in Our Study (Definition)	Previous Use as a Moderator (context)	Relationship(s) Moderated by the Moderator	Our Moderation Use; Justifications of its Use as a Moderator in Our Study
			innovation also has a role in adoption, organizations can make effective adoption decisions without necessarily being innovative. Therefore, the role of innovation in assimilation is more crucial than its role in adoption. The general practice of IS researchers is to use innovation as a dependent or independent variables, instead of a moderator. However, innovation is a dimension of organization culture, which has been heavily investigated as a moderator in other disciplines [e.g., 5, 14, 16, 28, 41]. Given this, and the fact that ERP is an innovation, organization innovation is a compelling moderator to consider.
Top management participation (the extent to which the behavior and actions performed by top management facilitate IT [25])	[13] (information security management); focuses on top management support	Institutional influences → Assimilation	We propose top management participation to moderate assimilation. It is difficult to imagine a scenario in which a firm is willing to undergo the huge investment, re-engineering, and strategic aligned involved with ERP assimilation without top-management participation. In contrast, top management may not have to participate in the process of adoption (as noted, it is important to have their buy in but adoption is less complex and less strategic, and thus their participation is less crucial). Their participation in assimilation, however, critically determines the visibility and financial support of ERP, which are fundamental to its assimilation success. This construct, when used as an independent variable, has been validated to be a critical determinant of many IS behaviors. However, tests of its moderation effects produce mixed results. Consequently, it is promising to consider this effect in an ERP innovation context.
	[33] (e-Business)	Market orientation → e-business innovation (1); e-Business innovation → customer relationship performance (2); e-Business innovation → Sales-based outcome (3)	
Vendor involvement (the extent to which vendor participates in advising and resolving the managerial and technical issues associated with IT implementation [38]).	[26] (ERP); focuses on consultant involvement	Mimetic pressures → ERP implementation extent	We propose vendor involvement to moderate assimilation. Logically, deeply strategic and integration ERP implementations are notorious expensive, difficult, and disruptive to organizations, and many organizations simply do not have the in-house expertise to oversee such a project on its own without doing so superficially. Consequently, to achieve assimilation, the use of outside vendors (e.g.,
	[32] (ERP); focuses on leading vendors	ERP adoption → Stock returns	

Moderators in Our Study (Definition)	Previous Use as a Moderator (context)	Relationship(s) Moderated by the Moderator	Our Moderation Use; Justifications of its Use as a Moderator in Our Study
			Oracle, SAP, Salesforce.com) or similar outside consultants (e.g., Ernst & Young LLP, PriceWaterhouseCoopers LLP, IBM Global Services) is common and crucial. Prior IS studies on IS involvement and support are mostly descriptive in nature. Empirical investigations, in general, only evaluate the direct effect of this variable on IT implementation [22, 39]. Vendor involvement's mediation and mediation effect are seldom explored. However, vendor involvement is a de facto factor in ERP implementation, and thus we argue it as a critical moderator to explore.

APPENDIX B. SUMMARY OF MEASUREMENT SCALES

Construct	Mean	S.D.	Factor Loading*	Item Reliability	C.R.	AVE
Adoption [11, 32] [2]					N.A.	N.A.
Level (adding 1 to be consistent with the scales of 1–5 used for other items)	2.723	.649	1.000†	N.A.		
Assimilation [25] [1]					N.A.	N.A.
Volume	67.548	24.866	.360†	1.748‡		
Diversity	67.415	26.293	.301†	2.337‡		
Depth	44.159	27.328	.377†	2.275‡		
Relative Advantage [2, 35, 42] [3]					N.A.	N.A.
Our firm adopted ERP because we believed that using it (as compared to the system it supersedes) would:						
improve the integration of business processes.	4.202	.815	.132†	2.757‡		
improve operations efficiency.	4.067	.956	.369†	2.359‡		
reduce operations costs.	3.928	.884	.177†	2.492‡		
standardize business processes.	4.308	.875	.132†	2.108‡		
accelerate adoption of international best business practices.	3.986	.945	.131†	2.135‡		
improve customer services.	3.793	.901	.235†	1.981‡		
improve management controls.	4.192	.829	.181†	2.245‡		
improve competitive competencies.	4.014	.843	.232†	2.510‡		
Compatibility [25] [2]					N.A.	N.A.
Our firm adopted ERP because we believed that using it would not create:						
a disruption to the existing software environment.	2.572	1.118	.293†	1.550‡		
a disruption to the data processing environment.	2.635	1.117	.205†	1.577‡		
an overall change in values, norms and culture within the company.	3.322	1.153	.107†	1.152‡		
Complexity [2, 35, 42] [3]					N.A.	N.A.
Our firm adopted ERP because we believed that it would not be difficult to:						
understand the use of ERP.	1.928	.997	.163†	2.075‡		
implement the business processes embedded in ERP.	1.938	1.022	.247†	2.273‡		
use ERP to integrate business processes across departments.	2.106	1.044	.276†	2.006‡		
manage the organization changes associated with the use of ERP.	2.236	1.020	.176†	1.961‡		
Frequency Imitation [10] [3]					.906	.709
Our firm adopted ERP because most:						
firms in my industry have already adopted ERP.	3.495	1.188	.875	.766		
of our customers have already adopted ERP.	3.135	1.216	.700	.490		
of our suppliers have already adopted ERP.	3.505	1.204	.904	.817		
of our competitors have already adopted ERP.	3.442	1.214	.868	.753		
Trait Imitation [10] [3]					.930	.768
Our firm adopted ERP because other firms that have adopted ERP in my industry are:						

very large.	3.659	1.169	.877	.769		
leading companies.	3.327	1.219	.883	.780		
very successful.	3.356	1.085	.900	.810		
favorably perceived by others in the same industry.	3.370	1.046	.843	.711		
Outcome Imitation [10] [3]						
Our firm adopted ERP because other firms that have adopted ERP in my industry:						
are very effective in their management.	3.447	.946	.745	.555		
have very effective internal communication systems.	3.462	.932	.708	.501		
are very profitable.	3.394	.916	.793	.629	.914	.604
maintain very good relationships with their customers.	3.442	.888	.821	.674		
maintain very good relationships with their business partners.	3.447	.866	.820	.672		
have very high market share.	3.287	.823	.747	.558		
have very high cost savings.	3.452	.883	.801	.642		
Technology Readiness [44] [2]						
total number of personal computers was sufficient for employee's daily use	3.012	.921	.751	.564	.824	.612
related technologies had been used	3.651	1.076	.872	.760		
the percentage of the number of IT professional over the total number of employees	.090	.011	.715	.511		
Environmental Uncertainty [9] [2]						
Our firm operates in a high turbulent market environment.	2.822	1.252	.722	.521		
Our customers frequently change their preferences.	2.529	1.094	.811	.658		
Our firm is unable to reduce market uncertainty.	2.663	1.104	.706	.498	.862	.556
Our firm is unable to respond to market opportunities.	2.120	1.007	.731	.534		
Our firm operates in a high turbulent technological environment.	2.433	1.106	.753	.567		
Competitive Intensity [19] [1]						
Price competition in our business is severe.	3.476	1.200	.779	.607	.842	.639
Competition in our business is intense.	3.990	.998	.788	.621		
We are in a business with very aggressive competitors.	3.332	1.104	.831	.691		
Organizational Innovativeness [37] [1]						
Compared to other firms in the same industry, our firm tends to be:						
first to market with innovative new products and services.	3.668	1.090	.824	.679		
first to develop a new process technology.	3.668	1.104	.895	.801	.904	.702
first to recognize and develop new markets.	3.784	.961	.807	.651		
at the leading edge of technological innovation.	3.899	1.014	.822	.676		
Top Management Belief [25] [1]						
The senior management of our firm believes that:						
ERP has the potential to provide significant business benefits to the firm.	4.043	.929	.880	.775	.827	.617
ERP will create a significant competitive arena for firms.	3.813	.992	.689	.475		
it is NOT necessary to use ERP to conduct business activities. (R)	4.231	1.083	.601	.601		

Vendor Involvement [3, 36] [3]						
This vendor has spent substantial time and effort to meet face-to-face with our implementation team.	3.438	1.132	.831	.691	.865	.683
This vendor has made significant investments in adapting its ERP software to meet our special requirements.	3.260	1.228	.722	.521		
This vendor has built a team to handle our company's ERP implementation.	3.591	1.176	.915	.837		
Top Management Participation [25] [1]						
The senior management of our firm actively:						
articulates a vision for the organizational use of ERP.	3.519	1.116	.745	.555	.828	.616
formulates a strategy for the organizational use of ERP.	3.409	1.077	.781	.610		
establishes goals and standards to monitor the ERP project.	3.760	1.129	.827	.684		

Note: * all factors loadings/weights are significant at the $p < 0.01$ level; † path weights for formative scales; ‡ variable inflation factor; N.A.: not applicable;
1 measurement items were original items adopted from the cited research; 2 measurement items were modified to fit the specific ERP systems in our research;
3 measurement items were developed based on the ideas stated in the cited research

APPENDIX C: DETAILED SUPPORT FOR CONVERGENT AND DISCRIMINANT VALIDITY

We performed several analyses to establish convergent and discriminate validity, as well as reliability. The composite reliability values of our reflective variables ranged from 0.824 to 0.930, which were all higher than the recommended cut-off value of 0.70, thus indicating acceptable composite reliability. Convergent validity was assessed in terms of factor loadings and average variance extracted (AVE) (see Appendix B). Item loadings greater than 0.70 and significant at the $p < 0.01$ level [7] suggested convergent validity. All items except for three (items 2 and 3 of top management belief) had loadings greater than 0.7 and were significant at the $p < 0.01$ level. Although those two items had loadings less than 0.7, they were significant at the $p < 0.01$ level. With regard to the assessment of convergent validity via AVE, all AVE values were greater than 0.5, which is the suggested cut-off value [6]. Thus, the constructs demonstrated acceptable convergent validity.

Discriminant validity was assessed by examining whether the square root of each construct's AVE was larger than any inter-correlations between the focal construct and all other constructs. Our results showed that the square root of each AVE was larger than the inter-correlations of the construct with the others, thereby confirming discriminant validity of our measures at the construct level (see Table C1).

In the second step, we assessed the reliability of our formative constructs by ensuring its indicator validity and the absence of multicollinearity. It should be noted that convergent and discriminant validity "by no means represents a reasonable criterion for evaluating formative measurement models" [8]. Thus, based on the methodological suggestions of [8] the path weights of the construct were checked for indicator validity, which shows the importance of each individual indicator of the related formative construct. Our analyses indicated that the significance, sign, and magnitude of the path coefficients met the requirements for indicator validity. First, all path weights were significant at the $p < 0.01$ level. Second, the signs of all path weights were consistent with our theoretical expectations. Third, all path weights were greater than 0.1. In addition, we calculated the variance inflation factor (VIF) for each indicator to ensure an absence of multicollinearity by following [7]. As shown in Appendix B, the VIF values of ERP assimilation ranged from 1.152 to 2.757, which were all lower than the rigorous cut-off value of VIF < 3.3 [29]. Thus, all indicators of this construct met the requirements for construct validity.

We also conducted a series of analyses to detect whether CMV was present. First, we conducted a Harmon's single-factor test by which CMV is present in the data if one factor accounts for most of the covariance; however, this is increasingly in dispute, per [31]. We checked the correlation matrix by which common method bias is unlikely if there are no excessively high correlations (> 0.9). Third, there were significant moderation effects in our models. The results of these three tests suggested that the data were not unduly influenced by CMV.

Table C1. Correlations among Constructs and Average Variance Extracted

Construct	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Adoption (1)	--															
Assimilation (2)	.882	--														
Imitation (3)	.182	.166	**.790**													
DOI (4)	.125	.112	.146	--												
Experience (5)	.217	.202	.145	.148	--											
Environment uncertainty (6)	-.048	-.065	.025	-.369	-.071	**.746**										
Competition intensity (7)	.113	.104	.221	-.065	.101	.321	**.799**									
Organization innovation (8)	.128	.128	.164	.190	.104	-.231	.135	**.838**								
Industry type (9)	-.132	-.136	.045	-.045	.017	.171	.025	-.085	--							
Ownership (10)	.188	.168	-.071	.011	-.178	-.034	-.056	.047	-.125	--						
Firm age (11)	.081	.060	.115	-.108	.133	-.012	.128	.004	-.121	-.224	--					
Firm size (12)	.278	.275	.150	.006	.176	-.108	.060	.148	-.171	.002	.445	--				
Vendor involvement (13)	.319	.291	.353	.250	.130	-.087	.193	.216	-.071	-.073	.156	.222	**.826**			
Management participation (14)	.318	.239	.275	.238	-.064	-.098	.149	.155	-.048	-.029	.059	.145	.676	**.785**		
Top management belief (15)	.178	.153	.361	.331	.103	-.232	.090	.183	-.069	.137	.082	.143	.296	.286	**.785**	
Technology readiness (16)	.321	.256	.121	.222	.152	.071	.059	.181	.097	.210	.181	.751	.112	.108	.169	**.782**

Note: The square root of average variance is shown on the diagonal in bold; Inter-construct correlation is shown off the diagonal; -- not applicable for formative and single-item constructs.

APPENDIX D: ANALYSIS ON CROSS-SECTIONAL ISSUE

DV=Adoption			Full Data (Original) N=208	Early-Stage Data only N=79[a]	Diff
Main	Imitation		0.135*	0.129*	n.s.
	DOI		0.112*	0.114*	n.s.
Moderators	Technological Readiness	Imitation	-0.182**	-0.193**	n.s.
		DOI	0.268**	0.251**	n.s.
	Top Management Belief	Imitation	0.017ns	0.054ns	n.s.
		DOI	0.049ns	0.035ns	n.s.
	Environmental Uncertainty	Imitation	-0.037ns	0.072ns	n.s.
		DOI	0.131**	0.133**	n.s.
	Competition Intensity	Imitation	-0.018ns	0.009ns	n.s.
		DOI	-0.052ns	-0.042ns	n.s.

DV=Assimilation			Full Data (Original) N=208	Later-Stage Data only N=54[a]	Diff
Main	Imitation		0.121*	0.131*	n.s.
	DOI		0.117*	0.122*	n.s.
Moderators	Top Management Participation	Imitation	0.015ns	0.021ns	n.s.
		DOI	0.021ns	0.017ns	n.s.
	Vendor Involvement	Imitation	0.048ns	0.072ns	n.s.
		DOI	0.142*	0.152*	n.s.
	Organizational Innovativeness	Imitation	-0.018ns	0.077ns	<0.05[b]
		DOI	0.126*	0.132*	n.s.

a. Early Stage: less than or equal to four (4) years (N=79); Later Stage: More than or equal to seven (7) years (N=54). This classification is based on [23], which adapted the original method of [35]. If we classify early stage as <=4 years (N=79) and later stage as >4 years (N=129). The comparison conclusions still hold the same.

b. Although this difference between original result and the result from later-stage data only is significant, both coefficients are not significant. Therefore, no meaningful difference exists.

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