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How Do IT Users' Attributes Influence Innovative Use of IT: The Mediating Role of Individual Absorptive Capacity

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ABSTRACT Individual innovation is increasingly considered as a crucial element of organizational innovation. Prior research on user attributes as antecedents of innovation behavior (e.g., innovative use of IT) has identified three key factors: domain-specific knowledge and skills (e.g., prior knowledge), creativity-related skills (e.g., absorptive capacity), and intrinsic motivation. However, it is still unclear how these factors jointly impact the innovative use of IT. To address this knowledge gap, we propose a model that builds on the absorptive capacity theory and creativity literature to study how individuals' innovative use of IT is influenced by prior knowledge, absorptive capacity, and intrinsic motivation as well as their joint interactions. Conceptualizing prior knowledge in two constructs (IT knowledge and domain knowledge) and absorptive capacity in four constructs (acquisition, assimilation, transformation, and exploitation), we empirically validate the proposed model with a survey of 249 business intelligence (BI) system users. In addition, we identify two mediating roles of absorptive capacity: indirect-only or complementary. The findings enhance our understanding of the innovative use of IT.

INDEX TERMS User attributes, innovative use of IT, BI user, complementary mediation, indirect-only mediation.

I. INTRODUCTION

Information technology (IT) has long been regarded as an important resource for business success [1], yet more than 60 percent of IT implementations fail to realize expected benefits [2]. Emerging computing tools such as business intelligence (BI) [3], artificial intelligence [4], and big data analysis [5] are now increasingly considered as the innovative solutions to solving business problems [6], [7] that have been continuously evolving and crucial to the vitality of organizations. Urgently, using IT routinely has been unable to satisfy the diverse needs of companies when they continue to deploy new IT initiatives [8]. Employees need to use IT in a full and in-depth manner to amplify its effects.

Innovative use of IT, indicating IT being used at a high level, is one of the key post-acceptance usage activities [1]. In light of its enormous potential to organizational innovation [9] or performance [7], innovative use of IT has received widespread attentions from information system (IS) scholars. This type of IT usage is completely different from traditional IT acceptance or routine use; the former emphasizes the novelty of use, whereas the latter pays more attention to the standardized use [1], [9], [10]. Although articles on innovative use of IT have appeared sporadically over the decades, they have already existed in other forms in IS research, such as IS deep usage [11], attempt to innovate with IT [12], and exploratory usage [13].

IS scholars have identified vast antecedents that may explain the innovative use of IT with the perspective of reasoned action theory [12], motivation theory [1], [10], effective use and adaptive structuration theory [14], slack resources theory [15], and absorptive capacity theory [7], [16]. Indeed, we believe that these efforts have deepened our understanding of the innovative use of IT, and carefully portrayed its driving

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and obstructive factors. However, we also find that these studies do not seem to facilitate routine research thinking, such as exploring the direct or indirect impact of individual, organizational, or technological factors on the innovative use of IT as well as the interactions of these factors. Additionally, IS scholars also recognized that users play a crucial role in the process of organizational innovation [17], [18], especially in their levels of IT use [1], [19]. For instance, examining the key drivers of innovative use, Huang *et al.* [7] depict the role of gatekeepers, referring to as the key users who can prevent or facilitate the absorption of new knowledge and are responsible for monitoring the IT environment, interacting with partners and vendors, and identifying potential opportunities for the innovative use of IT. In general, these users are often the excellent transmitters, disseminators, and disciples of new methods, who champion and advocate the use of new knowledge selected by the firm. Ye and Kankanhalli [20] elaborate the function of user innovators who differ from professional developers, examining the effects of key users' characteristics on innovation. Prior research has also found that ordinary users such as pure IT users can also use IT innovatively [1], [10], [13], [14], [21], [22].

Based on such insights, we wonder why and how these users will generate innovative behavior. Priors studies have acknowledged the importance of organizational, technological, and individual factors for the innovative use of IT, in which great efforts have been devoted to revealing the coupling effects between individual and organizational (or technological) factors. However, very few studies focus on how individual factors jointly impact innovative use of IT. To address this knowledge gap, we conduct a study based on user attributes and try to uncover the mechanism of innovative use of IT by users. Meanwhile, considering that BI has emerged as an important area of study for both practitioners and researchers [3] that provides users with more opportunities for innovation, we take BI systems as the research object to better explain this phenomenon.

The emerging BI system can help users discover useful knowledge from vast amount of data and information [1], thus providing support for enterprise's strategic decision-making [21], eventually enhancing the firm's competitive advantage and promoting organizational performance. We consider the case of a BI analyst to understand why BI users may have more chances to innovatively use IT. In general, BI analysts need to comprehensively use data warehouses (e.g., ORACLE, SQL), ETL tools (i.e., Extract, Transform and Load), and analytical model tools (e.g., OLAP, DM) after understanding the BI systems that a company has built. Aided by statistical software (e.g., SAS) and data visualization tools (e.g., Tableau), they can perform regular data analysis and infer the current and future state of the company's operations. The essential difference between BI and other systems is that BI analysts can explore data in a way to find valuable information and update the current data shape to identify logical relationships between multiple database objects. For instance, BI analysts can combine variables in different reports or develop new variables to generate a unique real-time report view to identify or monitor existing or potential customers, analyze technology trends, and capture new business opportunities or even potential risks to get the job done better. Such process of IT use has broken the standardized use procedures, and has a fundamental difference from routine use. Therefore, we suggest that BI users may have more chances to innovative use of IT.

The objective of this paper is to examine how users' salient attributes affect and shape their innovative use of IT. To address this question, we conceptualize a model that builds on absorptive capacity theory and creativity literature, and then empirically validate it using survey data from users of several companies regarding their use of BI related systems, such as Data Mining (DM), On-Line Analytical Processing (OLAP), Tableau, Statistical Analysis System (SAS), MicroStrategy, and so on. We believe that the study of the interactions within these important user attributes clarify how these user attributes play a role in individuals' innovative use of IT, helping managers better grasp the impact of different user attributes on post-acceptance usage activity (i.e., innovative use of IT).

This paper unfolds as follows. Next section reviews prior literatures on innovative use of IT, focusing on the role of user attributes. The third section proposes a theoretical model of innovative use of IT at individual level. The fourth section describes the research methods used to empirically test our research model. The fifth section presents the results of data analysis. The last section discusses the implications of our key findings, followed by its implications for research and practice.

II. LITERATURE REVIEW AND RESEARCH MODEL

A. PRIOR STUDIES ON INNOVATIVE USE OF IT

Innovative use of IT refers to the use of IT in novel ways to perform new or existing tasks to support their work [1], [15], [21]. Many scholars have studied individual innovative behavior in the context of IT [23], using other terms that are resemble to innovative use of IT (see the summary in Table 1). We suggest that the essence of all these behavior is to explore new ways of using IT to acquire benefits [14], such as supporting an individual's task performance or IT unit's performance [7], enhancing the level of collectively innovative use of IS [24], and influencing a manager's volume and diversity of ideas for organizational innovation [9].

Innovative use of IT can bring many benefits to an enterprise [25], leading to important theoretical and practical values [26]. Nevertheless, due to its high complexity and incomprehensibility, employees may fail to realize its potential benefits. Thus, many empirical studies have identified considerable antecedents of innovative use of IT that can be divided into four categories, including system-related [14], task-related [13], [16], organizational [15], [22], and user-related factors [1], [7]. First, the findings of prior studies on

TABLE 1. Summary of similar (innovative) behavior in the context of IS/IT.

Behavior	Definition or Description	Reference
Extended Use	Use more of the technology's features to support an individual's task performance.	[32]
	Users use more features of the IS to support a more comprehensive set of work tasks.	[33]
	Using more of the technology's features to support an individual's existing and new job tasks.	[14]
Innovative Behavior	Complex behavior consisting of activities pertaining to both the generation / introduction and the realization / implementation of new ideas.	[23]
	Developing and implementing new ideas.	[34]
Employee Creativity	The production of novel and useful ideas by an individual or by a group of individuals working together.	[35]
Exploratory Usage	The extent to which a user discovers the innovative uses of the system features to support job tasks.	[13]
	The extent to which a user seeks and experiments with new features and explores creative ways of using IS.	[14]

Notes: We only review similar innovative behavior in the context of IS or IT.

system-related factors indicate that complexity systems will hinder users from using IS [27]. Since BI systems are too complex, users may feel uncertain about whether they have the ability to overcome these barriers for system exploration. However, some scholars argue that complexity systems have a rich set of features [28] that may provide more possible chances for users to explore new ways of using systems [14]. Secondly, among task-related factors, the most effective one is job autonomy, which usually includes decision-making, scheduling, and work method autonomy [20], [29]. Scholars generally believe that a high degree of job autonomy can promote employees' innovative use of IT [13], [16]. In addition, factors including task complexity, task overload, and matching tasks to individuals' skill will also affect users' innovative use of IT [12], [14], [30], [31].

Thirdly, organizational factors refer to the resources and support needed for innovation. The resources provided by the organization, including technology, knowledge, and time are the fundamental elements for employees to engage in innovative activities [22], [30], [36]. Simultaneously, peer support and interactions, leadership authorization, and necessary rewards can all play a good role in promoting innovative use of IT [13], [16], [34], [35]. Among identified organizational factors, the innovation climate seems to be one of the most important elements [14], [23], [37], since it builds a suitable environment for the innovation of organizational members, representing the organization's desire and affirmation for employee innovation (including innovative use of IT). Definitively, considering employees as the main body of innovation, scholars naturally put a lot of effort into exploring the influence of individual factors on innovative use of IT, excavating many individual antecedents of innovative use of IT, including intrinsic motivation, IT knowledge, IT self-efficacy, IT mindfulness, personal innovativeness with IT, intentions, creativity-related skills, and user perception and expectation [1], [7], [11], [15], [21], [23], [32], [34], [35], [38], [39].

Compared with the other three categories of factors, user-related factors play a decisive role in the innovative use of IT [40], [41]. Although innovative use of IT varies from person to person, innovators tend to have the parallel characteristics. IS scholars try to identify these analogical attributes in an attempt to understand the mechanism by which these attributes work to give guidance and advice for organizations to cultivate these attributes of employees. However, the evidence of why and how such attributes affect innovative use of IT remains inadequate. Our rigorous review also finds that almost all researchers have incorporated user-related factors in their studies, and elaborate their relationship with organizations, systems, or tasks. But they may fail to outline how user attributes affect innovative use of IT, especially their joint interactions. We here summarize relevant literature that explicitly studies innovative use of IT in Table 2.

B. IMPACT OF USER ATTRIBUTES ON INNOVATIVE USE OF IT

Prior research on the influence of user-related factors in innovative use of IT has identified three most prominent individual attributes: creativity-related skills or abilities, knowledge, and intrinsic motivation [40], [41]. In addition, the existing research also finds that creativity-related skills or abilities (e.g. absorptive capacities) have a more direct impact on innovative use of IT [7], [16]. Thus, building upon the literature, we consider absorptive capacity, individual knowledge, and intrinsic motivation as the three salient attributes that an individual must possess in order to use IT innovatively. Although prior studies have documented the importance of these significant attributes, research on how these attributes affect innovative use of IT is still scarce. Our study addresses this gap by exploring the potential interactions among these attributes and the mechanism with which they jointly affect the innovative use of IT.

1) THE ROLE OF INDIVIDUAL ABSORPTIVE CAPACITIES ON INNOVATION

Since the concept of absorptive capacity [42] was proposed, it has been fully used at the individual level and received extensive attention from scholars. Prior research has linked individual-level absorptive capacity to the outcomes of innovation, such as exploration and exploitation [43], individual innovation performance [44], and innovative behavior [34]. IS scholars have also applied this concept in individuals' innovation [16], [34], [45], performance [46], [47], actual use of m-learning [48], and gatekeepers' innovative use of IT [7]. Existing studies suggest that individual absorptive capacity is a prerequisite for organizational absorptive capacity and is important for developing innovative activities. However, the empirical literature on individual absorptive capacity is scarce, especially on its relationship with innovative use of IT.

TABLE 2. Summary of the identified literature on innovative use of IT.

Antecedents	Outcomes	Key Findings	References
Job Autonomy, Overload	Trying to Innovate with IT	Individual perceptions of autonomy and overload influence the manner in which individuals interact with IT and slightly vary with gender.	[12]
PU*, RIM*	Innovative use	Two dimensions of RIM are stronger predictors of innovative use than PU in the IT context.	[1]
PU, Satisfaction	Innovate with IT	ITSE* can moderate the effect of satisfaction and PU on innovation with IT; PIIT* also moderates the impacts of PU and satisfaction on innovation with IT, but this effect could be context dependent.	[21]
Perceived IS Slack	Innovating with IT	Present a classification of IS slack which is crucial for innovating with IT.	[22]
Job Autonomy, Fairness of Rewards	Innovation with IS use	Both fairness of rewards and job autonomy have a stronger indirect effect on innovation with IS usage through the mediation of individual absorptive capacity.	[16]
Job Autonomy, Moving against people	Trying to innovate with IT	Investigate the impact of the moving against people aspect of dark side personality, cognitive style, and contextual factors on trying to innovate with IT.	[31]
EIS* Resources, RIM	Innovative use of IT	Conceptualize three types of EIS resources that are required to facilitate innovation of IT by intrinsically motivated users.	[15]
Prior IT Knowledge	Innovative use of IT	Elaborate two mechanisms of innovative use of IT and identify prior IT knowledge is an antecedent of innovative use of IT.	[7]
IT Mindfulness	Trying to innovative with IT	IT mindfulness is more closely relates to active system use (e.g., trying to innovate with IT) than automatic system use (e.g., continuance intention).	[39]

*Abbreviations: PU= Perceived Usefulness, RIM= Rich Intrinsic Motivation, ITSE= IT Self-Efficacy, PIIT= Personal Innovativeness with IT, EIS= Environmental IS Slack.

Individual absorptive capacity is defined as an individual's ability to acquire, assimilate, transform, and exploit new or valuable external knowledge [34], [43]. Based on the research of Jansen *et al.* [49], Zhang [46] considers that an individual's ability to assimilate and utilize (exploit) new knowledge represents the two main components of the individual's absorptive capacity. While other scholars [7], [43] recommend that the first step in the process of absorbing new knowledge be recognizing (acquiring) the value of that knowledge, some literature [34], [44] considers the influence of an individual's ability to transform new knowledge. Synthesizing the studies of individual absorptive capacities from these scholars, we believe that acquisition, assimilation, transformation, and utilization are the most comprehensive reflection of individual absorptive capacities. Thus, following the classification of Zahra and George [50] and Jansen *et al.* [49], we combine the related research on individual-level absorptive capacities, dividing individual absorptive capacities into two dimensions, potential absorptive capacity and realized absorptive capacity. The former mainly captures the ability to acquire and assimilate new knowledge while the latter denotes the ability to transform and utilize new knowledge [34].

Potential absorptive capacity is defined as an individual's ability to acquire and assimilate new knowledge for his(her) job [34]. It has been widely accepted that an individuals' prior experience [51], [52] and prior knowledge [7] play a significant role in the individual's potential absorptive capacity. As for innovation tasks, individual knowledge workers need to continuously and proactively identify events, trends, and changes [53], and extract useful information from them, eventually making full senses out of them. Furthermore, the more content that employees can acquire and assimilate, the more opportunities they can catch to engage in difficult tasks and find new ways to use IT.

Realized absorptive capacity is defined as an individual's ability to transform and exploit the new knowledge for his(her) job [34]. Innovation is a knowledge-intensive job; no matter who takes this kind of job, he(she) must have profound knowledge. If potential absorptive capacity can help individuals accumulate a wealth of knowledge, then realized absorptive capacity can help them exercise the benefits of absorptive capacity. Simultaneously, individuals may be more likely to achieve a better job performance by transforming [44] and applying [46] such knowledge. Thus, we believe that absorptive capacity is very necessary for innovative work.

2) INDIVIDUAL PRIOR KNOWLEDGE AND INTRINSIC MOTIVATION ON INNOVATION

Knowledge is the essential basis for carrying out various tasks; employees need knowledge to support any work (e.g., routine or innovative work) they perform [18]. Many studies on knowledge exist in prior literature, among which individual knowledge has been classified into various categories, such as tacit and explicit knowledge [54]–[56], and conceptual/ declarative knowledge and procedural knowledge [57], [58]. Prior literature indicates that diversity knowledge can facilitate the innovative process by enabling individuals to make novel associations and linkages [42], stimulating the generation of new ideas [40]. Given that our target system is BI, we divide individual prior knowledge into IT knowledge and domain knowledge [45]. IT knowledge represents the knowledge about BI (IT) tools and how to use them to implement information systems [59], containing software and hardware knowledge [59] as well as the knowledge of how they work and how to use them [59], [60]. Domain knowledge refers to the knowledge about the application domain of the IS being built and the context in which the BI system will be used [59], which includes the knowledge of task procedures [61], [62] and work processes [45]. Both IT knowledge and domain knowledge have been regarded as the important antecedents driving individual innovation behavior [7], [16], [45].

Intrinsic motivation denotes the state in which a person performs an activity for the joy or satisfaction derived from the activity itself [1], [63]. It reflects the extent to which an individual is interested in or fascinated with a task [35] and emphasizes inner sources of satisfaction [63]. Intrinsic motivation is the third key attribute that affects individual creativity [40], [41], [64]. In order to explore the motivation path of intrinsic motivation influencing individual creativity behavior, some scholars explore different types of intrinsic motivation (e.g., rich intrinsic motivation [1], [10]), studying how they influence individual innovation behavior from the perspective of motivation theory. The results show that different intrinsic motivations form different motivation paths [1], and intrinsic motivation is more influential in stimulating innovative use than extrinsic motivation [1], [40]. Furthermore, intrinsic motivation is also an important bridge linking environmental factors to creativity [65]–[67]. For instance, the support and empowerment of leaders to employees' can effectively stimulate the intrinsic motivation of employees to engage in creative behaviors and eventually generate innovative behavior [35]. In addition, intrinsic motivation is often associated with individual freedom or autonomy [63], [68], [69]. Autonomy plays an important role in the creative play of employees [65] and will trigger a series of self-driving program, such as encouraging themselves to be self-directed, to exercise creativity, to pursue opportunities [70], which are essential for effective innovative activities to occur.

III. RESEARCH MODEL AND HYPOTHESIS

We develop a theoretical model of innovative use of IT at the individual level in which individual knowledge, intrinsic motivation, and absorptive capacities are the three prominent attributes that influence innovation behavior [40], [41]. To explore how these user attributes affect the generation of individual innovation behavior, we apply absorptive capacity theory and posit that individual absorptive capacity constructs are the primary components that translate two other user attributes into innovation actions.

A. INTRINSIC MOTIVATION AND INNOVATIVE USE OF IT

Most studies agree that intrinsic motivation has a direct impact on individual innovation, such as creativity behavior [23], [35], [71], exploration use [13], [14], [72], and creativity performance [61]. In particular, some scholars identify the positive associations between intrinsic motivation and innovative use of IT [1], [10], [15]. Accordingly, we hypothesize:

- H1a: ''Intrinsic motivation is positively associated with innovative use of IT''.

B. INTRINSIC MOTIVATION AND ABSORPTIVE CAPACITIES

In the context of IS, intrinsic motivation reflects the degree of personal interests in IS activities. Research shows that intrinsic motivation is a key determinant of post-acceptance behavior [15], [73]. Intrinsic motivation is often considered as an enabling factor in the workplace, since employees need to have enough interests in their work, especially in innovative tasks [1]. Employees with high intrinsic motivations will continue to actively identify and assimilate knowledge that will be useful to their jobs in order to accumulate richer knowledge for difficult tasks. First, employees having sufficient intrinsic motivations will interact with their environment more proactively so they are more likely to discover the organization's real expectations and extract useful information for their job [53]. Additionally, intrinsic motivation will endow IS users enough confidence to independently and autonomously perform IS related tasks fulfilling the requirement of the work. Hence, they tend to self-identify IS features as well as ways to explore them [13], possessing more opportunities to identify valuable knowledge, ultimately contributing to the ability of acquiring and assimilating new knowledge [16]. Therefore, we hypothesize:

- H1b: ''Intrinsic motivation is positively associated with potential absorptive capacity''.

Similarly, employees' high intrinsic motivation should have a positive effect on their realized absorptive capacity. When individuals obtain knowledge of different varieties about their work, they need to transform the knowledge so that it can be applied at work [34]. This process may implicitly enhance an individual's ability to transform and apply knowledge. In some situations, employees may find it difficult to convert new knowledge into their own. However, their intrinsic interests will trigger them to actively find alternative solutions [23], for instance, seeking help from peers [16], which may also, but indirectly, improve the individual's ability to absorb new knowledge. Further, according to Cohen and Levinthal [42], external knowledge can only create opportunities for innovation when it is applied to practical work. Thus, employees will create values only if they internalize new knowledge and apply it to actual work; employees with embedded intrinsic motivations can complete this process better than those without. In summary, individuals with more intrinsic motivations will experience a stronger influence on their realized absorptive capacity, which is hypothesized as follows.

- H1c: ''Intrinsic motivation is positively associated with realized absorptive capacity''.

C. INDIVIDUAL PRIOR KNOWLEDGE AND INNOVATIVE USE OF IT

Knowledge is a fundamental element for employees to perform their work [18]. Every organization that aspires to benefit from their new IT systems (such as BI systems) must ensure that their users adopt and actually use these new systems [74], which may even require innovative use of IS when necessary [14]. Prior literature finds that individual characteristics, such as knowledge and experience with a technology, have a positive relationship with exploitive and exploratory technology adaptation [75]. In addition, individuals with the factual knowledge of their IS related

tasks (i.e., domain knowledge) contribute to the generation of new ideas [61]. Thus, we hypothesize:

- H2a: ''Individual prior knowledge is positively associated with innovative use of IT''.

D. INDIVIDUAL PRIOR KNOWLEDGE AND ABSORPTIVE CAPACITIES

The knowledge gained by an individual from experiencing a technology [76], [77] can create a growing capability for the individual to engage in innovative behavior [75]. There are several reasons why an individual's prior knowledge can promote the improvement of absorptive capacity. For instance, Huang *et al.* [7] argue that those who have prior IT knowledge are likely to recognize and assimilate new knowledge for IT use. This means that individuals who have IT knowledge will be more able to identify and learn related new knowledge. In addition, if employees are knowledgeable about the functionality of IS modules used, they will be more successful in recognizing the value of external information, events, and trends [53], and learning how to use IT systems' features in innovative manners [7], eventually improving their ability of acquiring and assimilating more novel knowledge. Furthermore, any new knowledge (e.g., IT knowledge and domain knowledge) contributing to individual tasks requires an assimilation effort [43], and the diversity knowledge can strengthen assimilative powers [42]. Apart from this, potential absorptive capacity is also crucial for individuals to recombine external knowledge with the existing internal knowledge base [43]. Thus, we hypothesize:

- H2b: ''Individual prior knowledge is positively associated with potential absorptive capacity''.

In addition to strengthening potential absorptive capacity, prior knowledge also facilitates realized absorptive capacity. Scholars generally agree that learning is a process of knowledge accumulation, and that having prior knowledge of a certain field (e.g. IT field) can increase the personal tendency of learning new knowledge in this field [7], which improves employees' intention to use IT [78]. Moreover, prior literature [51], [52] also points out that various prior experiences (including expertise, general and related knowledge) play a significant role in an individual's absorptive capacity. However, not all employees have such knowledge [7], or they may have only a handful of knowledge in this domain; therefore, they often need to learn to accumulate this knowledge. Third, employees with IT knowledge [7] and domain knowledge [79] are more capable of grasping the new knowledge needed for the use of IT and more likely to fulfill the potential benefits of new knowledge. Consequently, the enhancement of realized absorptive capacity requires prior knowledge; only those with these two kinds of knowledge can better absorb new knowledge in the context of IT.

- H2c: ''Individual prior knowledge is positively associated with realized absorptive capacity''.

E. ABSORPTIVE CAPACITIES AND INNOVATIVE USE OF IT

Prior studies have linked individual absorptive capacities with innovation [7], [16], [34], [43], [44], [80], [81]. Building upon existing literature, we divide individual absorptive capacities into two components. Since the potential absorptive capacity mainly captures the ability to acquire and assimilate new knowledge for jobs, individuals with a high potential absorptive capacity are more likely to generate creative ideas [34] and access more potential opportunities for innovation [82]. Besides, to inspire new ways of IT use, individuals must be fully aware of new opportunities [83], including useful information or knowledge as well as novel thoughts. Enkel *et al.* [43] suggest that alert individuals often search for new ideas proactively, so that they are more capable of finding new ways to use IT. Additionally, the diversity knowledge assimilated by individuals also promotes the innovative process by enabling individuals to establish new connections [42], inferring the effect of this assimilation ability on innovation effort. Given that our research subjects mainly use BI systems, which are often embedded in IT or IT related contexts, potential absorptive capacity is likely to be the trigger for innovative use of IT.

- H3: ''Potential absorptive capacity is positively associated with innovative use of IT''.

Realized absorptive capacity represents the ability to transform and utilize new knowledge, which may have more direct effects on innovative behavior. When individuals acquire the new knowledge from external environments, they need realized absorptive capacity to make this knowledge work, i.e., applying this knowledge to their tasks [84]. Hence, individuals with this ability can enhance themselves to combine new and existing knowledge in novel ways [16], which enables them to explore the system intensively. Conversely, without the ability to apply new knowledge, individuals may find it difficult to promote their performance [46], so they will just take in the new knowledge without using it. Further, once the antecedents' prior knowledge is deployed, one could view it as the potential for innovation outcomes [44]. For example, when individuals take efforts to explore BI systems intensively, they have more chances to find and attempt new ways to use BI systems.

- H4: ''Realized absorptive capacity is positively associated with innovative use of IT''.

F. THE MEDIATION ROLE OF INDIVIDUAL ABSORPTIVE CAPACITIES

Consistent with prior studies, we assume that individual knowledge, intrinsic motivation, and absorptive capacities are the three prominent attributes that influence innovation behavior [40], [41]. Accordingly, we further propose that potential absorptive capacity and realized absorptive capacity support the four critical mechanisms to clarify the mechanism between intrinsic motivation, individual knowledge, and innovative use of IT.

Most scholars suggest that intrinsic motivations have a direct impact on individual innovative behavior [1], [10], [15], [23], [35]. Only a few scholars consider that the functioning of intrinsic motivations requires the use of other forces [33]. When individuals perceive that their own ability is insufficient, their motivation for innovation may stimulate them to actively improve their own innovation attributes (e.g. absorptive capacities). Thus, we consider that intrinsic motivations can be beneficial through absorptive capacity.

- H5: ''Potential absorptive capacity and realized absorptive capacity have a partial mediating role between intrinsic motivation and innovative use of IT path''.

In addition, some studies have found that individuals' prior knowledge / experience can facilitate IT use, but need some boosters [19], [85]. The absorptive capacity (i.e., both potential and realized absorptive capacity) is essential to turn the benefits of prior knowledge eventually into improved IT innovativeness. It often requires a medium for applying knowledge innovatively, such as the ability to recognize or assimilate new knowledge [7], eventually integrating new knowledge into IT use. Good absorptive capacity thus can help individuals to effectively capture the potential benefits of knowledge and transform them into new idea outcomes. Consequently, we assume that the utility of prior knowledge may be achieved through absorptive capacity.

- H6: ''Potential absorptive capacity and realized absorptive capacity have a partial mediating role between individual knowledge and innovative use of IT path''.

IV. METHODS

A. RESEARCH SETTING AND PARTICIPANTS

We surveyed full-time BI employees from several IT companies in China that have deployed BI systems. All participants were engaging users of BI related tools such as Query/Report Tools, Online Analytical Processing tool (OLAP), and Data Mining tool. Follow the recommendation of Brislin [86], the entire survey was translated from English to Chinese by a researcher and back into English by another researcher. Then we compared the two English versions and obtained the first Chinese version of the questionnaire. We also conducted a pilot study prior to the formal large-scale survey and further refined the Chinese questionnaire based on the suggestions of several researchers and BI users to ensure conceptual equivalence and comparability. We used an online questionnaire tools, dividing the questionnaire into three sections. The first part was basic information of BI users, the second part was used to measure users' knowledge, absorptive capacities, and innovative behavior, and the third part was designed to measure intrinsic motivation of BI users and other control variables. In large scale surveys, the order of the measures in the latter two parts would appear randomly among all respondents. All items were measured on seven-point Likert scales, with a score of 1 meaning strongly disagree and 7 meaning strongly agree.

TABLE 3. Demographics of respondents (n=249).

Measure	Category	Number	Percentage
Gender	Male	104	41.8%
	Female	145	58.2%
Education level	Post PhD	4	1.6%
	PhD	4	1.6%
	Master's	66	26.5%
	Bachelor's	170	68.3%
	Others	5	2.0%
Occupation	General Staff	35	14.1%
	Junior Manager	28	11.2%
	Middle Manager	97	39.0%
	Senior Manager	23	9.2%
	Technical Staff	49	19.7%
	Analyst	17	6.8%
Age	<=21	2	0.8%
	22-25	39	15.7%
	26-29	66	26.5%
	30-33	62	24.9%
	34-37	44	17.7%
	38-41	19	7.6%
	>=42	17	6.8%
Years of BI related work experience	<1	12	4.8%
	1-2	51	20.5%
	3-4	85	34.1%
	5-6	38	15.3%
	7-8	25	10.0%
	9-10	21	8.4%
	>10	17	6.8%
Average hours of BI related work time every day	<=1	10	4.0%
	2	32	12.9%
	3	49	19.7%
	4	65	26.1%
	5	40	16.1%
	6	32	12.9%
	>=7	21	8.4%

The questionnaire survey was performed for two weeks to collect sufficient samples. Finally, this study collected 249 valid samples (38.9% of 641 surveys are valid), which was enough for further analyses. After checking sample selection criteria, all participants' responses were valid for data analysis. Of the 249 participants surveyed, 58.2% were female and 41.8% were male. Table 3 shows their demographic data.

B. MEASURES

Intrinsic Motivation was measured with five items scale adopted from Yuan and Woodman [23]. When these items were conducted, responders would see the following question: in your job, to what extent do you engage in the follow actions when seeking to accomplish a BI system related assignment or solve a BI system related problem. The measure of individual knowledge contained IT knowledge and domain knowledge. Since we were interested in the BI systems, we modified the measures developed by Deng, *et al.* [45]. In addition, each construct had four items respectively. Individual absorptive capacities covered the two major components, and each component had two dimensions. Potential absorptive capacity captured the ability to acquire and assimilate new knowledge while realized absorptive capacity represented the ability to transform and utilize new knowledge. The measure of individual absorptive capacity

TABLE 4. Definitions of constructs in the paper.

Constructs	Definition	Reference
Innovative Use of IT	Use BI (IT) in novel ways to perform new tasks or existing tasks to support their work.	[1, 15, 21]
Individual Absorptive Capacity	Individual's ability to acquire, assimilate, transform and exploit new or valuable external knowledge.	[34, 44]
Potential Absorptive Capacity	Individual's ability to acquire and assimilate new knowledge for the job	[34]
Realized Absorptive Capacity	Individual's ability to transform and exploit new knowledge for the job.	[34]
IT Knowledge	The knowledge about BI (IT) tools and how to use them in the implementation of information systems.	[59]
Domain Knowledge	The knowledge about the application domain of the IS being built and the context in which the system will be used.	[59]
Intrinsic Motivation	The state in which a person performs an activity for the joy or satisfaction derived from the activity itself.	[1, 63]
Personal Innovativeness of IT	The willingness of an individual to try out any new IT.	[88]
IT Self-Efficacy	The confidence about BI (IT) staff's ability to perform a particular task.	[89, 90]

TABLE 5. Results of reliability and validity tests for first-order constructs.

	Construct												
	CA	CR	AVE	AC	AS	DK	EX	IM	ITK	ITSE	IUIT	PIIT	TR
AC	0.79	0.88	0.70	**0.84**									
AS	0.75	0.86	0.67	0.69	**0.82**								
DK	0.81	0.88	0.64	0.54	0.65	**0.80**							
EX	0.76	0.86	0.68	0.62	0.69	0.63	**0.82**						
IM	0.87	0.91	0.66	0.64	0.74	0.67	0.71	**0.81**					
ITK	0.86	0.91	0.71	0.51	0.58	0.77	0.61	0.60	**0.84**				
ITSE	0.78	0.86	0.61	0.52	0.63	0.70	0.63	0.68	0.63	**0.78**			
IUIT	0.79	0.88	0.70	0.64	0.68	0.66	0.71	0.67	0.66	0.69	**0.84**		
PIIT	0.74	0.84	0.57	0.63	0.64	0.64	0.66	0.72	0.63	0.65	0.68	**0.75**	
TR	0.80	0.87	0.63	0.73	0.73	0.66	0.72	0.71	0.63	0.65	0.69	0.67	**0.79**

Notes: CA = Cronbach's Alpha; CR = Composite Reliability; AVE = Average Variance Extracted; AC = Acquisition; AS = Assimilation; DK = Domain Knowledge; EX = Exploitation; IM = Intrinsic Motivation; ITK = IT Knowledge; ITSE = IT Self-Efficacy; IUIT = Innovative Use of IT; PIIT = Personal Innovativeness with IT; TR = transformation. Bold font in the diagonal of the correlation matrix report the square root value of AVE.

was adopted from Kang and Lee [34] and Lowik *et al.* [44]. Innovative Use of IT was measured with three items scale developed by Li *et al.* [1] and was completed by employees. Although Huang *et al.* [7] developed four items by combining the items of Li *et al.* [1] and Zhou and George [87] to measure key users, showing better reliability and validity, it is not suitable for the respondents (general staff) of this study.

To fully account for the differences among individuals, we identified two vital control variables, namely personal innovativeness with IT (PIIT) and IT self-efficacy (ITSE). We selected these particular variables because of their potential impact on IT use as suggested by the extant literature. All variables were measured in the form of questionnaires. PIIT is defined as the willingness of an individual to try out any new IT [88]. Because not all employees are willing to try new IT, Agarwal and Prasad [88] believe that PIIT might be highly salient for studies examining innovative behaviors in the IT context; thus, some scholars [14] follow the recommendation from Agarwal and Prasad [88] and design PIIT as a control variable in individual level studies. We used four items adapted from Agarwal and Prasad [88] to measure PIIT. ITSE is defined as the confidence about IT staff's ability to perform a particular task [89], [90]. A large body of IS literature [91]–[93] shows that ITSE has an impact on individual intentions. It has also been pointed out in a few studies [e.g., 14] that there may be a potential relationship between ITSE and IT users' behavior. We used four items modified from Liang *et al.* [14] to measure ITSE.

In addition to the two significant influence control variables mentioned above, we also control five variables: age, gender, education level, years of BI related work experience, and average hours of BI related work time every day, which may potentially affect individual innovative behavior [12], [14]. These five control variables are reported by the participants themselves. Table 4 provides the conceptual definitions of all constructs.

V. DATA ANALYSIS AND RESULTS

Given that PLS has no restrictions on the distribution of samples and the existence of second-order reflection variables (i.e., prior knowledge, potential absorptive capacities and realized absorptive capacities), PLS-SEM seemed to be more appropriate for this study [94]. Thus, data analyses in this study were performed using Smart PLS version 3.2.7 [95]. We assessed the measurement model through using Smart PLS to test internal consistency reliability, convergent, and discriminate validity.

TABLE 6. Cross-loadings for first-order constructs.

	AC	AS	DK	EX	IM	ITK	ITSE	IUIT	PIIT	TR
AC1	**0.84**	0.59	0.44	0.55	0.55	0.41	0.38	0.55	0.52	0.61
AC2	**0.85**	0.62	0.45	0.53	0.49	0.41	0.48	0.52	0.52	0.65
AC3	**0.84**	0.53	0.47	0.49	0.57	0.47	0.46	0.55	0.56	0.57
AS1	0.63	**0.86**	0.48	0.59	0.63	0.49	0.49	0.59	0.57	0.61
AS2	0.55	**0.84**	0.54	0.59	0.60	0.45	0.52	0.58	0.55	0.53
AS3	0.51	**0.76**	0.58	0.52	0.58	0.49	0.53	0.49	0.45	0.65
DK1	0.44	0.52	**0.84**	0.54	0.55	0.59	0.54	0.52	0.51	0.55
DK2	0.40	0.49	**0.77**	0.47	0.49	0.65	0.56	0.52	0.48	0.51
DK3	0.47	0.52	**0.75**	0.48	0.55	0.56	0.56	0.49	0.50	0.52
DK4	0.41	0.53	**0.83**	0.49	0.55	0.67	0.58	0.55	0.55	0.53
EX1	0.52	0.59	0.53	**0.84**	0.57	0.55	0.54	0.62	0.57	0.60
EX2	0.54	0.60	0.54	**0.83**	0.62	0.50	0.56	0.59	0.55	0.63
EX3	0.47	0.52	0.47	**0.80**	0.55	0.44	0.46	0.55	0.51	0.54
IM1	0.52	0.58	0.48	0.54	**0.79**	0.42	0.49	0.51	0.50	0.56
IM2	0.56	0.66	0.59	0.61	**0.85**	0.54	0.61	0.56	0.64	0.63
IM3	0.43	0.54	0.53	0.51	**0.76**	0.40	0.50	0.49	0.53	0.53
IM4	0.56	0.61	0.58	0.61	**0.84**	0.53	0.58	0.62	0.67	0.61
IM5	0.51	0.61	0.55	0.59	**0.83**	0.52	0.57	0.52	0.56	0.56
ITK1	0.48	0.50	0.68	0.53	0.50	**0.87**	0.51	0.57	0.55	0.52
ITK2	0.36	0.45	0.65	0.47	0.46	**0.81**	0.53	0.51	0.50	0.49
ITK3	0.48	0.54	0.65	0.56	0.54	**0.87**	0.56	0.59	0.54	0.55
ITK4	0.41	0.47	0.63	0.47	0.52	**0.83**	0.52	0.55	0.54	0.55
ITSE1	0.47	0.46	0.56	0.46	0.53	0.54	**0.74**	0.55	0.57	0.50
ITSE2	0.38	0.55	0.58	0.54	0.56	0.50	**0.83**	0.54	0.52	0.51
ITSE3	0.32	0.41	0.46	0.45	0.47	0.38	**0.74**	0.45	0.40	0.37
ITSE4	0.45	0.52	0.57	0.52	0.56	0.51	**0.81**	0.59	0.52	0.61
IUIT1	0.52	0.58	0.60	0.62	0.55	0.53	0.59	**0.84**	0.57	0.56
IUIT2	0.56	0.59	0.50	0.62	0.54	0.59	0.57	**0.84**	0.59	0.60
IUIT3	0.53	0.53	0.54	0.55	0.59	0.54	0.57	**0.84**	0.55	0.57
PIIT1	0.52	0.54	0.51	0.51	0.56	0.49	0.49	0.58	**0.77**	0.55
PIIT2	0.51	0.43	0.39	0.43	0.54	0.45	0.47	0.44	**0.73**	0.47
PIIT3	0.36	0.44	0.49	0.44	0.50	0.42	0.49	0.48	**0.70**	0.47
PIIT4	0.51	0.50	0.51	0.58	0.56	0.53	0.51	0.53	**0.80**	0.51
TR1	0.54	0.59	0.55	0.54	0.58	0.52	0.45	0.53	0.54	**0.82**
TR2	0.66	0.54	0.47	0.51	0.53	0.47	0.51	0.54	0.57	**0.78**
TR3	0.54	0.57	0.56	0.63	0.57	0.51	0.53	0.53	0.52	**0.81**
TR4	0.57	0.61	0.51	0.60	0.59	0.48	0.56	0.58	0.51	**0.75**

Notes: Items in bold are loadings. AC = Acquisition; AS = Assimilation; DK = Domain Knowledge; EX = Exploitation; IM = Intrinsic Motivation; ITK = IT Knowledge; ITSE = IT Self-Efficacy; IUIT = Innovative Use of IT; PIIT = Personal Innovativeness with IT; TR = transformation.

A. MEASUREMENT MODEL

The results show that all of the Cronbach's alpha values for each first-order constructs was well above the recommended threshold of 0.70 [96] and ranged from 0.74 (PIIT) to 0.87 (IM). Composite reliability coefficients were above 0.70 [97] and ranged from 0.84 (PIIT) to 0.91 (ITK), demonstrating adequate internal reliability [98]. Table 5 presents the detail of results. In addition, in order to further assess validity of our measurement instruments, a cross-loadings table was constructed. It can be observed that each item loading was higher on its assigned construct than on the other constructs (see detail in Table 6).

With respect to convergent validity, each average variance extracted was above 0.50 and ranged from 0.57 (PIIT) to

TABLE 7. Assessing the hierarchical model of second-order constructs[a].

	IK	PAC	RAC
CA	0.90	0.85	0.87
CR	0.92	0.89	0.90
AVE	0.60	0.58	0.56
ITK	0.95*** [0.93, 0.96][b]		
DK	0.94*** [0.92, 0.95]		
AC		0.92*** [0.89, 0.94]	
AS		0.92*** [0.90, 0.94]	
TR			0.94*** [0.93, 0.96]
EX			0.91*** [0.88, 0.93]

Notes: [a]***p < 0.001, CA = Cronbach's Alpha; CR = Composite Reliability; AVE = Average Variance Extracted; ITK = IT Knowledge; DK = Domain Knowledge; AC = Acquisition; AS = Assimilation; TR = transformation; EX = Exploitation; IK = Individual Knowledge; PAC = Potential Absorptive Capacity; RAC = Realized Absorptive Capacity.
[b]Percentile estimate of 95% confidence interval [99].

TABLE 8. Measures for first-order constructs.

Construct	Items	Descriptions	Mean (SD)	Source
Innovative Use of IT	IUIT1	I have discovered new uses of the BIS to enhance my work performance.	5.48(1.15)	[1]
	IUIT2	I have used the BIS in novel ways to support my work.	5.36(1.14)	
	IUIT3	I have developed new applications based on the BIS to support my work.	4.88(1.36)	
Acquisition	AC1	I regularly visit or contact other departments to acquire new knowledge.	5.40(1.11)	[34]
	AC2	I frequently interact with other departments.	5.04(1.22)	
	AC3	I regularly approach third parties such as consultants or external experts.	5.15(1.27)	
Assimilation	AS1	I frequently share my new knowledge with colleagues to establish a common understanding.	5.35(1.21)	[44]
	AS2	I translate new knowledge in such a way that my colleagues understand what I mean.	5.37(1.08)	
	AS3	I communicate newly acquired knowledge that might be of interest for our unit.	5.65(0.98)	
Transformation	TR1	I often sit together with colleagues to come up with good ideas.	5.51(1.23)	
	TR2	I attend meetings with people from different departments to come up with new ideas.	5.40(1.22)	
	TR3	I develop new insights from knowledge that is available within our firm.	5.42(1.05)	
	TR4	I can turn existing knowledge into new ideas.	5.39(1.15)	
Exploitation	EX1	I often apply newly acquired knowledge to my work.	5.71(1.10)	[45]
	EX2	I exploit new knowledge to create new products, services, or work methods.	5.60(1.05)	
	EX3	I constantly consider how I can apply new knowledge to improve my work.	5.68(1.05)	
IT Knowledge	ITK1	I am knowledgeable about the functionality of BI modules.	5.44(1.04)	
	ITK2	I have a great deal of knowledge about how to implement a BI system.	5.61(1.05)	
	ITK3	I have extensive experience in using BI systems.	5.30(1.22)	
	ITK4	I can use different BI tools skillfully.	5.31(1.12)	
Domain Knowledge	DK1	I have general knowledge of this process for which I am using the BIS.	5.64(1.02)	
	DK2	I have expertise on this process.	5.50(1.09)	
	DK3	I have a theoretical understanding of this process.	5.45(1.06)	
	DK4	I have an understanding of what the output of BIS should look like.	5.42(1.08)	
Intrinsic Motivation	IM1	I enjoy finding solutions to complex problems.	5.27(1.28)	[23]
	IM2	I enjoy coming up with new ideas for products.	5.57(1.26)	
	IM3	I enjoy engaging in analytical thinking.	5.59(1.03)	
	IM4	I enjoy creating new procedures for work tasks.	5.44(1.22)	
	IM5	I enjoy improving existing processes or products.	5.53(1.14)	
Personal Innovativeness with IT	PIIT1	If I heard about a new information technology, I would look for ways to experiment with it.	5.63(1.09)	[88]
	PIIT2	Among my peers, I am usually the first to try out new information technologies.	4.80(1.24)	
	PIIT3	In general, I am hesitant to try out new information technologies (Reverse item).	5.41(1.14)	
	PIIT4	I like to experiment with new information technologies.	5.68(1.01)	
IT Self-Efficacy	ITSE1	I could complete my job using BIS if there was no one around to tell me what to do as I go.	5.28(0.95)	[14]
	ITSE2	I could complete my job using BIS if I had used similar system before this one to do the same job.	5.60(0.94)	
	ITSE3	I could complete my job using BIS if someone showed me how to do it first.	5.57(1.01)	
	ITSE4	I could complete my job using BIS if I had just the built-in help facility for assistance.	5.27(1.05)	

0.71 (ITK), satisfying the suggested criterion [98]. Further, the square root values of the average variance, extracted for all first-order constructs and reported in the diagonal of the correlation matrix, were greater than the off-diagonal elements in the corresponding row and column (i.e. correlation values with other constructs). All the results supported adequate convergent and discriminant validity.

Considering that there are three second-order reflective variables in our model, Table 7 includes the Cronbach's alpha, composite reliability, and average variance extracted of the measures in the higher-order models [100], which provides evidence of reliable measures. Moreover, the loadings of the first-order latent variables on the second order factors exceeded 0.90 and our results indicated that all loadings fell within the corresponding confidence interval with a 95% probability and all confidence interval excluded the value zero. Thus, we could conclude that all loadings were significant ($\alpha = 0.001$).

TABLE 9. Results of hypotheses tests.

Hypothesis	Path Coefficient	t-value	Confidence Interval (95%)	Result
Theoretical Paths				
H1a: IM—>IUIT	-0.01	0.19ǂ	[-0.15, 0.13]	Not Support
H1b: IM—>PAC	0.56	9.53***	[0.44, 0.66]	Support
H1c: IM—>RAC	0.51	8.24***	[0.39, 0.63]	Support
H2a: IK—>IUIT	0.17	2.33*	[0.03, 0.31]	Support
H2b: IK—>PAC	0.29	4.21***	[0.16, 0.42]	Support
H2c: IK—>RAC	0.38	6.03***	[0.26, 0.51]	Support
H3: PAC—>IUIT	0.20	2.49*	[0.04, 0.35]	Support
H4: RAC—>IUIT	0.24	3.07**	[0.09, 0.39]	Support
Control Paths				
PIIT—>IUIT	0.14	2.09*	[0.01, 0.27]	Significant
ITSE—>IUIT	0.20	3.24**	[0.08, 0.32]	Significant

Notes: ***p < 0.001, **p < 0.01, *p < 0.05, ǂ = not significant; IM = Intrinsic Motivation; IK = Individual Knowledge; PAC = Potential Absorptive Capacity; RAC = Realized Absorptive Capacity; IUIT = Innovative use of IT; PIIT = Personal Innovativeness with IT; ITSE = IT Self-Efficacy.

TABLE 10. Mediation analysis of individual absorptive capacity.

Path	Indirect Effects		Direct Effects		Mediation Types
	β	CI (95%)	β	CI (95%)	
IM—>PAC—>IUIT	0.11*	[0.02, 0.21]	-0.01ǂ	[-0.15, 0.13]	IoM
IM—>RAC—>IUIT	0.12**	[0.04, 0.21]			IoM
IK—>PAC—>IUIT	0.06*	[0.01, 0.11]	0.16*	[0.03, 0.31]	CM
IK—>RAC—>IUIT	0.09**	[0.03, 0.17]			CM

Notes: **p < 0.01, *p < 0.05, ǂ = not significant; CI = Confidence Interval; IoM = Indirect-only Mediation; CM = Complementary Mediation; IM = Intrinsic Motivation; IK = Individual Knowledge; PAC = Potential Absorptive Capacity; RAC = Realized Absorptive Capacity; IUIT = Innovative use of IT.

B. COMMON METHOD BIAS

Since each respondent self-reported all measurement items, there was a potential for common method biases [101]. As mentioned above, we used the online questionnaire survey tool to disrupt the order in which items appeared, which can alleviate the bias caused by the item approximation. We also added marker variables into the questionnaire to detect whether there was a common method bias [102]. Specifically, we conducted Harman's one-factor test to assess the severity of common method bias [103]. The result of analysis yielded nine factors with eigenvalues greater than one and the first factor explained only 44.76% of the variance, which was smaller than the recommended threshold of 50%. Second, we used marker variable technique to conduct a partial correlation procedure. Following the procedures outlined by Lindell and Whitney [104], we compared the correlation between fashion consciousness [102] and other constructs in the study. The correlations ranged from 0.19 (ITSE) to 0.34 (AC), indicating that there was no evidence of major common method bias (the average correlation was 0.23). Thus, common method bias did not seem to be a serious problem in this study.

C. HYPOTHESIS TESTING

Before hypotheses testing, the structural model was assessed for multicollinearity [98]. The variance inflation factor values calculated for all of the items were well below the acceptable threshold of 5.0, and ranged from 1.33 (PIIT3) to 2.32 (ITK3). Thus, collinearity was not an issue. Table 8 provides the measures of each constructs. Then, the bootstrap resampling method with 249 cases and 5000 resamples was used to test the proposed research hypotheses. The results of analysis were described with path coefficients and significance level in Table 9, indicating that excluding H1aV-DV-D, all hypotheses were supported by our samples. Our results also indicate that IT self-efficacy and personal innovativeness with IT have significant positive effects on innovative use of IT. Besides, as show in Fig.1, our model explained substantial variance in innovative use of IT ($R^2 = 0.655$), potential absorptive capacities ($R^2 = 0.604$) and realized absorptive capacities ($R^2 = 0.664$). We made further efforts on examining the mediating role of potential absorptive capacities and realized absorptive capacities between the other two users' attributes (i.e. intrinsic motivation and individual knowledge) and innovative use of IT.

D. MEDIATING EFFECT

We adopted the bootstrapping procedure to test the mediation effects. In addition, following the recommendation of Zhao *et al.* [105], we also analyzed the mediation types of potential absorptive capacity and realized absorptive capacity respectively. Table 10 shows the results of the mediation analysis. Considering the path of intrinsic motivation on innovative use of IT, we found that both potential absorptive capacity and realized absorptive capacity mediated the relationship between intrinsic motivation and innovative use of IT. Furthermore, both potential absorptive capacity and realized absorptive capacity had full mediation effects on the relationship between intrinsic motivation and innovative use of IT, signaling indirect-only mediation. In addition, given

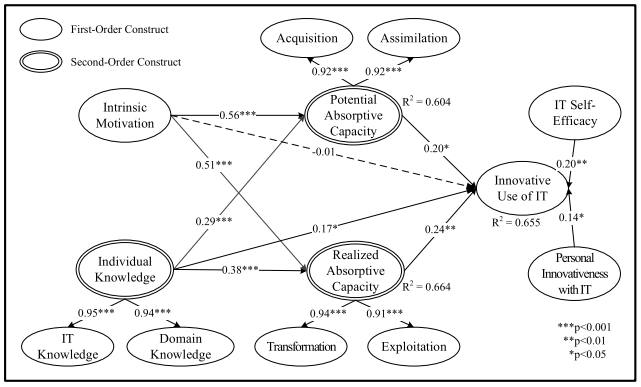

FIGURE 1. **Results of the structural model testing.**

the path of individual knowledge on innovative use of IT, we also found that both potential absorptive capacity and realized absorptive capacity mediated the relationship between intrinsic motivation and innovative use of IT. Besides, both potential absorptive capacity and realized absorptive capacity had partial mediation effects on the relationship between individual knowledge and innovative use of IT. The direct and indirect effects involved in these relationships were statistically positive, signaling complementary mediation. All in all, the effect of intrinsic motivation on innovative use of IT was completely mediated by potential absorptive capacity and realized absorptive capacity (partial support H5). While the effect of individual knowledge on innovative use of IT was partial mediated by potential absorptive capacity and realized absorptive capacity (support H6).

VI. DISCUSSION

Although researchers have identified the antecedents of user (employee) innovation, including creativity behavior, very few studies have explored the internal logic of innovative use of IT in the IS field. Our study fills in the gaps by exploring the mechanisms of innovative use of IT by users, concentrating on how IT users generate innovative behavior. In particular, we focus on user attributes and consider how they shape innovative use of IT. This paper develops and tests one of the earliest models of innovative use of IT, focusing specifically on the role of user attributes. Based on the absorptive capacity theory and the creativity literature, we outline the key capacities that IT users must possess to facilitate the innovative use of IT (i.e., potential absorptive capacities and realized absorptive capacities) and two prerequisites for such innovative use (i.e., intrinsic motivation and individual knowledge). Specifically, potential absorptive capacity represents the ability to acquire and assimilate individual knowledge, while realized absorptive capacity denotes the ability to transform and exploit individual knowledge covering both IT and domain knowledge.

The first important finding of this study is to elaborate two types of mechanisms with which users promote innovative use of IT. Synthesizing prior literature, we suggest that innovative use of IT follows two different mechanisms. First, users' tacit attributes (attributes such as intrinsic motivation that arise spontaneously or are embedded in an individual and are hard to change by the outside factors) will eventually come into play through explicit attributes (attributes that can be cultivated through own effort or study etc., such as absorptive capacities). Second, individual prior knowledge can influence innovative use of IT directly and through absorptive capacities indirectly. Further, IT users having weaker absorptive capacities but a wealth of IT-related knowledge may still have greater potential to use IT innovatively. The findings imply that although user-specific attributes are important in innovative use of IT, the attributes acquired through post-cultivation are more important.

A second key finding in our study is that intrinsic motivation is a predictor of potential absorptive capacity and realized absorptive capacity. Intrinsic motivation is a voluntary and spontaneous state generated by users, which is hard to change via outside efforts. Our result indicates that the impact of intrinsic motivation on innovative use of IT is completely mediated through individual absorptive capacity. This result suggests that even when IT users have high intrinsic motivations, the benefits of intrinsic motivations cannot be fully fulfilled without enough innovation ability (such as absorptive capacity). Although prior research indicates that intrinsic motivations have a direct impact on individual innovative use of IT [e.g., 1, 10, 15], our finding suggests that such effect will be fully mediated by absorptive capacity.

Finally, the IT and domain knowledge acquired by users can not only directly influence innovative use of IT, but also do so indirectly via absorptive capacity. Compared with intrinsic motivation, such knowledge plays a stronger role in innovative use of IT. To assess the value of knowledge for innovation, some studies have pointed out that prior IT knowledge is necessary for users to identify and assimilate new IT knowledge (i.e., equipped with the ability to identify and assimilate), and eventually apply IT innovatively [7]. Our results find that the impact of individual knowledge on innovative use of IT is only partially mediated due to absorptive capacity, indicating that the effect of knowledge on innovative use of IT is irreplaceable.

A. CONTRIBUTIONS TO RESEARCH

This study makes several significant contributions to IS research. First, this study develops a preliminary model of how IT user attributes drive innovative use of IT. Prior studies have sporadically noted that user attributes may contribute to innovative use of IT [e.g., 17]. However, the mechanism and empirical evidence are limited. This research uncovers two types of mechanisms for users to turn their intrinsic motivation and prior knowledge into innovative use of IT. We find that absorptive capacity can completely shift the impact of intrinsic motivation on innovative use of IT and at the same time partially transfer the impact of individual knowledge on innovative use of IT. Our findings provide

great insights for organizations to understand and facilitate innovative use of IT at a deeper level.

Second, we depict how intrinsic motivation contributes to using IT innovatively. Most scholars focused on the internal and external motivation factors of IT usage behavior [e.g., 1], and suggested that internal motivation (e.g., intrinsic motivation) is a major driver of individual innovation behavior. Yet prior studies have not explicitly revealed how intrinsic motivation influences innovative use of IT. Our research shows that the performance of intrinsic motivation depends on the level of special ability related to user creativity (such as the ability to acquire, assimilate, transform, and exploit knowledge). Further, we also investigate the role of prior knowledge in innovative use of IT, which may be the essential element for individuals to use IT innovatively.

Third, we provide an effective answer to address why and how IT users can innovatively use IT. Recent research has highlighted the importance of special users (e.g., gatekeepers [7], lead users [20]) for innovative use of IT. Our research suggests that it is possible for individuals with sufficient intrinsic motivation and prior knowledge to innovatively use IT. Not only can special users drive organizational innovation, but ordinary users with adequate intrinsic motivation and prior knowledge can also generate innovative behavior to drive organizational innovation.

Finally, this study also expands our understanding of absorptive capacity, especially at the individual level. Research on individual absorptive capacities and innovative use of IT is still in its infancy, and there still exist possible knowledge gaps worth addressing. Some interesting phenomena have been examined at the enterprise level, for instance, some researchers have started exploring situations when too much absorptive capacity might be a bad thing for organizations [106]. Our findings may be able to pave the way for such research.

B. IMPLICATIONS FOR PRACTICES

Our study also makes several contributions to IS practice. First, our results shed the light for IT managers to drive IT users towards innovative use of IT. Prior research has shown that employees' innovative use of IT benefits their teams [24] or organizations [7]. Thus, enterprise managers are interested in how to promote the innovative use of IT by employees. It is commonly known that domain-specific knowledge and skills, creativity-related skills, and intrinsic motivation are three decisive drivers. Our research implies that the domain-specific knowledge accumulated by employees and the creativity-related ability equipped with employees are two drivers more important than intrinsic motivation.

Second, our findings indicate that even ordinary users can be valuable sources of organizational innovation, if they are equipped with profound knowledge or requisite ability as well as enough intrinsic motivation. Therefore, enterprises should empower their employees to use more IT components, not just a single IT module. For instance, limiting the number of functional modules available to BI systems users will inhibit the possibility of employees gaining diversified knowledge.

Third, we suggest that managers focus not only on the importance of key users in innovative use of IT, but also on potential key users (i.e. ordinary users with profound knowledge, etc.). Ordinary users can also be a source of innovative IT use, in addition to key users. Furthermore, organizations should provide systematic training to employees to help them develop the necessary desirable attributes, such as IT-related knowledge and absorptive capacities.

C. LIMITATIONS AND FUTURE RESEARCH

While our study offers significantly new insights on innovative use of IT, we must acknowledge the limitations and point out the opportunities for future research. The first limitation is the narrow constructs used in this article, i.e., we have only explored user attributes to explain innovative use of IT. Through the dialogue between the creativity literature and the theory of absorptive capacity, we extract the constructs used in this paper. There may be additional antecedents or motivators of innovative use of IT that are not examined in this study, such as contextual antecedents. Prior studies also argue that studying the joint impact of user-related factors and contextual antecedents may be more interesting for innovative use of IT [14]. Future studies may consider other theoretical perspectives and organizational constructs from those theories to develop a profound understanding of innovative use of IT.

Second, as individual absorptive capacities may be quite dynamic, our study may not fully explain the role of potential and realized absorptive capacities based on the sectional data. Future studies may conduct a longitudinal research to probe the mediating role of individual absorptive capacities on innovative use of IT or explore other related factors. They can also examine the relationship between absorptive capacities and innovative use of IT at a more intricate level, such as investigating the point at which absorptive capacities produces diminishing returns to innovative use of IT.

The third limitation is that the data we used from online survey may not be very effective to control the impact of organizational differences. Future study can explore the impact of user attributes as well as contextual factors on innovative use of IT in a large company. Besides, our data is self-reported from BI users, which are considered to be subjective. Future research should pay attention to different data sources, such as objective data from human resource department or using quiz to measure users' knowledge.

Finally, this study only uses BI systems as the research background, which may exclude the influencing factors unique to the BI environment. Future research can focus on BI systems by contextualizing related theories around BI systems to reveal new constructs or factors.

VII. CONCLUSION

Capturing the major attributes of innovative use of IT based on the absorptive capacity theory and the creativity literature, this paper proposes a theoretical model and empirically

validates it through the investigation of BI users. We demonstrate that any users with domain-specific knowledge (both IT and domain knowledge) and creativity-related ability (absorptive capacities) can be an important source of innovative behavior (innovative use of IT). Further, the impact of intrinsic motivation on innovative use of IT is completely mediated through individual absorptive capacity. We also elaborate two types of mechanisms for innovative use of IT and identify its two antecedents. We hope that our study will inspire further research interests in exploring innovative use of IT in organizations.

REFERENCES

[1] X. Li, P.-A. Hsieh, and A. Rai, "Motivational differences across post-acceptance information system usage behaviors: An investigation in the business intelligence systems context," *Inf. Syst. Res.*, vol. 24, no. 3, pp. 659–682, Sep. 2013.

[2] J. F. Veiga, M. M. Keupp, S. W. Floyd, and F. W. Kellermanns, "The longitudinal impact of enterprise system users' pre-adoption expectations and organizational support on post-adoption proficient usage," *Eur. J. Inf. Syst.*, vol. 23, no. 6, pp. 691–707, Nov. 2014.

[3] H.-C. Chen, R. H. L. Chiang, and V. C. Storey, "Business intelligence and analytics: From big data to big impact," *Mis Quart.*, vol. 36, no. 4, pp. 1165–1188, Sep. 2012.

[4] L. Chen, Z. Qiao, M. Wang, C. Wang, R. Du, and H. E. Stanley, "Which artificial intelligence algorithm better predicts the Chinese stock market?" *IEEE Access*, vol. 6, pp. 48625–48633, Jul. 2018.

[5] W. Lin, Z. Wu, L. Lin, A. Wen, and J. Li, "An ensemble random forest algorithm for insurance big data analysis," *IEEE Access*, vol. 5, pp. 16568–16575, Aug. 2017.

[6] A. Tiwana and E. R. McLean, "Expertise integration and creativity in information systems development," *J. Manag. Inf. Syst.*, vol. 22, no. 1, pp. 13–43, Dec. 2005.

[7] M. Huang, A. Bhattacherjee, and C.-S. Wong, "Gatekeepers' innovative use of IT: An absorptive capacity model at the unit level," *Inf. Manage.*, vol. 55, no. 2, pp. 235–244, Mar. 2018.

[8] H. Choi, S. Oh, S. Choi, and J. Yoon, "Innovation topic analysis of technology: The case of augmented reality patents," *IEEE Access*, vol. 6, pp. 16119–16137, 2018.

[9] N. Roberts, D. E. Campbell, and L. R. Vijayasarathy, "Using information systems to sense opportunities for innovation: Integrating postadoptive use behaviors with the dynamic managerial capability perspective," *J. Manage. Inf. Syst.*, vol. 33, no. 1, pp. 45–69, Jun. 2016.

[10] X. Li, P. A. Hsieh, and A. Rai, "A motivational account for post-acceptance routine and innovative use: Introducing the concept of tri-dimensional intrinsic motivation," in *Proc. 30th Int. Conf. Inf. Syst.*, 2009, pp. 177–198.

[11] W. Wang, "Factors influencing employees' deep usage of information systems," *Proc. 9th Pacific Asia Conf. Inf. Syst.*, 2005, pp. 30–43.

[12] M. K. Ahuja and J. B. Thatcher, "Moving beyond intentions and toward the theory of trying: Effects of work environment and gender on post-adoption information technology use," *MIS Quart.*, vol. 29, no. 3, pp. 427–459, Sep. 2005.

[13] W. Ke, C.-H. Tan, C.-L. Sia, and K.-K. Wei, "Inducing intrinsic motivation to explore the enterprise system: The supremacy of organizational levers," *J. Manag. Inf. Syst.*, vol. 29, no. 3, pp. 257–290, Dec. 2012.

[14] H. Liang, Z. Peng, Y. Xue, X. Guo, and N. Wang, "Employees' exploration of complex systems: An integrative view," *J. Manag. Inf. Syst.*, vol. 32, no. 1, pp. 322–357, Jul. 2015.

[15] M. P. Joshi and Y. Rahrovani, "Organizational support for innovative use of IT: A slack resources perspective," in *Proc. 23th Amer. Conf. Inf. Syst.*, 2017, pp. 1–10.

[16] W. Wang, L. Liu, Y. Feng, and T. Wang, "Innovation with IS usage: Individual absorptive capacity as a mediator," *Ind. Manage. Data Syst.*, vol. 114, no. 8, pp. 1110–1130, Sep. 2014.

[17] A. Kankanhalli, H. Ye, and H. H. Teo, "Comparing potential and actual innovators: An empirical study of mobile data services innovation," *MIS Quart.*, vol. 39, no. 3, pp. 667–682, Sep. 2015.

[18] S. Nambisan, R. Agarwal, and M. Tanniru, "Organizational mechanisms for enhancing user innovation in information technology," *MIS Quart.*, vol. 23, no. 3, pp. 365–395, Sep. 1999.

[19] V. Venkatesh and H. Bala, "Technology acceptance model 3 and a research agenda on interventions," *Decision Sci.*, vol. 39, no. 2, pp. 273–315, May 2008.

[20] H. J. Ye and A. Kankanhalli, "User service innovation on mobile phone platforms: Investigating impacts of lead userness, toolkit support, and design autonomy," *MIS Quart.*, vol. 42, no. 1, pp. 165–187, Mar. 2018.

[21] W. Wang, X. Li, and J. P.-A. Hsieh, "The contingent effect of personal IT innovativeness and IT self-efficacy on innovative use of complex IT," *Behav. Inf. Technol.*, vol. 32, no. 11, pp. 1105–1124, May 2013.

[22] Y. Rahrovani and A. Pinsonneault, "User's perceived is slack resources and their effects on innovating with IT," in *Proc. 35th Int. Conf. Inf. Syst.*, 2014, pp. 1–12.

[23] F. Yuan and R. W. Woodman, "Innovative behavior in the workplace: The role of performance and image outcome expectations," *Acad. Manage. J.*, vol. 53, no. 2, pp. 323–342, Apr. 2010.

[24] H. Ling, C. Zhang, and Y. Xu, "Individual and collective innovative use of enterprise system- mediating role of collective learning," in *Proc. 17th Pacific Asia Conf. Inf. Syst.*, 2012, pp. 20–35.

[25] J. Zhang *et al.*, "A hybrid mechanism for innovation diffusion in social networks," *IEEE Access*, vol. 4, pp. 5408–5416, 2016.

[26] A. P. Massey, M. M. Montoya-Weiss, and S. A. Brown, "Reaping the benefits of innovative IT: The long and winding road," *IEEE Trans. Eng. Manag.*, vol. 48, no. 3, pp. 348–357, Aug. 2001.

[27] J. Lee, E. Suh, H. Park, and S. Lee, "Determinants of users' intention to purchase probability-based items in mobile social network games: A case of South Korea," *IEEE Access*, vol. 6, pp. 12425–12437, 2018.

[28] J. Jasperson, P. E. Carter, and R. W. Zmud, "A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems," *MIS Quart.*, vol. 29, no. 3, pp. 525–557, Sep. 2005.

[29] F. P. Morgeson and S. E. Humphrey, "The Work Design Questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design and the nature of work," *J. Appl. Psychol.*, vol. 91, no. 6, pp. 1321–1339, Nov. 2006.

[30] G. Baker and A. Mills, "Creative Use," in *Proc. 16th Pacific Asia Conf. Inf. Syst.*, 2011, pp. 131–143.

[31] L. Jiang and H. Sun, "Dark side of personality and innovation with IT," in *Proc. 23th Eur. Conf. Inf. Syst.*, 2015, pp. 67–79.

[32] J. J. P.-A. Hsieh and W. Wang, "Explaining employees' extended use of complex information systems," *Eur. J. Inf. Syst.*, vol. 16, no. 3, pp. 216–227, Jul. 2007.

[33] V. M. Tennant, A. M. Mills, and W. W. Chin, "A generalized darwinism perspective on changes in individuals' use of information systems," in *Proc. 35th Int. Conf. Inf. Syst.*, 2014, pp. 1–18.

[34] M. Kang and M.-J. Lee, "Absorptive capacity, knowledge sharing, and innovative behaviour of R&D employees," *Technol. Anal. Strategic Manage.*, vol. 29, no. 2, pp. 219–232, Jul. 2017.

[35] X. Zhang and K. M. Bartol, "Linking empowering leadership and employee creativity: The influence of psychological empowerment, intrinsic motivation, and creative process engagement," *Acad. Manage. J.*, vol. 53, no. 1, pp. 107–128, Feb. 2010.

[36] S. Leal, J. Esteves, and L. Guerra, "Examining the factors that influence the innovation process," in *Proc. Medit. Conf. Inf. Syst.*, 2012, pp. 36–47.

[37] G.-W. Bock, R. W. Zmud, Y.-G. Kim, and J.-N. Lee, "Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate," *MIS Quart.*, vol. 29, no. 1, pp. 87–111, Mar. 2005.

[38] W. Ke and K. K. Wei, "Exploratory usage of enterprise systems: The joint effects of intrinsic motivation and psychological empowerment," in *Proc. 20th Pacific Asia Conf. Inf. Syst.*, 2015, pp. 232–241.

[39] J. B. Thatcher, R. T. Wright, H. Sun, T. J. Zagenczyk, and R. Klein, "Mindfulness in information technology use: Definitions, distinctions, and a new measure," *MIS Quart.*, vol. 42, no. 3, pp. 831–847, Sep. 2018.

[40] T. M. Amabile, "A model of creativity and innovation in organizations," *Res. Organizational Behav.*, vol. 10, no. 1, pp. 123–167, Jan. 1988.

[41] P. R. Sackett, F. Lievens, C. H. Van Iddekinge, and N. R. Kuncel, "Individual differences and their measurement: A review of 100 years of research," *J. Appl. Psychol.*, vol. 102, no. 3, pp. 254–273, Mar. 2017.

[42] W. M. Cohen and D. A. Levinthal, "Absorptive capacity: A new perspective on learning and innovation," *Administ. Sci. Quart.*, vol. 35, no. 1, pp. 128–152, Mar. 1990.

[43] E. Enkel, S. Heil, M. Hengstler, and H. Wirth, "Exploratory and exploitative innovation: To what extent do the dimensions of individual level absorptive capacity contribute?" *Technovation*, vols. 60–61, pp. 29–38, Feb. 2017.
[44] S. Lowik, J. Kraaijenbrink, and A. J. Groen, "Antecedents and effects of individual absorptive capacity: A micro-foundational perspective on open innovation," *J. Knowl. Manage.*, vol. 21, no. 6, pp. 1319–1341, Oct. 2017.
[45] X. Deng, W. J. Doll, and M. Cao, "Exploring the absorptive capacity to innovation/productivity link for individual engineers engaged in IT enabled work," *Inf. Manage.*, vol. 45, no. 2, pp. 75–87, Mar. 2008.
[46] X. Zhang, "Knowledge management system use and job performance: A multilevel contingency model," *MIS Quart.*, vol. 41, no. 3, pp. 811–840, Sep. 2017.
[47] J.-H. Park, H.-J. Suh, and H.-D. Yang, "Perceived absorptive capacity of individual users in performance of Enterprise Resource Planning (ERP) usage: The case for Korean firms," *Inf. Manage.*, vol. 44, no. 3, pp. 300–312, Apr. 2007.
[48] H. Mohammadi, "Social and individual antecedents of m-learning adoption in Iran," *Comput. Hum. Behav.*, vol. 49, pp. 191–207, Aug. 2015.
[49] J. J. P. Jansen, F. A. J. Van Den Bosch, and H. W. Volberda, "Managing potential and realized absorptive capacity: How do organizational antecedents matter?" *Acad. Manage. J.*, vol. 48, no. 6, pp. 999–1015, Dec. 2005.
[50] S. A. Zahra and G. George, "Absorptive capacity: A review, reconceptualization, and extension," *Acad. Manage. Rev.*, vol. 27, no. 2, pp. 185–203, Apr. 2002.
[51] A. O. Ojo, M. Raman, and C. W. Chong, "Microlevel antecedents of absorptive capacity in joint project engineering teams," *Manage. Res. Rev.*, vol. 40, no. 9, pp. 990–1006, Sep. 2017.
[52] A. O. Ojo and M. Raman, "The role of prior experience and goal orientation in individual absorptive capacity," *Ind. Manage. Data Syst.*, vol. 116, no. 4, pp. 723–739, May 2016.
[53] Y. Hwang, W. J. Kettinger, and M. Y. Yi, "Personal information management effectiveness of knowledge workers: Conceptual development and empirical validation," *Eur. J. Inf. Syst.*, vol. 24, no. 6, pp. 588–606, Nov. 2015.
[54] I. Nonaka, "A dynamic theory of organizational knowledge creation," *Organ. Sci.*, vol. 5, no. 1, pp. 14–37, Feb. 1994.
[55] M. Alavi and D. E. Leidner, "Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues," *MIS Quart.*, vol. 25, no. 1, pp. 107–136, Mar. 2001.
[56] S. Faraj, G. von Krogh, E. Monteiro, and K. R. Lakhani, "Special section introduction—Online community as space for knowledge flows," *Inf. Syst. Res.*, vol. 27, no. 4, pp. 1–17, Dec. 2016.
[57] M. Schneider, B. Rittle-Johnson, and J. R. Star, "Relations among conceptual knowledge, procedural knowledge, and procedural flexibility in two samples differing in prior knowledge," *Develop. Psychol.*, vol. 47, no. 6, pp. 1525–1538, Aug. 2011.
[58] S. Gupta and R. Bostrom, "Research note—An investigation of the appropriation of technology-mediated training methods incorporating enactive and collaborative learning," *Inf. Syst. Res.*, vol. 24, no. 2, pp. 454–469, Jun. 2013.
[59] K. Kang, J. Hahn, and P. De, "Learning effects of domain, technology, and customer knowledge in information systems development: An empirical study," *Inf. Syst. Res.*, vol. 28, no. 4, pp. 797–811, Dec. 2017.
[60] M. J. Tippins and R. S. Sohi, "IT competency and firm performance: Is organizational learning a missing link?" *Strategic Manage. J.*, vol. 24, no. 8, pp. 745–761, Aug. 2003.
[61] Y.-H. Chiang, C.-C. Hsu, and K.-P. Hung, "Core self-evaluation and workplace creativity," *J. Bus. Res.*, vol. 67, no. 7, pp. 1405–1413, Jul. 2014.
[62] B. L. Marcolin, D. R. Compeau, M. C. Munro, and S. L. Huff, "Assessing user competence: Conceptualization and measurement," *Inf. Syst. Res.*, vol. 11, no. 1, pp. 37–60, Mar. 2000.
[63] S. L. Alam and J. Campbell, "Temporal motivations of volunteers to participate in cultural crowdsourcing work," *Inf. Syst. Res.*, vol. 28, no. 4, pp. 744–759, Dec. 2017.
[64] T. M. Amabile, R. Conti, H. Coon, J. Lazenby, and M. Herron, "Assessing the work environment for creativity," *Acad. Manage. J.*, vol. 39, no. 5, pp. 1154–1184, Oct. 1996.
[65] D. Liu, X. P. Chen, and X. Yao, "From autonomy to creativity: A multilevel investigation of the mediating role of harmonious Passion," *J. Appl. Psychol.*, vol. 96, no. 2, pp. 294–309, Mar. 2011.
[66] J. Zhou and C. E. Shalley, "Research on employee creativity: A critical review and directions for future research," *Res. Pers. Hum. Res. Manag.*, vol. 22, no. 3, pp. 165–217, Jan. 2003.
[67] C. E. Shalley and L. L. Gilson, "What leaders need to know: A review of social and contextual factors that can foster or hinder creativity," *Leadership Quart.*, vol. 15, no. 1, pp. 33–53, Feb. 2004.
[68] R. M. Ryan and E. L. Deci, "Intrinsic and extrinsic motivations: Classic definitions and new directions," *Contemp. Educ. Psychol.*, vol. 25, no. 1, pp. 54–67, Jan. 2000.
[69] S. K. Parker, U. K. Bindl, and K. Strauss, "Making things happen: A model of proactive motivation," *J. Manage.*, vol. 36, no. 4, pp. 827–856, Jul. 2010.
[70] M. Hughes and R. E. Morgan, "Deconstructing the relationship between entrepreneurial orientation and business performance at the embryonic stage of firm growth," *Ind. Market. Manage.*, vol. 36, no. 5, pp. 651–661, Jul. 2007.
[71] J. Schmidhuber, "Formal theory of creativity, fun, and intrinsic motivation (1990–2010)," *IEEE Trans. Auton. Mental Develop.*, vol. 2, no. 3, pp. 230–247, Jul. 2010.
[72] X. Li and J. J. P. A. Hsieh, "Impact of transformational leadership on system exploration in the mandatory organizational context," in *Proc. 28th Int. Conf. Inf. Syst.*, 2007, pp. 86–107.
[73] H. Van der Heijden, "User acceptance of hedonic information systems," *MIS Quart.*, vol. 28, no. 4, pp. 695–704, Sep. 2004.
[74] R. Aggarwal, D. Kryscynski, V. Midha, and H. Singh, "Early to adopt and early to discontinue: The impact of self-perceived and actual IT knowledge on technology use behaviors of end users," *Inf. Syst. Res.*, vol. 26, no. 1, pp. 127–144, Mar. 2015.
[75] K. W. Schmitz, J. T. C. Teng, and K. J. Webb, "Capturing the complexity of malleable it use: Adaptive structuration theory for individuals," *MIS Quart.*, vol. 40, no. 3, pp. 663–686, Sep. 2016.
[76] D. Leonard and S. Sensiper, "The role of tacit knowledge in group innovation," *California Manage. Rev.*, vol. 40, no. 3, pp. 112–132, Mar. 1998.
[77] L. A. Nemanich, R. T. Keller, D. Vera, and W. W. Chin, "Absorptive capacity in R&D project teams: A conceptualization and empirical test," *IEEE Trans. Eng. Manag.*, vol. 57, no. 4, pp. 674–688, May 2010.
[78] J. E. Scott and S. Walczak, "Cognitive engagement with a multimedia ERP training tool: Assessing computer self-efficacy and technology acceptance," *Inf. Manage.*, vol. 46, no. 4, pp. 221–232, May 2009.
[79] W. F. Boh, J. A. Espinosa, and J. A. Espinosa, "Learning from experience in software development: A multilevel analysis," *Manage. Sci.*, vol. 53, no. 8, pp. 1315–1331, Aug. 2007.
[80] W. Weiwei, F. Yuqiang, and L. Luning, "The effect of organizational levers and the mediating role of individual absorptive capacity in information system innovation," in *Proc. 48th Hawaii Int. Conf. Syst. Sci.*, Jan. 2015, pp. 3780–3789.
[81] A. S. Lukito-Budi and N. Indarti, "A conceptual interaction cycle between individual and group absorptive capacity with social integration mechanism and cohesive learning group as moderating variables," in *Proc. Int. Conf. Ind. Eng. Manag.*, 2018, pp. 1361–1365.
[82] S. G. Scott and R. A. Bruce, "Determinants of innovative behavior: A path model of individual innovation in the workplace," *Acad. Manage. J.*, vol. 37, no. 3, pp. 580–607, Jun. 1994.
[83] A. Salter, A. L. J. Wal, P. Criscuolo, and O. Alexy, "Open for ideation: Individual-level openness and idea generation in R&D," *J. Prod. Innov. Manage.*, vol. 32, no. 4, pp. 488–504, Jul. 2015.
[84] N. Roberts, P. S. Galluch, M. Dinger, and V. Grover, "Absorptive capacity and information systems research: Review, synthesis, and directions for future research," *MIS Quart.*, vol. 36, no. 2, pp. 625–648, Jun. 2012.
[85] E. Karahanna, R. Agarwal, and C. M. Angst, "Reconceptualizing compatability beliefs in technology acceptance research," *MIS Quart.*, vol. 30, no. 4, pp. 781–804, Dec. 2006.
[86] R. W. Brislin, "Back-translation for cross-cultural research," *J. Cross-Cultural Psychol.*, vol. 1, no. 3, pp. 185–216, Sep. 1970.
[87] J. Zhou and J. M. George, "When job dissatisfaction leads to creativity: Encouraging the expression of voice," *Acad. Manage. J.*, vol. 44, no. 4, pp. 682–696, Aug. 2001.
[88] R. Agarwal and J. Prasad, "A conceptual and operational definition of personal innovativeness in the domain of information technology," *Inf. Syst. Res.*, vol. 9, no. 2, pp. 204–215, Jun. 1998.
[89] R. Agarwal and E. Karahanna, "Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage," *MIS Quart.*, vol. 24, no. 4, pp. 665–694, Dec. 2000.

[90] H. W. Kim and A. Kankanhalli, "Investigating user resistance to information systems implementation: A status quo bias perspective," *MIS Quart.*, vol. 33, no. 3, pp. 567–582, Sep. 2009.
[91] A. C. Johnston and M. Warkentin, "Fear appeals and information security behaviors: An empirical study," *MIS Quart.*, vol. 34, no. 3, pp. 549–566, Sep. 2010.
[92] B. Bulgurcu, H. Cavusoglu, and I. Benbasat, "Information security policy compliance: An empirical study of rationality-based beliefs and information security awareness," *MIS Quart.*, vol. 34, no. 3, pp. 523–548, Sep. 2010.
[93] K.-Y. Kwahk and J.-N. Lee, "The role of readiness for change in ERP implementation: Theoretical bases and empirical validation," *Inf. Manage.*, vol. 45, no. 7, pp. 474–481, Nov. 2008.
[94] T. K. Dijkstra and J. Henseler, "Consistent partial least squares path modeling," *MIS Quart.*, vol. 39, no. 2, p. 297–316, Jun. 2015.
[95] C. M. Ringle, S. Wende, and J.-M. Becker. Smart PLS 3. SmartPLS GmbH, Bönningstedt, Germany. [Online]. Available: http://www.smartpls.com 2015.
[96] L. J. Cronbach, "Coefficient alpha and the internal structure of tests," *Psychometrika*, vol. 16, no. 3, pp. 297–334, Sep. 1951.
[97] C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *J. Marketing Res.*, vol. 18, no. 1, pp. 39–50, Feb. 1981.
[98] J. F. Hair, M. H. G. Tomas, C. Ringle, and M. Sarstedt. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Thousand Oaks, CA, USA: Sage, 2014.
[99] B. Efron and R. J. Tibshirani, *An Introduction to the Bootstrap*. London, U.K.: Chapman & Hall, 1993, pp. 49–54.
[100] M. Wetzels, G. Odekerken-Schröder, and C. van Oppen, "Using PLS path modeling for assessing hierarchical construct models: Guidelines and empirical illustration," *MIS Quart.*, vol. 33, no. 1, pp. 177–195, Mar. 2009.
[101] P. M. Podsakoff *et al.*, "Common method biases in behavioral research: A critical review of the literature and recommended remedies," *J. Appl. Psychol.*, vol. 88, no. 5, pp. 879–903, Oct. 2003.
[102] N. K. Malhotra, S. S. Kim, and A. Patil, "Common method variance in IS research: A comparison of alternative approaches and a reanalysis of past research," *Manage. Sci.*, vol. 52, no. 12, pp. 1865–1883, Dec. 2006.
[103] P. M. Podsakoff and D. W. Organ, "Self-reports in organizational research: Problems and prospects," *J. Manage.*, vol. 12, no. 4, pp. 531–544, Sep. 1986.
[104] M. K. Lindell and D. J. Whitney, "Accounting for common method variance in cross-sectional research designs," *J. Appl. Psychol.*, vol. 86, no. 1, pp. 114–121, Feb. 2001.
[105] X. Zhao, J. G. Lynch, Jr., and Q. Chen, "Reconsidering baron and kenny: Myths and truths about mediation analysis," *J. Consum. Res.*, vol. 37, no. 2, pp. 197–206, Aug. 2010.
[106] W. J. Wales, V. Parida, and P. C. Patel, "Too much of a good thing? Absorptive capacity, firm performance, and the moderating role of entrepreneurial orientation," *Strategic Manage. J.*, vol. 34, no. 5, pp. 622–633, May 2013.

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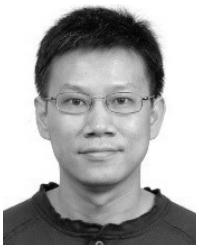

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