How Does Intelligent System Knowledge Empowerment Yield Payoffs? Uncovering the Adaptation Mechanisms and Contingency Role of Work Experience

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Abstract

Intelligent systems are transforming the nature of work as humans and machines collectively perform tasks in novel ways. While intelligent systems empower employees with algorithm-generated knowledge, they require employees to adapt how they work to enhance their job performance. We draw upon the coping-adaptation framework as the overarching theoretical lens to explain how employees' perceptions of IntelSys knowledge as an empowering external coping resource affect the mechanisms through which they adapt to IntelSys-induced changes to their work, as well as how their internal coping resources regulate their adaptation. Our coping-adaptation explanation of intelligence augmentation integrates (i) the empowering role of external coping resources, specifically IntelSys knowledge, captured as intelligent system knowledge empowerment (ISK-Emp), (ii) the *benefit-maximizing adaptation mechanism* (through infusion use enhancement) and the *disturbance-minimizing adaptation mechanism* (through role conflict reduction) that channel the impact of ISK-Emp on job performance, and (iii) the regulating role of internal resources, specifically, employees' work experience, in influencing the importance of the adaptation mechanisms for the employee. We conduct studies in three distinct settings in which different intelligent systems were implemented to support employees' knowledge work. Our findings show that ISK-Emp increases job performance through each of the two adaptation mechanisms. The benefit-maximization mechanism (via enhanced infusion use) plays a more important role for novice employees than for experienced employees, whereas the disturbance-minimization mechanism (via reduced role conflict) has higher importance for experienced employees than for novice employees. Our work provides insights into the critical role of adaptation mechanisms in linking ISKEmp with performance outcomes and into the relative importance of the adaptation mechanisms through which job performance payoffs are realized by novice and experienced employees.

Keywords:

Intelligence augmentation, Coping-adaptation framework, Intelligent system knowledge empowerment, Infusion use, Role conflict, Job performance

How Does Intelligent System Knowledge Empowerment Yield Payoffs? Uncovering the Adaptation Mechanisms and Contingency Role of Work Experience

1. INTRODUCTION

An intelligent system (IntelSys), in contrast to transaction support systems that execute operational processes, is a computer-assisted system that leverages computational tools such as learning algorithms and statistical models to generate algorithmic knowledge and support employees in accomplishing their tasks (von Krogh 2018). Rapid IntelSys advances are redefining the interdependence between these systems and employees in terms of how they perform tasks together (Davenport 2018; Raisch and Krakowski 2020). Initially, system–employee interdependence was characterized by *substitution*, with the system delivering algorithm-generated knowledge to automate tasks and replace employees (e.g., Huang and Rust 2018). Now, however, these systems can also be used for *augmentation*, with the system generating knowledge to expand employees' cognitive capabilities, thereby empowering them to achieve superior performance (Marinova et al. 2017; Rai et al. 2019). Acknowledging the two modes of interdependence (i.e., automation vs. augmentation), we focus on IntelSys ***augmentation*** capabilities for humans. After all, IntelSys implementation represents an organizational initiative that empowers employees to utilize the knowledge provided by an intelligent system (hereafter IntelSys knowledge) to augment their decision-making and problem-solving abilities and achieve better job performance (Han and Farn 2013).

In knowledge work across domains (e.g., medicine, business, education), intelligent systems can change how employees generate inputs, perform activities, and determine outputs, and in doing so augment their ability to conduct knowledge-intensive tasks (Kleinberg et al. 2018). For example, using an intelligent system to generate fragrance formulas, master perfumers may acquire knowledge about new combinations of fragrance ingredients while experiencing disruptions in terms of their evaluation of novel fragrance formulas beyond their experiential knowledge (Bergstein 2019; Goodwin et al. 2017). As another example, physicians who work with an AI-based pathology system to examine human cells may learn new skills for navigating and interpreting digital images, thus enhancing the speed and accuracy of their diagnoses. At the same time, they may also encounter challenges in reconciling the inconsistencies between novel image analysis-based diagnosis and traditional microscope-based diagnosis

(Davenport 2020).

Despite the potential benefits of intelligence augmentation brought by an intelligent system, these systems introduce substantial changes in employees' knowledge work. Many IntelSys implementations will bring benefits but also spur disruptions in terms of how the algorithmic knowledge augments human knowledge (Stone et al. 2016). In the context of intelligence augmentation, where employees have the ultimate control to decide whether and how to use IntelSys knowledge, it is vital to understand how employees appraise the IntelSys knowledge and adapt to the changes introduced by the intelligent system to enhance their performance (Lyytinen and Grover 2017). While the success of intelligence augmentation lies in smooth interactions between human knowledge and IntelSys knowledge, the existing literature offers little insight regarding whether employees' perceptions of the empowerment rendered to them by IntelSys knowledge could differentially impact their adaptation to an intelligent system based on their level of work experience (i.e., novice versus experienced employees).

To this end, we draw upon the coping-adaptation framework as our overarching theoretical lens for understanding knowledge employees' adaptation to an intelligent system. This framework posits that, when individuals encounter a change, they assess the availability of internal and external coping resources, activate appraisals of the change, and engage in different adaptation responses to cope with the change (Beaudry and Pinsonneault 2005; Lazarus and Folkman 1984). According to this perspective, it is vital to understand how employees perceive and utilize internal and external coping resources in adapting to IntelSys-induced work changes in order to accomplish their tasks. As such, appropriating the coping-adaptation framework for the context of intelligence augmentation, we view IntelSys knowledge as an external coping resource (Kellogg et al. 2020) and employees' work experience (i.e., the human knowledge that has been accumulated over time) as an internal coping resource (Baillergeau and Duyvendak 2016; Schwarzer and Greenglass 1999).

As employees have volitional control over how to use IntelSys knowledge in their work, their perception of IntelSys knowledge as an external coping resource is essential in shaping their responses to the changes brought by an intelligent system. We adopt the perspective of psychological empowerment as a concept that captures employees' perceptions of available resources in their working environment and motivates their job behaviors (Spreitzer 1996; Thomas and Velthouse 1990) to illuminate how employees' perceptions of IntelSys knowledge influence their adaptation to the job changes brought by an intelligent system and eventually affect their job performance. Accordingly, we conceptualize *intelligent system knowledge empowerment* (ISK-Emp) to describe employees' psychological state arising from the introduction of IntelSys knowledge, and develop the theoretical linkage between this concept and the adaptation responses and performance outcomes.

As an intelligent system may change employees' knowledge work in different ways, employees may perceive IntelSys-induced changes as opportunities or threats (or both) and respond differently in order to accomplish their work (Chen et al. 2012). Regarding *opportunities*, an intelligent system enables employees to acquire new knowledge for their work practices in new ways after system deployment. In this case, the encouraging psychological state of ISK-Emp could be instrumental in motivating employees to maximize benefits by devoting extra effort to using the intelligent system to its fullest potential (i.e., infusion use) (e.g., Kim and Gupta 2014). Regarding *threats*, an intelligent system disrupts established routines, changes knowledge dependencies across roles, and creates entropy and perturbations in work (Polites and Karahanna 2012, 2013). In such a circumstance, because employees generally expect their jobs to follow established routines (Huang et al. 2010), they may experience incompatible expectations regarding how to conduct their work (i.e., role conflicts) after IntelSys deployment, leading to compromised performance. In this case, the encouraging psychological state of ISK-Emp could be instrumental in motivating such employees to minimize disturbances by framing threats positively and approaching their work flexibly (Ang et al. 2007; Chen et al. 2010).

Thus, there is a critical need to uncover the distinct mechanisms—benefit maximization and disturbance minimization—through which ISK-Emp can facilitate effective adaptation responses. Specifically, it is important to investigate *how* and *why* employees' empowerment perceptions regarding the external coping resource (i.e., the IntelSys knowledge) generate performance payoffs by facilitating different adaptation responses to IntelSys-induced changes. While benefit maximization represents a constructive pathway to be enhanced, disturbance minimization represents a disruptive pathway to be mitigated. In our investigative context where IntelSys augments human knowledge, we examine the mediating role of infusion use (for benefit maximization) and role conflicts (for disturbance minimization) as two adaptation responses, leading to our first research question (**RQ1**): How do infusion use and role conflicts mediate the impact of ISK-Emp on job performance?

Further, the effectiveness of these two mechanisms that convert empowerment perceptions of IntelSys knowledge into successful adaptation may not be the same for all employees, as the impacts of such conversion could be contingent on employees' work experience (i.e., their internal coping resources) (Bala and Venkatesh 2016; Van den Heuvel 2013). In the context of intelligence augmentation, work experience represents a reasonable proxy for internal coping resources, including professional skills and work routines that have been accumulated through job activities over time. Such internal coping resources are likely to shape how employees' perceptions of IntelSys knowledge affect their task performance through distinct adaptation mechanisms. Specifically, experienced employees have different cognitive schemas compared to novices because of their substantial job-related knowledge (Arnold and Sutton 1998; Ko and Dennis 2011; Markus 2001; Markus and Robey 1988). This difference in their work experience may cause novice and experienced employees to respond differently in terms of how they adapt to IntelSys-induced work changes (Mao and Benbasat 2000). As such, we focus on work experience as a key contingency that affects how employees' perceptions of external coping resources (i.e., ISK-Emp) influence their work performance via the two different adaptation mechanisms, leading to our second research question (**RQ2**): How does the importance of the mechanisms through which ISK-Emp affects job performance differ for novice and experienced employees?

2. TECHNOLOGICAL CONTEXT: INTELLIGENT SYSTEMS AUGMENTATION OF HUMAN KNOWLEDGE

We situate this study in the context of intelligent systems augmenting human knowledge. As IntelSys applications continuously evolve, definitions of an intelligent system may vary based on its structure, behaviors, capabilities, functions, and principles (Wang 2008). Recognizing the evolving nature of intelligent systems, we take a broad view and define an intelligent system as a computer-assisted system that employs computational tools such as learning algorithms and statistical models to provide knowledge for problem solving and decision making (von Krogh 2018). In contrast to transaction support systems that digitize organizational routines and support business operations, intelligent systems have the common feature of generating machine knowledge in performing cognitive functions such as reasoning, learning, and interacting (Davenport and Kirby 2016; Rai et al. 2019).

Prior literature has recognized two broad types of human–machine interdependence: automation and augmentation (Amey and VanDerLinden 2003). **Automation** implies that machines substitute for humans in a task, with the objective of keeping humans out of the equation to allow for more consistent, rational, and efficient machine processing

(Davenport and Kirby 2016). **Augmentation**, in contrast, means that humans collaborate and interact closely with machines to perform a task (Licklider 1960; Pavlou 2018). Intelligence is augmented when we optimize the computational power of an intelligent system with the cognition, intuition, and reasoning of human beings (Daugherty and Wilson 2018). Leveraging the two parties' complementary strengths, humans can help machines overcome their limitations, while machines can augment human abilities and activities (Wilson and Daugherty 2018).

Given our focus on augmentation from a human frame of reference, we specify **our research scope** as intelligent systems designed to enhance human intelligence in problem-solving and decision-making tasks that are characterized by complexity, uncertainty, and equivocality (Jarrahi 2018). Through its computational capacity and analytical methods for learning and discovery, an intelligent system can extend employees' cognition in addressing complex tasks (Jarrahi 2018), and employees may leverage their own experience and contextual knowledge to take a holistic approach when dealing with uncertainty and equivocality (Jarrahi 2018). Our review of intelligence augmentation applications (details in Table A1, Appendix A) further suggests that although intelligence augmentation can be achieved in various ways, a common feature across intelligence augmentation applications is that humans have the ultimate control to decide whether and how to use the IntelSys-provided output (i.e., the IntelSys knowledge). In this vein, the core issue is how employees with different levels of work experience (internal coping resources) best leverage IntelSys knowledge (external coping resources) to achieve the desirable performance outcomes.

3. THEORETICAL PERSPECTIVE

3.1 Coping-Adaptation Framework

The implementation of an information system, such as intelligent systems, often brings dramatic changes to business processes and employee work routines (Beaudry and Pinsonneault 2005). As system users, employees may utilize different resources to cope with these changes and may interpret the changes in different ways, triggering varied and complex responses (Pinsonneault and Rivard 1998). Accordingly, a significant stream of research has developed to understand how users adapt to IS-induced changes to their work (Wu et al. 2017).

In general, adaptation occurs neither in the environment nor in the individual alone, but rather occurs as a product of their interplay (Lazarus and Folkman 1984). Prior research has often drawn upon coping theories to explain individuals' acts of adaptation in response to changes in their environment (Lazarus 1993; Lazarus and Folkman 1984).

According to the coping-adaptation framework, the adaptation process involves the appraisal of situations, activation of the individual's coping resources, and the individual's use of available external and internal coping resources to adapt to changes. The ways in which employees actively cope with change depend significantly on the resources that are available and the constraints that inhibit the use of these resources.

Appropriating the above lens to our technological context, we propose the intelligence augmentation coping-adaptation framework in Figure 1. Specifically, we view **IntelSys knowledge** as an external coping resource and employees' **knowledge accumulated from work experience** as an internal coping resource. We suspect that employees may rely on their perceptions of these resources and engage in different adaptation responses to **maximize opportunities** and **reduce threats** when coping with the changes brought by an intelligent system in order to accomplish tasks.

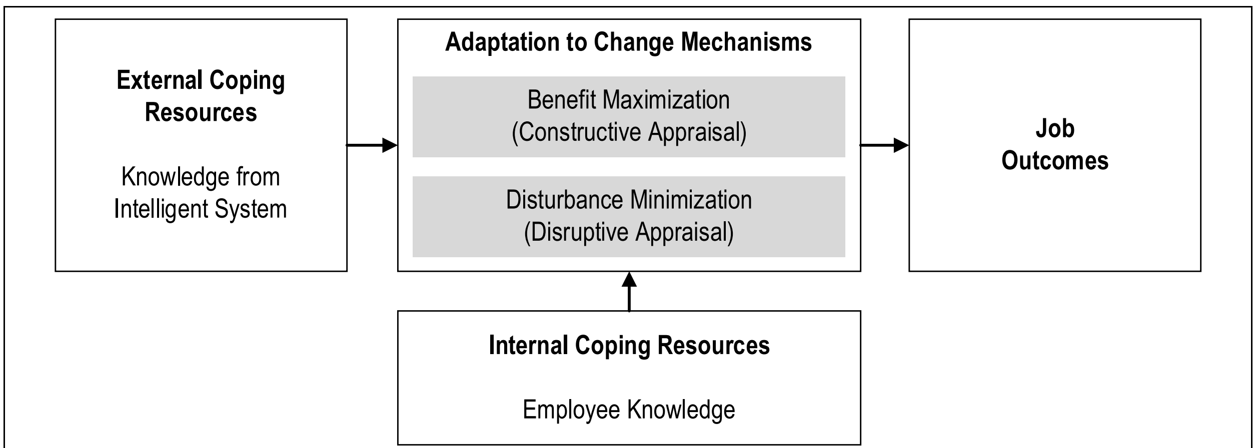


Figure 1. Intelligence Augmentation Coping-Adaptation Framework

In the next subsections, we conceptualize the constructs associated with the two coping resources and introduce the two adaptation responses before developing hypotheses regarding the relationships among these constructs in Section 4.

3.2 Coping Resources

Coping resources have been found to play an essential role in individual adaptation (Hobfoll 2001; Taylor et al. 2000). In particular, the availability of different coping resources may shape individuals' interpretations of changes, and they may accordingly engage in different adaptation responses to cope with changes (Lazarus 1993; Terry and Callan 2000). Prior research has differentiated between external coping resources and internal coping resources from the perspective of individuals (Van den Heuvel 2013). The former are social and material support that individuals can *access*, while the latter include characteristics and skills that the individuals themselves *possess* (Moos and Holahan 2007). There could be different forms of internal and external coping resources. In the context of intelligence augmentation, we are interested in coping resources that enable us to examine the tension between human knowledge versus IntelSys knowledge. Accordingly, we focus on the knowledge provided by an IntelSys (i.e., IntelSys knowledge) as an external coping resource that the organization provides to employees, while work experience as an internal coping resource possessed by employees.

3.2.1 Perceptions of External Coping Resources: Psychological Empowerment

IntelSys knowledge is an external coping resource because it expands employees' cognitive capabilities and empowers them to adapt to the IntelSys-induced changes. As employees have volitional control over how to use IntelSys knowledge in their work, their perception of this type of external coping resource is essential in shaping their responses to the changes brought about by an intelligent system. Since psychological empowerment captures employees' perceptions of available resources in their working environment and motivates their job behaviors (Spreitzer 1996; Thomas and Velthouse 1990), we adopt the psychological empowerment perspective to capture employees' psychological states based on their cognitive assessments of IntelSys knowledge and illuminate how these psychological states influence their adaptation to the job changes introduced by an intelligent system, enhancing their job performance and augmenting their intelligence.

Psychological empowerment has been conceptualized as an employees' experienced psychological state based on cognitions about themselves in relation to their work role (Spreitzer, 1995; Seibert et al. 2004). Appropriating the concept of psychological empowerment for a specific and increasingly pervasive context—employees using IntelSys knowledge in support of their work—we propose the construct of ISK-Emp to capture employees' perceptions of IntelSys knowledge as a coping resource for adapting to intelligence augmentation. Similar to psychological empowerment, ISK-Emp manifests in four dimensions: meaningfulness, competence, self-determination, and impact. *Meaningfulness* is the value an employee ascribes to IntelSys knowledge in relation to his or her own ideals or standards. *Competence* refers to an employee's belief in his or her own ability to perform work tasks with the support of IntelSys knowledge. *Self-determination* describes an employee's sense of having a choice in initiating and regulating actions with the support of IntelSys knowledge. Finally, *impact* refers to the degree to which an employee perceives that IntelSys knowledge enables him or her to make a difference in organizational outcomes. Overall, ISK-Emp reflects employees' perceptions regarding the extent to which IntelSys knowledge provides necessary psychological energy for mobilizing adaptation responses and protects them against dysfunctional psychological states during their adaptation to changes.

3.2.2 Internal Coping Resources: Work Experience

Work experience is an internal coping resource as it is the accumulated human knowledge, including skills and practices, as well as routines and habits that are associated with a specific job (Beus et al. 2014; Beyer and Hannah, 2002; Carr et al. 2006; Quiñones et al. 1995). The cognitive psychology literature has noted that work experience leads to the development of cognitive schemas, or the general knowledge structures that humans construct to help them understand the environment (Derry 1996; Reber 1993). The structural characteristics of cognitive schemas will in turn carry over to individuals' adaptation responses in processing system-provided knowledge (Mao and Benbasat 2000). We theorize why and how novice and experienced employees, who differ in their cognitive schemas, will adapt differently upon encountering IntelSys-induced changes at work.

In general, as human knowledge accumulates with an increase in work experience, cognitive schemas become more sophisticated in terms of the number of attributes and the relationships among the attributes, but lose flexibility for adaptation due to cognitive entrenchment (Dane 2010). As a result, employees with different levels of work experience demonstrate different structural characteristics in their cognitive schemas. While expert cognitive schemas are more complex than novice schemas in terms of the number of attributes and interrelationships among the attributes, novice schemas are more flexible than expert schemas with respect to modification.

Accordingly, we conceive a double-edged role of work experience as an internal coping resource that are heterogenous across employees. On the one hand, work experience reflects the practices and skills employees have learned over time (Ko and Dennis 2011; Schmidt et al. 1986). On the other hand, work experience captures employees' potential rigidity regarding their existing work routines (Polites and Karahanna 2012, 2013). While experienced employees benefit from their proficient skills and abilities arising from their complex cognitive schema, novice employees benefit from their openness to change due to their flexible cognitive schema.

3.3 Adaptation Responses

Employees may engage in different adaptation responses based on how they appraise the relevance of an organizational change to their well-being given the resources they have to cope with the change (Bala and Venkatesh 2016; Beaudry and Pinsonneault 2005; Folkman et al. 1986). Adaptation appraisal involves determining the change's personal significance and its likely consequences. To assess a change's personal significance, individuals evaluate whether they have the resources and options to control the situation to improve their prospects for benefits or overcome harm (Bala and Venkatesh 2016; Major et al. 1998). To assess a change's potential consequences, individuals categorize organizational changes into two main types: opportunities perceived as having positive consequences or threats perceived as having negative consequences (Carpenter 1992; McCrae 1989). As organizational changes are often multifaceted, these changes typically comprise both opportunities and threats (Lazarus and Folkman 1984).

In the intelligence augmentation context, employees have the discretion to determine how to make use of an intelligent system and the knowledge it provides, indicating that they have a high level of control over the changes. In this vein, employees may assess the potential consequences of IntelSys-induced changes as opportunities or threats. It is the relative importance of opportunities versus threats that influences employees' types of adaptation responses. In particular, when employees appraise IntelSys-induced changes as an **opportunity**, they are likely to focus on maximizing benefits in their adaptation responses (Beaudry and Pinsonneault 2015). When they appraise IntelSys-induced changes as a **threat**, they tend to rely on their ability to minimize disturbances to reduce the expected negative consequences. Next, we appropriate the adaptation responses to the intelligence augmentation context. Specifically, we theorize two adaptation responses to cope with opportunity and threat appraisals.

3.3.1 Constructive Appraisal of Change: Enhancing Infusion Use to Maximize Benefits

An intelligent system may trigger employees' opportunity appraisals because collaboration with it will open up new and better ways to perform tasks. **Infusion use,** or employees' self-assessments of the extent to which they can use an information system to its fullest potential to best support their work, captures the highest level of system use of various aspects (e.g., the scope of functions, inter-related tasks, and usage fashions) (Jones et al. 2002; Saga and Zmud 1994; Sundaram et al. 2007). **Enhancing infusion use** is especially important for maximizing the benefits of intelligence augmentation. Through infusion use, employees adapt to IntelSys-induced changes by exerting extra effort to acquire new and different skills from the intelligent system (Hogg 2019).

The nature of an intelligent system requires employees to proactively make sense of IntelSys knowledge and apply it to problem solving and decision making in their work (Grublješič and Jaklič 2015). In addition, the work processes in which an intelligent system can be used are likely to be less structured, presenting employees with significant discretion in how to best use these systems (Deng and Chi 2013). In such situations, infusion use of an intelligent system reflects an important adaptation response when employees believe that the IntelSys knowledge augments their cognition for decision making and problem solving. At the same time, infusion use also serves as a critical enhancer of job performance, since the full benefits of an intelligent system can only be obtained when employees utilize the system to the greatest extent (Chen et al. 2020). In section 4.2.1, we theorize that enhancing infusion use, as an adaptation response to IntelSys-induced changes, serves a vital role in channeling the benefits of ISK-Emp for job performance.

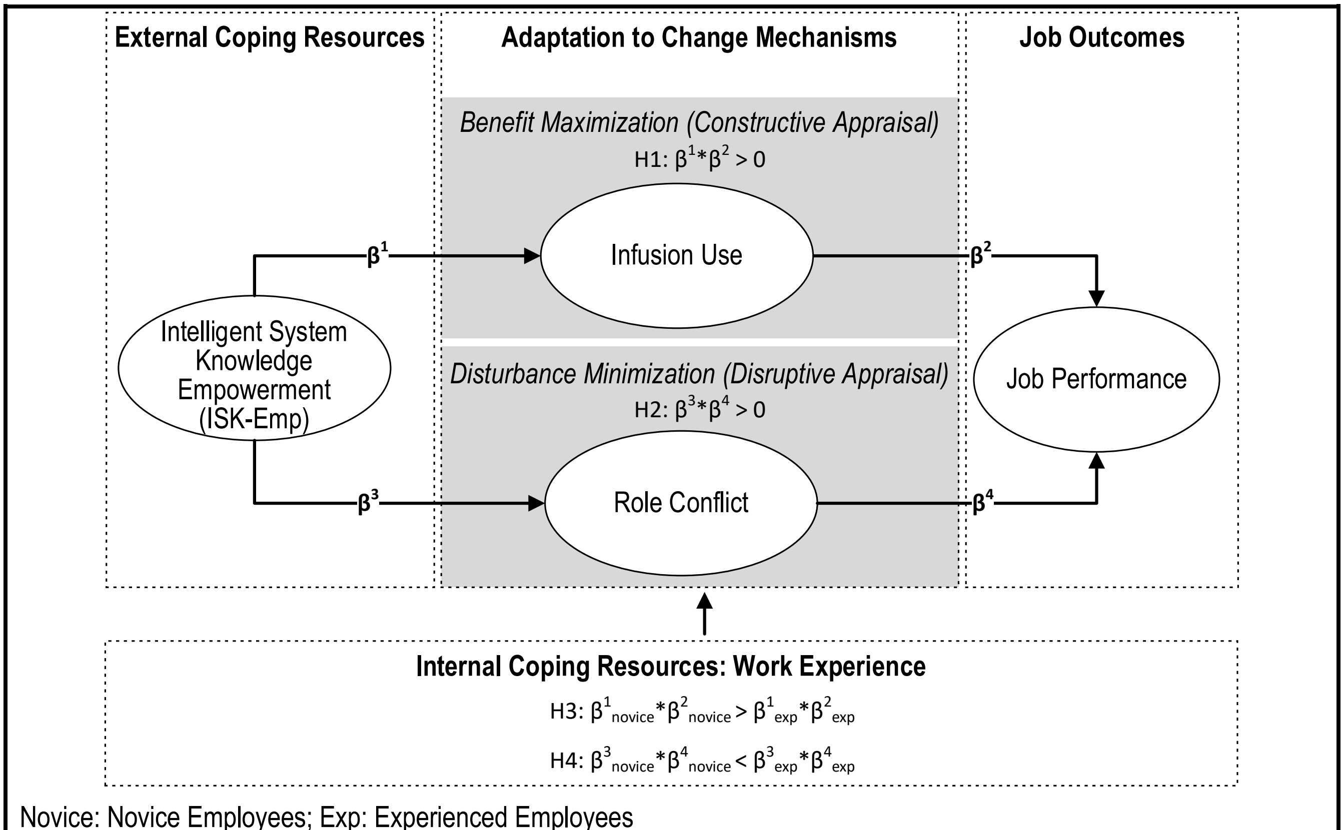
3.3.2 Disruptive Appraisal of Change: Reducing Role Conflicts to Minimize Disturbance

An intelligent system may expose employees to new work conditions and work roles with which they are unfamiliar. Thus, IntelSys implementation changes the roles of employees, and the knowledge-based dependencies among employees' roles (Chreim et al. 2007). Such changes may result in **role conflicts**, or employees' perceptions of incompatible expectations regarding how they should perform their work (Ross et al. 1970). These incompatible expectations usually manifest in terms of the magnitude of changes, a lack of adjustments, and unnecessary complications in their work practices (Speier and Venkatesh 2002). **Reducing role conflicts** is thus especially important in minimizing disturbances in order to achieve intelligence augmentation.

In the context of an intelligent system, role conflicts occur when employees expect to follow their prior work routines to complete tasks, while the organization expects them to incorporate the newly implemented intelligent system into their work routines to complete their tasks. By providing a new channel for employees to access knowledge, IntelSys implementation disrupts employees' roles and knowledge dependencies across roles, leading to changes in their work routines and creating mismatched role expectations for the employees. In Section 4.2.2, we theorize that reducing role conflicts, as another adaptation response to IntelSys-induced changes, serves a vital role in mediating the effect of ISK-Emp on job performance.

4. HYPOTHESIS DEVELOPMENT

Our core theoretical question is to understand how employees' appraisal of the empowerment of IntelSys knowledge (i.e., ISK-Emp) enables them to adapt to the IntelSys-induced changes, and thereby facilitates their job performance. To this end, we conceive ISK-Emp as the antecedent affecting employees' coping behaviors and resulting outcomes. We incorporate work experience as a contingency, as it enables us to examine how this between-employee heterogeneity moderates the downstream impacts of ISK-Emp. Accordingly, we propose the research model shown in Figure 2 and follow a systematic theorization approach to (1) delineate the impact of ISK-Emp on job performance, (2) identify two mechanisms through which ISK-Emp impacts job performance, and (3) integrate the role of work experience as a contingency affecting the salience of these two mechanisms for novice and experienced employees.



Novice: Novice Employees; Exp: Experienced Employees

Figure 2. Research Model

4.1 ISK-Emp → Job Performance

Prior literature has suggested that psychological empowerment drives employees to achieve better performance (Seibert et al. 2011). In particular, employees feel empowered when they perceive that external coping resources are available to achieve their work goals and cope with adversity (Zimmerman 1995). Psychologically empowered employees therefore tend to proactively utilize these resources and engage in more active, persistent, and change-oriented behaviors in their work (Spreitzer 1995, 2008), which results in superior performance (Humphrey et al. 2007) and innovation (Bandura and Locke 2003).

In the context of intelligence augmentation, we expect ISK-Emp to enhance employees' job performance for the following reasons. First, if they perceive that IntelSys knowledge is meaningful and consistent with their personal goals and values, employees are likely to appreciate this synergy between such external knowledge and its benefits for attaining their work goals. In this regard, employees will likely feel that IntelSys knowledge is highly relevant (Thomas and Velthouse 1990). Second, the strong competence beliefs stemming from IntelSys knowledge will enhance the tenacity and efforts that employees need for coping with challenging situations (Bandura 1977), and hence improve their job performance (Salomon 1984; Zimmerman 2000). Third, with the support of IntelSys knowledge, employees may develop a strong sense of self-determination, choose how to do their jobs, and act as they see fit when dealing with problems. This sense of autonomy with external knowledge support will likely allow employees to see the beneficial outcomes associated with their efforts (Gagné and Deci 2005) and make them more willing to explore how to handle challenging tasks. Fourth, as IntelSys knowledge facilitates employees' understanding of the impacts resulting from their work efforts, employees are empowered with a sense of self-worth and the ability to influence their work outcomes (Brown et al. 1988; Smidts et al. 2001). To reinforce this sense of self-worth, empowered employees will tend to engage in proactive behaviors that may enhance the effectiveness of their work (Spreitzer 2008). Overall, ISK-Emp promotes an intrinsically motivated state that inspires employees to engage in proactive behaviors to utilize the available external coping resources to cope with the IntelSys-induced changes at work, resulting in better job performance.

4.2 The Mechanisms through which ISK-Emp Influences Job Performance

In our investigative context of intelligence augmentation, we propose that ISK-Emp may improve job performance through two adaptation responses: (i) enhanced infusion use of an intelligent system, which enables employees to acquire work-related knowledge, and (ii) reduced role conflicts, which enables employees to break established routines in their work practices. Next, we theorize how ISK-Emp impacts job performance through each of these responses.

4.2.1 Mediation Effect through Infusion Use

ISK-Emp may promote employees' empowered behaviors to seize the opportunities to enrich their work knowledge and enhance job performance. To elaborate, we expect ISK-Emp to be positively associated with the infusion use of an intelligent system. Employees with a high level of ISK-Emp are likely to believe that IntelSys knowledge fits their instrumental goals at work, enhances their self-efficacy to accomplish tasks, improves their sense of personal control over their jobs, and satisfies their self-worth needs (Smidts et al. 2001). When employees utilize the knowledge provided by an intelligent system to accomplish their work (Salomon 1984; Zimmerman 2000), the multidimensional ISK-Emp construct represents a flourishing psychological state that leads to specific cognitive changes, such as broader information searches and greater memory recall (Cervone et al. 1991). With these cognitive changes, empowered employees are likely to engage in persistent exploration, have increased resilience when handling challenging tasks, and carry out discretionary behaviors beyond the minimum requirements of their jobs (Maynard et al. 2014; Seibert et al. 2011). Employees will thus be intrinsically motivated to engage in proactive exploration of the intelligent system (Li et al. 2013). As a result, they will extend and integrate their use of the intelligent system in support of their work to the greatest extent, thus achieving infusion use of the intelligent system (Kim and Gupta 2014).

Infusion use of an intelligent system should in turn be positively associated with job performance. By engaging in infusion use of an intelligent system, employees are likely to increase their likelihood of conducting precise and comprehensive information searches and retrieving timely, reliable, and complete information to best support their work (Jones et al. 2002; Schwarz 2003; Sundaram et al. 2007). The high quality of knowledge that employees obtain from the intelligent system will position them to make decisions and solve problems effectively, resulting in better performance outcomes.

In sum, we expect that infusion use of an intelligent system mediates the relationship between ISK-Emp and job performance. ISK-Emp inspires employees to engage in infusion use of the intelligent system, which consequently enhances their job performance. We refer to this indirect effect of ISK-Emp on job performance through infusion use as the *benefit-maximization* mechanism. Accordingly, we propose:

> *H1: The effect of ISK-Emp on job performance is mediated by infusion use of the* intelligent system *such that ISK-Emp increases infusion use, which in turn increases job performance.*

4.2.2 Mediation Effect through Role Conflicts

A shift to intelligence augmentation could change employees' prior work routines in which they relied on their human knowledge to make decisions and solve problems. Although the implementation of an intelligent system may provide a new channel for employees to access knowledge, such system implementation disrupts employees' roles and knowledge dependencies across roles, leading to changes in their work routines. These changes are likely to create inconsistent role expectations for employees and result in conflicts in how employees fulfill their respective job roles. In this case, the employees need to reconcile conflicts induced by the system implementation in order to carry out their work.

As a psychological state, ISK-Emp could help employees cope with the threats of changes in their work routines that are introduced by the intelligent system and reduce their role conflict, which will subsequently enhance their job performance. To begin with, increased ISK-Emp reduces role conflict derived from IntelSys implementation. Employees who believe that IntelSys knowledge is meaningful and relevant to their instrumental goals at work are more likely to feel it fits with their role identity and thus positively frame challenging tasks (Piliavin et al. 2002; Stryker and Burke 2000). The strong competence beliefs stemming from IntelSys knowledge enhance employees' confidence about coping with changes and make "impossible" missions possible (Herold et al. 2007; Vardaman et al. 2012). As IntelSys knowledge provides employees with discretion and autonomy to control how they conduct their work, employees may see opportunities to adjust and accommodate in order to reconcile the seemingly incompatible situations arising from the intelligent system (Troyer et al. 2000). A strong sense of being able to influence their work practices with IntelSys knowledge will encourage employees to anticipate and resolve problems and to view threats as addressable (Laschinger and Havens 1997). Based on the above, the motivating psychological state captured by ISK-Emp inspires employees to adapt to changes by framing threats positively and approaching their work flexibly (Ang et al. 2007; Chen et al. 2010); as such, employees are less likely to perceive misalignment with their role expectations and thus minimize role conflict.

Next, a lower level of role conflict can reduce psychological tension so that employees can focus on problem solving and decision making to accomplish their work goals (Keith and Frese 2005; Muraven and Baumeister 2000). With a greater focus on work goals and activities, employees who experience a lower level of role conflict are more likely to adapt to the changes resulting from IntelSys implementation and consequently perform their work better.

In sum, in addition to infusion use, we expect role conflict to channel the effect of ISK-Emp on job performance. We refer to the indirect effect of ISK-Emp on job performance through reduced role conflicts as the *disturbance-minimization* mechanism. Accordingly, we propose the following:

H2: The effect of ISK-Emp on job performance is mediated by role conflicts such that ISK-Emp reduces role conflicts, which in turn increases job performance.

4.3 The Differential Effects of ISK-Emp for Novice and Experienced Employees

The above two adaptation mechanisms might not be equally effective for employees with different levels of work experience. As a critical internal coping resource, work experience may shape how people react to external knowledge resources like IntelSys knowledge that have been designated to support their work (Arnold and Sutton 1998). In what follows, we theorize the role of work experience in moderating the effectiveness of the two mediation mechanisms through which ISK-Emp enhances job performance.

To begin with, employees with different work experience levels develop different cognitive schema structures, which explain what they attend to, how they view and think about work-related situations, and why they exhibit different needs for support from external coping resources in the workplace (Mackay and Lamb 1991; Markus 2001). Based on this logic, novice and experienced employees may exhibit different needs and expectations for IntelSys knowledge, thus attending in different ways to the aforementioned two types of adaptation responses to IntelSys-induced changes. Specifically, novice employees may have a stronger need than experienced employees to enrich their cognitive schemas, because they lack the organizational, contextual, and domain knowledge (e.g., firm-specific vocabulary, guidelines) needed to accomplish their jobs (Ko and Dennis 2011). With a greater need to expand their knowledge in order to conduct their work, novices are more likely to view an intelligent system as a valuable knowledge source for problem solving and decision making and hence engage more proactively in infusion use of the intelligent system. Compared to experienced employees, novice employees who are empowered by IntelSys knowledge may rely on the intelligent system more intensively to find the knowledge needed for their tasks (Haas and Hansen 2005).

In contrast, experienced employees have established more sophisticated cognitive schemas based on the job-related knowledge they have accumulated over time (Ko and Dennis 2011; Markus 2001; Markus and Robey 1988).

Such job-related knowledge helps them understand and perform their jobs well and reduces their need to acquire external knowledge from an intelligent system. Unlike their novice counterparts, experienced employees have learned how to handle most work-related situations. Hence, when an intelligent system is introduced, experienced employees, unlike novices, may not aspire to acquire new knowledge from the intelligent system. In other words, the value of ISK-Emp in motivating employees to enrich their cognitive schema and acquire more job-related knowledge from an intelligent system is less important for experienced employees than for novice employees.

As theorized before, the mediating effect of infusion use on the relationship between ISK-Emp and job performance represents employees' efforts to maximize benefits in adaptation to IntelSys-induced changes. Compared to experienced employees, novice employees who feel empowered by IntelSys knowledge are more likely to be motivated to engage in infusion use of an intelligent system to fulfill their cognitive needs and enhance job performance. Thus,

H3: The mediating effect of infusion use on the relationship between ISK-Emp and job performance is stronger for novice employees than for experienced employees.

As employees accumulate work experience over time, they gradually integrate their experiential knowledge to develop cognitive schemas that they can draw upon (Kolodner 1983; Van Overschelde and Healy 2001). As a result, experienced employees are more likely to suffer from cognitive entrenchment, leading them to perform tasks in a more habitual manner than novice employees (Dane 2010; Wood and Neal 2007). When IntelSys implementation introduces changes to existing work routines, experienced employees may be restricted in their cognitive flexibility to accommodate new rules and may thus encounter work disturbances when they need to approach tasks from new perspectives (i.e., using IntelSys knowledge).

Compared to novice employees, experienced employees have a greater need to deliberately overcome their cognitive entrenchment and modify the cognitive schemas they have built on prior work experience. Experienced employees require greater effort to resolve the disruptions to their ingrained work routines in order to accomplish their work (Polites and Karahanna 2012, 2013; Speier and Venkatesh 2002). In addition, as IntelSys provides employees with a novel channel to access knowledge, experienced employees may perceive a loss of power and their unique value within the organization as a source of knowledge. Thus, role conflict emerges with the implementation of IntelSys and creates disturbance in work routines for employees, especially experienced employees. For this reason, ISK-Emp will be more valuable for experienced employees than for novice employees in terms of motivating them to minimize disturbances and conflicts when adapting to the IntelSys-induced changes.

In contrast, novice employees are less entrenched than experienced employees in their work routines (Ko and Dennis 2011; Polites and Karahanna 2013) and are less likely to experience disturbances in dealing with IntelSys-induced changes. In particular, novices will be more open to new solutions with the assistance of the intelligent system because they have less well-established frames regarding what is (or is not) relevant and how things should be done (Nelson et al. 2000; Repenning and Sterman 2002; Shanteau 1988). Novices could also strive to conform to their organizations' expectations with a desire to fit in (Tsai and Bagozzi 2014). Without having existing frames to be broken, the value of ISK-Emp in motivating employees to handle disturbances associated with IntelSys-induced changes will be less crucial for novices than for experienced employees.

As theorized in H2, the encouraging psychological state of ISK-Emp enables employees to adapt to changes by viewing threats positively and approaching work flexibly (Ang et al. 2007; Chen et al. 2010). This value of ISK-Emp for handling disturbances is likely more vital for experienced employees because it enables them to adjust their cognitive frames of reference, accommodate new rules and routines, and change the ways they conduct their work. Thus, experienced employees can benefit from ISK-Emp insofar as it helps reduce their perceived role conflicts stemming from IntelSys-induced changes, enabling them to accomplish their work. In sum, ISK-Emp enables disturbance handling and mitigates role conflicts for experienced employees to a greater extent than for inexperienced employees. Hence, we propose:

H4: The mediating effect of role conflicts on the relationship between ISK-Emp and job performance is stronger for experienced employees than for novice employees.

5 METHODOLOGY

5.1 Empirical Settings and Data Collection

We collected survey data from three empirical settings, which we refer to as sites (summarized in Table 1). The data from Site 1 and Site 2 were used to validate the ISK-Emp measurement model. The data from Site 3 were used to evaluate the mediating mechanisms through which ISK-Emp impacts job performance and how work experience moderates the mediation mechanisms.

Table 1. Summary of Empirical Materials			
	Site 1	**Site 2**	**Site 3**
Purpose	• Validate the measurement model of ISK-Emp	• Assess the second-order multidimensional structure of ISK-Emp	• Evaluate the mediating mechanisms through which ISK-Emp impacts job performance • Assess the moderating effects of work experience on the mediated impact of ISK-Emp on job performance
Context and Types of Intelligent Systems	• *Where*: Telecommunication service firm • *Who*: Sales representatives (N = 130) • *What*: An intelligent system that provides knowledge for sales representatives to offer tailored recommendations to customers (e.g., the service plan that best fits a customer's preferences and consumption history)	• *Where*: Global shipping company • *Who*: Fleet planners (N = 237) • *What*: An intelligent system that provides knowledge to support fleet planners in scheduling shipments and making cargo arrangements (e.g., optimized logistics planning, real-time route recommendations, best practices, and consolidated regulatory requirements)	• *Where*: Technical service company • *Who*: Maintenance technicians (N = 202) • *What*: An intelligent system that provides knowledge about the diagnosis of technical problems and possible solutions (e.g., the technical specifications of the particular machine, the maintenance records of the machine, the specific problem, the causes of the problem, the best possible solutions, and the tools needed to address the problem)
Research Design	Cross-sectional design	Cross-sectional design	Multi-wave design
Constructs	ISK-Emp	ISK-Emp	ISK-Emp, IntelSys infusion use, role conflicts, job performance, work experience

5.1.1 Research Site 1

To explore the ISK-Emp measurement model, we surveyed sales representatives in a telecommunication company who made direct contact with customers and were given a quota of value-added telecommunication services to sell. This company implemented an intelligent system that consolidates comprehensive customer profiles, product offerings, and real-time market intelligence and provides knowledge for sales representatives to make personalized recommendations to customers. This company had been using the system for about 18 months when we conducted the survey. The system supported the company's sales representatives by generating knowledge about customers, available products, sales policies, and competitors' offerings. The resulting IntelSys knowledge helped the sales representatives to personalize their sales behaviors when interacting with different customers and to make accurate recommendations of telecom products and services (e.g., mobile services, data plans, value-added packages, etc.)

We conducted a pilot test with 20 sales representatives who had experience using the system. The pilot test offered preliminary evidence of acceptable construct validity and reliability. We made minor modifications in the wording of items and instructions based on feedback from the participants. With the support of senior management, we distributed the final survey to 200 randomly sampled sales representatives who had used the system. A total of 130 representatives responded, for a response rate of 65%. All of these responses were used for the analysis. Table 2 presents the demographic profile of the respondents.

Table 2. Sample Demographics for Site 1		
	Category	**Percentage**
Gender	Male	2.3%
	Female	97.7%
Education	Secondary/High school	0.0%
	Post-secondary	0.0%
	University graduate	7.7%
	Post-graduate	83.1%
	Other	9.2%
	Mean	**S.D.**
Age (Years)	26.07	3.36
Years in Current Position	2.23	1.63

5.1.2 Research Site 2

We conducted a second survey with fleet planners in a leading global shipping company to test the second-order multidimensional structure of ISK-Emp. ISK-Emp is especially crucial in this setting for two primary reasons. First, the shipping industry is a knowledge-intensive environment and has long been regulated by industrial policies and government regulations (Durvasula et al. 2004). Second, this company's extensive global business requires employees to utilize IntelSys knowledge to augment their individual capacity to conduct their work.

At the time of data collection, the company was using a global intelligent system that had been in place for over two years. The system provided knowledge, including intelligent logistics planning, real-time regulatory requirements, and best practices, to support fleet planners in responding to policy changes, optimizing shipment scheduling, and making cargo arrangements. While the fleet planners were not required to use the system, they could voluntarily use it to support their work.

We administrated an online survey (written in English) at the Hong Kong headquarters of this company. Our subjects were fleet planners who used the system to support their daily work tasks, such as creating shipping schedules and conducting cargo planning. We invited 500 randomly selected fleet planners to participate in our survey, and we sent reminder letters to encourage participants to complete the survey within the fieldwork period. We received 237 responses (see the demographic profile in Table 3), yielding a response rate of 47.4%.

Table 3. Sample Demographics for Site 2		
	Category	**Percentage**
Gender	Male	53.2%
	Female	46.8%
Education	Secondary/High school	12.7%
	Post-secondary	13.1%
	University graduate	65.0%
	Post-graduate	6.8%
	Other	2.5%
System Use History	6 months or less	16.0%
	More than 6 months but less than 12 months	15.6%
	12 months or more	68.4%
	Mean	**S.D.**
Age (Years)	36.26	10.01
Years in Current Position	7.43	7.42

5.1.3 Research Site 3

To test the hypotheses, we conducted a multi-wave survey in an automated teller machine (ATM) service company. We collected data across three time points from the ATM technicians who provided field maintenance services to their bank clients. The technicians' work requires a variety of knowledge to address the various technical issues their clients encounter. In addition, the knowledge required for their work constantly changes due to rapid technology improvements. With the mission of increasing the operational efficiency and effectiveness of their services, the company implemented an intelligent system that diagnoses complex technical problems and provides tentative solutions for technicians to resolve onsite issues and deliver satisfactory onsite services to their bank clients. The company required their technicians to use the system and utilize the IntelSys knowledge to better understand the problems, consider alternative solutions, prepare appropriate tools, and solve the problems. Although the technicians were required to use the system, they had discretion over how they used it. This setting enabled a conservative empirical test of our arguments and allowed us to observe whether ISK-Emp is influential even in a mandatory-use setting.

With support from the firm's top management, we were allowed to contact employees and customers. We collected data at three time points. Three months after the IntelSys implementation (i.e., T1), we sent the survey to randomly sampled employees to measure their ISK-Emp and work experience, along with demographic variables. Three months later (i.e., T2), we measured the IntelSys infusion use and role conflicts using the same sampled employees. One month after that (i.e., T3), we selected the customer each employee had most recently served and sent the survey to the person responsible for the ATM at the customer's site. For each employee, we measured the customer's satisfaction with the employee's service as a proxy for job performance. This multi-wave multi-source research design (see Figure 3) allowed us to better justify the causal direction of the hypothesized relationships (Seibert et al. 2011). We invited 251 maintenance technicians to participate in our survey and gathered 202 complete responses across all three time points for the analysis, achieving a response rate of 80.5% (see the demographic profile in Table 4).

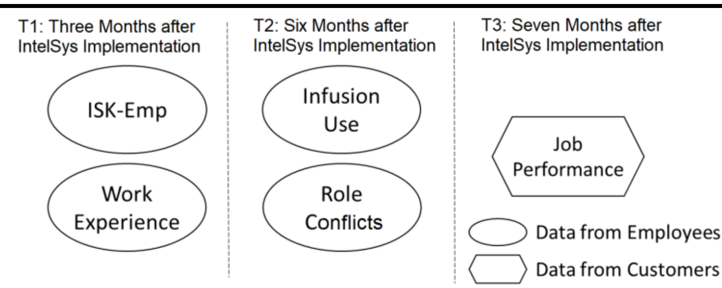


Figure 3. Data-Collection Timeline and Data Structure

Table 4. Sample Demographics for Site 3

	Category	**Percentage**
Gender	Male	99.3%
	Female	0.7%
Education	Secondary/High school	8.3%
	Post-secondary	87.5%
	University graduate	4.2%
	Mean	**S.D.**
Age	26.04	3.37
Months in Current Position	29.44	22.00

5.2 Measures

All measures were adapted from prior literature with minor modifications of wording to fit our study context. Table B1 in Appendix B summarizes the measurement items.

We measured ISK-Emp by adapting Spreitzer's (1995) measures of psychological empowerment for our investigative context and using a seven-point Likert scale ranging from 1 = "Strongly disagree" to 7 = "Strongly agree." In specifying the measurement model for ISK-Emp, we assessed the appropriateness of reflective versus formative models (Petter et al. 2007) for both first-order factors and second-order factors. The choice was primarily guided by the underlying theory of the construct. First, we specified ISK-Emp as a second-order construct with four first-order constructs as reflective indicators. This specification is consistent with empowerment theory, which construes ISK-Emp as a higher-level abstraction of four underlying dimensions (i.e., meaningfulness, competence, self-determination, and impact) rather than as a composite of the dimensions. The overarching higher-order ISK-Emp latent construct leads to the four dimensions, as the dimensions represent different manifestations of the overarching construct. The reflective second-order ISK-Emp captures the common variance of the four dimensions and explains why the first-order dimensions covary with each other (Law et al. 1998). This reflective specification has been well established and consistently used in the current literature (Seibert et al. 2011; Zhang and Bartol 2010; Zhang et al. 2014). Second, we specified reflective measurement models for each first-order ISK-Emp dimension, because each observed measure is affected by an unobservable underlying dimension. Respondents' variations in a latent ISK-Emp dimension will cause all of its measures to reflect this change. Thus, we used a reflective measurement model in which causality runs from the dimensions to the measures to capture each ISK-Emp dimension. In brief, we used reflective specifications at the level of the first-order dimensions and the level of the second-order ISK-Emp construct. We combined exploratory and confirmatory analytic approaches to test the measurement properties of ISK-Emp.

In addition, we adapted the IntelSys infusion use measures from Jones et al. (2002), Schwarz (2003), and Sundaram et al. (2007) for our context. Following Speier and Venkatesh (2002), we measured role conflict using four items on a Likert scale ranging from 1 = "Strongly disagree" to 7 = "Strongly agree." Job performance was measured as customer satisfaction because we tested our hypotheses in a customer service setting. In such settings, customers have become a key factor for defining employee performance (Bowen and Waldman 1999; Liao and Chuang 2004). Specifically, the ultimate goal of employees' job is to fulfill customer expectations and satisfy customer needs. Thus, customer satisfaction, which reflects the confirmation of customer expectations associated with particular services, is an effective indicator for evaluating the employees' job performance. Accordingly, consistent with prior literature in the customer service context (e.g., Babalola et al. 2019; Liao and Chuang 2004; Schneider et al. 1994; Snipes et al. 2005), we use customer satisfaction as a proxy to evaluate employees' job performance from the customers' perspective. The items for customer satisfaction were adapted from Bettencourt (1997), Chan et al. (2010), and Homburg et al. (2009) with different reference targets specified. Finally, we focused on job tenure to capture employees' work experience, measured as the number of months an employee had worked in his or her current job position.[1] We also collected employee and customer demographics (e.g., age, gender, level of education) for validation and control purposes.

[1] We also measured work experience as organizational tenure (i.e., the number of months an employee had worked in the firm). The correlation between job tenure and organizational tenure is 0.943 ($p < 0.01$), suggesting that almost all participants remained technicians after joining the firm. We also tested the model using organizational tenure as an alternative measure of work experience, and the results were qualitatively the same as those using job tenure.

6 Analyses and Results

6.1 Measurement Evaluation

6.1.1 Exploratory Factor Analysis

The data collected from Site 1 were used to assess the measurement properties of ISK-Emp. We performed a series of analyses to examine the reliability and validity of the ISK-Emp instrument (see the descriptive statistics, reliabilities, and correlations in Table 5). The Cronbach's alpha and composite reliability values were greater than 0.88 for all dimensions of the ISK-Emp construct, exceeding the recommended threshold of 0.707 (Nunnally 1978). Given the sample size, we conducted exploratory factor analysis (EFA) using IBM SPSS Statistics 24.0. Specifically, we used the principal components method with varimax rotation. Four factors with eigenvalues greater than 1 were extracted and collectively accounted for 86.23% of the total variance. All items loaded more highly on their own constructs than on other constructs, supporting a four-factor solution for ISK-Emp. Overall, the results suggest adequate psychometric properties for measurement of the ISK-Emp dimensions.

Table 5. Descriptive Statistics, Reliability of Dimensions, and Correlations among Dimensions for Site 1

Dimensions	Items	Mean	S.D.	Cronbach's Alpha	Composite Reliability	1.	2.	3.	4.
1. Meaningfulness	3	5.46	0.97	0.95	0.95	0.86			
2. Competence	3	5.35	0.98	0.92	0.92	0.33***	0.79		
3. Self-Determination	3	5.36	0.96	0.89	0.89	0.23***	0.29***	0.73	
4. Impact	3	5.25	0.93	0.88	0.88	0.33***	0.27***	0.30***	0.72

*** $p < 0.01$. Diagonal entries represent the square root of the AVE, and off-diagonal entries represent correlations.

We further conducted a two-step EFA to explore the hierarchical factor structure underlying the ISK-Emp items. We calculated the average score for items under each ISK-Emp dimension and performed EFA on these scores using the principal components method with varimax rotation. We obtained one factor with an eigenvalue greater than 1, and this single factor accounted for 70.89% of the total variance. The results of the two-step EFA indicate that the four dimensions of meaningfulness, competence, self-determination, and impact together reflect a single construct, which we identified as ISK-Emp. These results collectively suggest a second-order structure for the relationship between ISK-Emp and the four dimensions.

6.1.2 Confirmatory Factor Analysis

We assessed the second-order structure of ISK-Emp using the data collected from the second research site. The descriptive statistics, reliability, and correlations are shown in Table 6. The Cronbach's alpha and composite reliability values were above 0.707 for all four dimensions of ISK-Emp, indicating high internal consistency (Nunnally 1978).

Table 6. Descriptive Statistics, Reliability of Dimensions, and Correlations among Dimensions for Site 2

Dimensions	Mean	S.D.	Cronbach's Alpha	Composite Reliability	1.	2.	3.	4.
1. Meaningfulness	5.14	1.04	0.87	0.77	0.70			
2. Competence	4.97	1.02	0.94	0.89	0.36***	0.85		
3. Self-Determination	4.90	1.07	0.93	0.86	0.33***	0.48***	0.82	
4. Impact	4.79	1.06	0.92	0.84	0.41***	0.45***	0.48***	0.79

*** $p < 0.01$. Diagonal entries represent the square root of the AVE, and off-diagonal entries represent correlations.

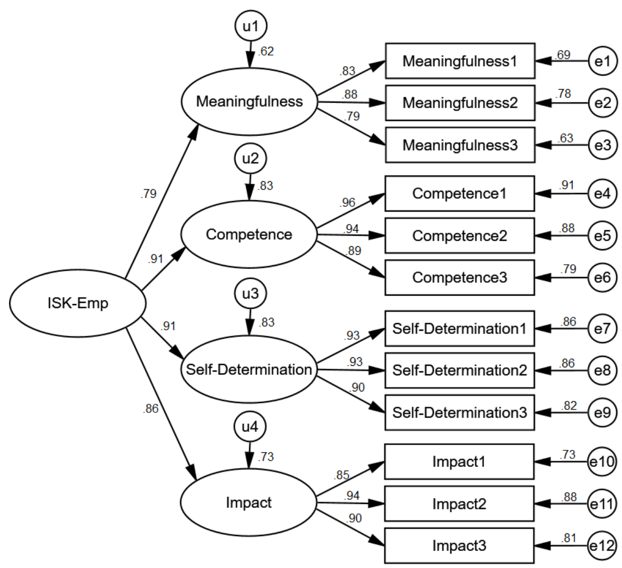


Figure 4. Results of the Second-Order CFA for Site 2

Following the procedures to assess whether a second-order factor model or a first-order model should be employed (e.g., Grover et al. 2002; Tanriverdi 2006; Tanriverdi and Uysal 2011; Venkatraman 1990), we compared four measurement models for ISK-Emp through a series of confirmatory factor analyses (CFAs) using AMOS 24 (the results are given in Tables C1 and C2 in Appendix C). We used three alternative first-order factor models (Models 1 to 3) to assess the dimensionality and the convergent and discriminant validity of the ISK-Emp construct. Model 1 assumes that a unidimensional first-order factor accounts for the variance among the 12 items. Model 2 assumes that the 12 items form four uncorrelated first-order factors: meaningfulness, competence, self-determination, and impact. Model 3 assumes that the 12 items form four freely correlated first-order factors. Finally, Model 4 assumes a second-order factor that accounts for the relationships among the four first-order factors.

In line with the evaluation criteria suggested by Hair et al. (2006), Model 4—the second-order factor model (Figure

4)—should be accepted because it is a more parsimonious model with fewer parameters to be estimated and more degrees of freedom (Grover et al. 2002; Venkatraman 1990). In addition, all second-order factor loadings were highly significant ($p < 0.01$), supporting the second-order factor model (Tippins and Sohi 2003; Venkatraman 1990). The target coefficient value (i.e., the ratio of the $\chi 2$ of the first-order model to the $\chi 2$ of the higher-order model) was 0.95, indicating that the second-order factor accounted for 95% of the covariance among the first-order factors, which again supports the superiority of the second-order factor model (Tanriverdi 2006; Tanriverdi and Uysal 2011).

6.1.3 Reliability and Validity

Table 7 summarizes the descriptive statistics, reliability, and correlations for the constructs based on the multi-wave data collected at the third research site. In addition, we assessed the convergent and discriminant validity of ISK-Emp, infusion use, role conflict, and job performance. The results show that all items correlated most strongly with their intended constructs, and the square root of the average variance extracted (AVE) for each construct was larger than any related inter-construct correlations, thus supporting the validity of the constructs. Following Gefen et al. (2003), we further constrained the correlation between each pair of constructs to unity and then performed a chi-square test to compare this model to the unconstrained model. The chi-square changed from 59.14 to 73.30 ($\Delta\chi^2$ (1) = 14.17, $p < 0.01$), thereby confirming significant distinction between the constructs.

Table 7. Descriptive Statistics, Reliability, and Correlations among Constructs for Site 3

Constructs	Mean	S.D.	Cronbach's Alpha	Composite Reliability	1.	2.	3.	4.
1. ISK-Emp	5.35	0.81	0.87	0.87	0.79			
2. Infusion Use	5.20	1.19	0.96	0.96	0.28***	0.92		
3. Role Conflict	3.93	1.37	0.87	0.88	-0.15**	-0.33***	0.85	
4. Job Performance	6.47	0.57	0.93	0.93	0.06	0.08	-0.07	0.88
5. Work Experience	49.50	39.24	NA	NA	0.03	-0.06	0.05	-0.01

*** $p < 0.01$; ** $p < 0.05$. Diagonal entries represent the square root of the AVE, and off-diagonal entries represent correlations.

6.2 Test of Mediation Effects

Following the suggestions by Hayes (2009) and Preacher and Hayes (2008), we used the bootstrapping approach described by Taylor et al. (2008) to test the mediation effects. The significance of the indirect effects was determined via bias-corrected bootstrap confidence intervals using 10,000 bootstrap samples and 95% confidence intervals (Hayes 2015). An indirect effect is significant when its confidence interval does not include 0.

Our results show that our model explained 14.47% of the variance in job performance. The mediated effect of ISK-

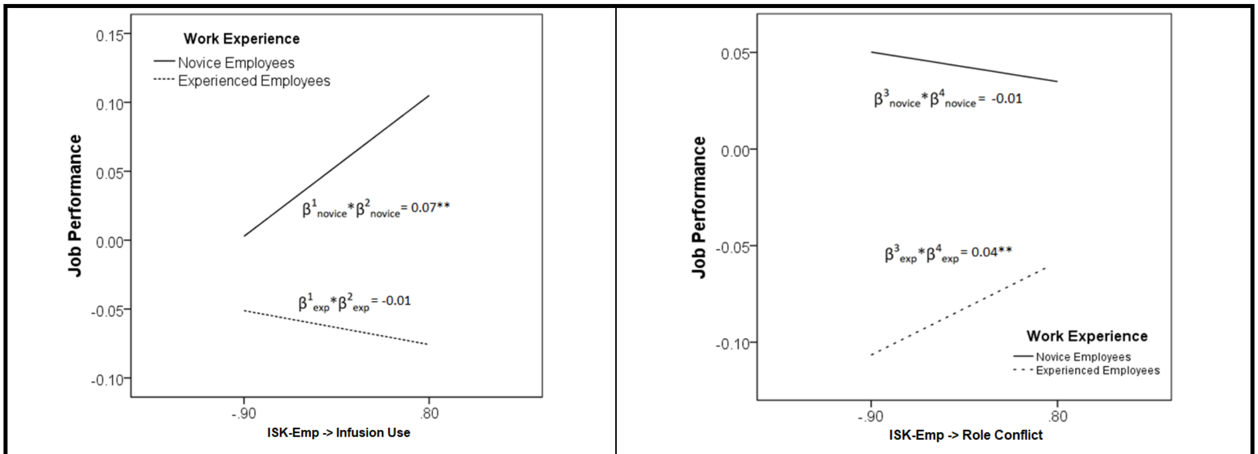
Emp on job performance through infusion use was significantly positive ($\beta_1 = 0.31$, $p < 0.01$; $\beta_2 = 0.05$, $p < 0.05$; β_1*β_2 = 0.02, $p < 0.05$), with a bootstrap confidence interval excluding 0. In addition, the mediated effect through role conflict was significant ($\beta_3 = -0.15$, $p < 0.01$; $\beta_4 = -0.04$, $p < 0.05$; β_3*β_4 = 0.01, $p < 0.05$), with a bootstrap confidence interval not including 0. To conclude, the bootstrapping results suggest that H1 and H2 are both supported.

6.3 Test of Moderated Mediation Effects

H3 and H4 proposed moderated mediation effects, which signify that the magnitude of an indirect effect is contingent on the moderator (Preacher et al. 2007). We performed the moderated mediation analyses in SPSS using the Process macro developed by Hayes (2017). We used the bootstrapping method to generate bootstrap confidence intervals for each indirect effect conditional on different levels of the moderator and to identify which indirect effect is significant at each particular level of the moderator. Specifically, we entered ISK-Emp as the independent variable, infusion use and role conflicts as the two mediators, job performance as the dependent variable, work experience as the moderator, and employees' and customers' age, gender, and education as the control variables to estimate the moderating effects of work experience on the impact of ISK-Emp on job performance mediated by infusion use and role conflicts. Moderated mediation is established if one or both of two patterns exist: (1) the paths between ISK-Emp and the mediators (i.e., infusion use and role conflicts) are moderated by work experience, and/or (2) the paths between the mediators (i.e., infusion use and role conflicts) and job performance are moderated by work experience.

Based on the bootstrapping results, the indirect effect of ISK-Emp on job performance through infusion use was significant for novice employees (β^1_{novice}*β^2_{novice} = 0.07, $p < 0.05$) but not significant for experienced employees (β^1_{exp}*β^2_{exp} = -0.01, $p > 0.1$). In contrast, the indirect effect of ISK-Emp on job performance through role conflict was significant for experienced employees (β^3_{exp}*β^4_{exp} = 0.04, $p < 0.05$) but not significant for novice employees (β^3_{novice}*β^4_{novice} = -0.01, $p > 0.1$). Thus, H3 and H4 are both supported.

For visualization purposes, we plotted the indirect effects for employees with low and high levels of work experience (one standard deviation below the mean and one standard deviation above the mean, respectively) in Figure 5. In sum, ISK-Emp enhanced job performance for both novice and experienced employees, but through different mechanisms. ISK-Emp benefited novice employees by enhancing their IntelSys infusion use, while ISK-Emp benefited experienced employees by reducing their role conflicts.



Indirect Effect via Infusion Use	Indirect Effect via Role Conflicts

Figure 5. Conditional Indirect Effect

6.4 Post Hoc Analysis

We scrutinized the conditional indirect effects by analyzing the moderating effects of work experience at the two stages of each mediating mechanism (reported in Table 8). In the first stage of the benefit-maximization mechanism (i.e., the mediation effect via infusion use), ISK-Emp had a significant positive impact on infusion use (β^1= 0.33, $p < 0.01$), yet this impact was not significantly moderated by work experience ($\beta_{ISK\text{-}Emp*WE}$ = -0.08, $p > 0.1$; β^1_{novice} = 0.39, $p < 0.01$; β^1_{exp} = 0.22, $p < 0.05$). In other words, ISK-Emp significantly enhanced infusion use for both experienced and novice employees with no discernible difference across levels of work experience. In the second stage of this mediation effect, infusion use displayed a significant positive impact on job performance (β^2 = 0.08, $p < 0.05$), and this impact was significantly moderated by work experience ($\beta_{Infusion*WE}$ = -0.08, $p < 0.05$). The results for the conditional second-stage effect using 10,000 bootstrap resamples indicate that for novice employees, infusion use was positively associated with job performance (β^2_{novice} = 0.17, $p < 0.01$). However, for experienced individuals, the relationship between infusion use and job performance became non-significant (β^2_{exp} = -0.03, $p > 0.1$).

We plotted both stages of the mediated relationship for novice and experienced employees (Figure 6). In sum, once empowered by IntelSys knowledge, both experienced and novice employees engaged in infusion use of the intelligent system. However, only novice employees benefited from their enhanced infusion use of the intelligent system by obtaining a higher level of job performance. In contrast, experienced employees did not achieve gains in job performance even when they achieved a higher level of infusion use.

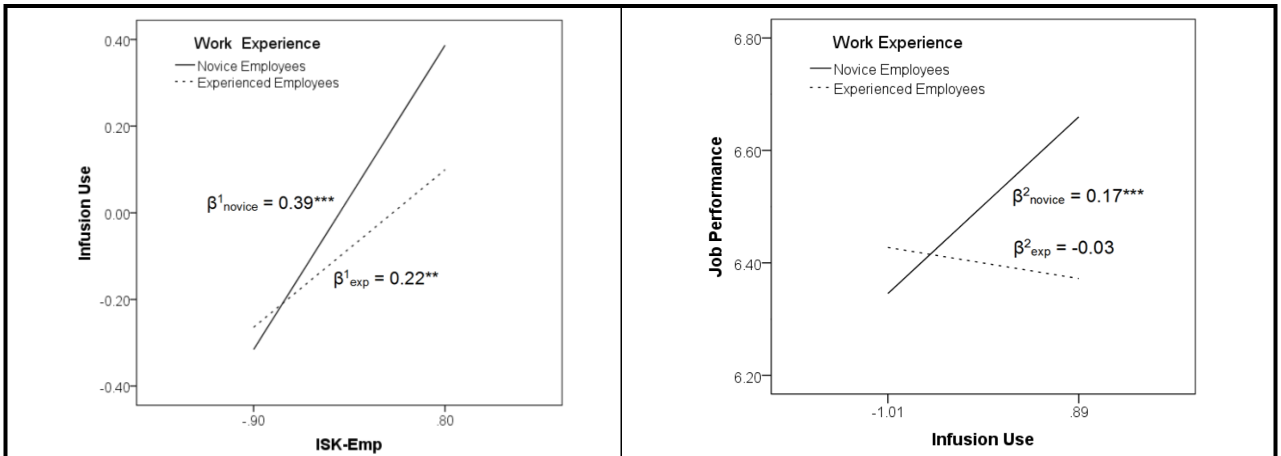
Table 8. Results of the Moderated Mediation Analyses												
Model	**Step 1: Main Effects**						**Step 2: Interaction Effects**					
	Infusion Use (M1)		**Role Conflicts (M2)**		**Job Performance (DV)**		**Infusion Use (M1)**		**Role Conflicts (M2)**		**Job Performance (DV)**	
	β	**p**	**β**	**p**	**β**	**p**	**β**	**p**	**β**	**p**	**β**	**p**
Constant	-1.43	0.45	2.83	0.14	2.61**	0.02	2.97	0.06	-1.23	0.26	2.42**	0.02
ISK-Emp	-0.16**	0.02	0.31***	0.00	0.01	0.81	0.33***	0.00	-0.14**	0.02	-0.01	0.43
WE	0.08	0.30	-0.05	0.49	-0.03	0.48	-0.05	0.26	0.09	0.14	-0.05	0.17
ISK-Emp * WE							-0.08	0.13	-0.12**	0.04	0.07	0.06
Infusion					0.05	0.25					0.08**	0.04
RC					-0.03	0.44					-0.01	0.39
Infusion * WE											-0.08**	0.02
RC * WE											-0.07**	0.04
EmpAge	-0.07***	0.00	0.02	0.37	0.00	0.95	0.02	0.19	-0.07***	0.00	0.00	0.45
EmpEdu	0.12	0.54	-0.10	0.60	0.08	0.47	-0.09	0.33	0.14	0.23	0.09	0.21
EmpGen	0.66	0.25	-0.95	0.10	0.31	0.36	-1.01**	0.04	0.56	0.17	0.34	0.16
CusAge	0.00	0.97	-0.11	0.17	-0.01	0.81	-0.13	0.07	-0.02	0.41	-0.01	0.45
CusGen	-0.18	0.18	-0.03	0.83	0.29***	0.00	-0.02	0.43	-0.18	0.09	0.28***	0.00
CusEdu	0.10	0.39	-0.07	0.53	0.09	0.16	-0.08	0.24	0.09	0.22	0.09	0.08
R^2	0.19		0.18		0.15		0.19		0.2		0.18	
ΔR^2							0.01		0.01*		0.03**[2]	
Notes: One-tailed tests were performed, as directional effects were hypothesized. ** p < 0.05, *** p < 0.01. β: unstandardized coefficient WE: work experience; RC: role conflict; ISK-Emp: intelligent system knowledge empowerment; EmpAge: employee age; EmpGen: employee gender; EmpEdu: employee education; CusAge: customer age; CusGen: customer gender; CusEdu: customer education; M1: mediator 1; M2: mediator 2; DV: dependent variable												

We plotted both stages of the mediated relationship for novice and experienced employees (Figure 6). In sum, once empowered by IntelSys knowledge, both experienced and novice employees engaged in infusion use of the intelligent system. However, only novice employees benefited from their enhanced infusion use of the intelligent system by obtaining a higher level of job performance. In contrast, experienced employees did not achieve gains in job performance even when they achieved a higher level of infusion use.

We followed the same procedure to scrutinize the moderating effect of work experience on the disturbance-minimization mechanism (i.e., the mediation effect via role conflicts). As reported in Table 8, ISK-Emp had a significant

[2] The marginal contribution of the interaction terms to job performance is practically meaningful and theoretically reasonable. Prior research has found that interaction effects are typically smaller in effect size (Dong et al. 2017; Chin et al. 2003; Aguinis et al. 2005). Our research design, which involves multi-sourced data from employees and customers and time lags among T1, T2, and T3, may collectively contribute to a downward bias in the effect size (Cohen et al. 2013, Jaccard and Turrisi 2003). Finally, job performance in customer service (i.e., customer satisfaction) is of significant practical value. Thus, while the effect sizes are smaller in absolute magnitude, they are meaningful since the relationships provide novel and practically meaningful insights on how to increase customer satisfaction and derive gains in economic value.

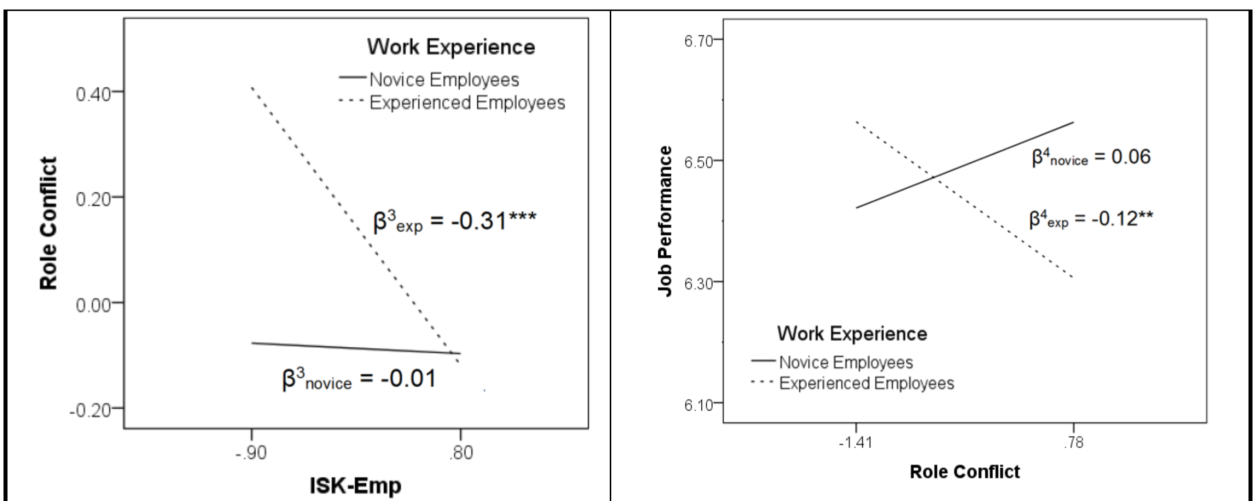
positive impact on role conflicts ($\beta^3 = -0.14$, $p < 0.05$), and this impact was significantly moderated by work experience ($\beta_{ISK\text{-}Emp*WE} = -0.12$, $p < 0.05$). Specifically, ISK-Emp significantly reduced role conflicts for experienced employees ($\beta^3_{exp} = -0.31$, $p < 0.01$) but not for novice employees ($\beta^3_{novice} = -0.01$, $p > 0.1$).



First-Stage Effect: ISK-Emp → Infusion Use	Second-Stage Effect: Infusion Use → Job Performance

Figure 6. Stage-wise Moderation of the Benefit-Maximization Mechanism by Work Experience

Turning to the second stage, role conflicts were not significantly associated with job performance ($\beta^4 = -0.01$, $p > 0.1$), yet this impact was significantly moderated by work experience ($\beta_{RC*WE} = -0.07$, $p < 0.05$). The results for the conditional indirect effects using 10,000 bootstrap resamples indicate that for experienced employees, role conflicts were negatively associated with job performance ($\beta^4_{exp} = -0.12$, $p < 0.05$). However, for novice employees, the relationship between role conflicts and job performance became non-significant ($\beta^4_{novice} = 0.06$, $p > 0.1$).



First-Stage Effect: ISK-Emp → Role Conflicts	Second-Stage Effect: Role Conflicts → Job Performance

Figure 7. Stage-wise Moderation of the Disturbance-Minimization Mechanism by Work Experience

The plots of the moderating effects are shown in Figure 7. Once empowered by IntelSys knowledge, only experienced employees perceived a significantly lower level of role conflicts. In addition, only experienced employees benefited from the reduced role conflicts by achieving a higher level of job performance. In contrast, novice employees did not demonstrate a significant reduction in their perceived role conflicts, even when they were empowered by IntelSys knowledge, and reduced role conflicts did not necessarily enhance their job performance.

7 DISCUSSION

7.1 Theoretical Contributions

Table 9. Summary of Theoretical Contributions

RESEARCH OBJECTIVES	RESULTS & FINDINGS	THEORETICAL CONTRIBUTIONS
Coping-Adaptation Framework to Understand Intelligence Augmentation	● By including internal and external coping resources, the coping-adaptation framework effectively explains how employees respond to IntelSys-induced work changes in order to accomplish their work	● Cohesively discern the types of human and system resources and the mechanisms underlying IntelSys-enabled intelligence augmentation ● Extend the coping-adaptation framework to the intelligence augmentation context that involves humans and machines by incorporating *internal* (human) and *external* (system) *coping resources* ● Uncover that both internal and external coping resources influence employees' adaptation responses to intelligent systems
The Role of ISK-Emp in Employee Adaptation	● Verify the measures and the second-order multidimensional structure of ISK-Emp ● ISK-Emp significantly enhances employee job performance, such as customer satisfaction in the customer service setting	● Conceptualize ISK-Emp as employees' perceptions of an *external coping resource* (i.e., IntelSys knowledge) that motivates their adaptation to IntelSys-induced work changes ● Integrate ISK-Emp into the user adaptation framework and explicate the knowledge-centric nature of intelligent systems in empowering employees
Mediating Mechanisms	● ISK-Emp $\xrightarrow{+}$ Infusion use $\xrightarrow{+}$ Job performance ● ISK-Emp $\xrightarrow{-}$ Role conflict $\xrightarrow{-}$ Job performance	● Identify two distinct adaptation mechanisms through which user perceptions of external coping resources (i.e., ISK-Emp) convert into downstream job performance: ▪ Maximize benefits by enhancing *infusion use* ▪ Minimize disturbances by reducing *role conflicts*
Salience of Mediating Mechanisms Contingent on Work Experience	● ISK-Emp $\xrightarrow{+}$ Infusion use $\xrightarrow{+}$ Job performance is stronger for novice employees than for experienced employees ● ISK-Emp $\xrightarrow{-}$ Role conflict $\xrightarrow{-}$ Job performance is stronger for experienced employees than for novice employees	● Discover how work experience, as an *internal coping resource*, moderates employees' adaptations to an intelligent system: ▪ For novice employees: ISK-Emp enhances job performance via infusion use of the intelligent system ▪ For experienced employees: ISK-Emp enhances job performance by reducing role conflicts

The emergence of intelligent systems offers new opportunities to redefine the relationship between humans and machines in terms of how they jointly perform tasks to achieve job outcomes. We draw upon the coping-adaptation framework to advance an explanation of how IntelSys knowledge empowers employees to achieve better task outcomes. In particular, we theorize the mediating mechanisms through which ISK-Emp impacts job performance and the conditions under which each mediating mechanism becomes stronger or weaker. Table 9 summarizes our findings and contributions.

7.1.1 The Coping-Adaptation Perspective for Understanding Intelligence Augmentation

Our findings offer important contributions to various streams of the IS literature. First, we contribute to the emerging intelligence augmentation literature by introducing the coping-adaptation perspective to understand how an intelligent system designed for intelligence augmentation affects employees' task performance through two distinct adaptation mechanisms (i.e., benefit maximization via the enhancement of infusion use and disturbance minimization via the reduction of role conflicts) and how employees' work experience moderates the effects of these two mechanisms. While the potential of intelligence augmentation has stimulated intensive discussions, much of the existing work focuses on the design of intelligence augmentation rather than the deployment of such systems (i.e., IntelSys implementations) and the ensuing performance impacts. To advance this line of literature, we submit that successful intelligence augmentation through IntelSys implementation relies on not only technological advancement but also, and more importantly, on users' adaptation to the remarkable changes in the work processes resulting from the deployment of the technology. To the best of our knowledge, our study is among the first that explore IS-enabled intelligence augmentation through the lens of coping adaptation, an important postimplementation phenomenon. Based on the coping-adaptation framework (Beaudry and Pinsonneault 2005; Lazarus and Folkman 1984), we uncover the importance of differentiating between types of coping resources (internal and external) and their roles in adaptation responses, which together affect performance outcomes. Our results suggest that an intelligent system that is designed to augment employees' cognitive capabilities to perform their jobs can bring changes that help people use systems to their full potential in their work and can also disrupt their work routines. Confronting this duality in IntelSys-induced changes to work, the coping-adaptation lens becomes especially valuable as it provides a holistic view of how employees utilize the coping resources to maximize benefits and minimize disruptions.

Informed by the coping-adaptation lens, we advance our understanding about intelligence augmentation by uncovering the crucial roles of both ***internal*** and ***external*** **coping resources** in shaping the adaptation responses and ensuring outcomes. In doing so, we also contribute to the understanding of coping in adaptation to information systems.

Pioneering this way of looking at IS implementations, Beaudry and Pinsonneault (2005) conceptualized the adaptation processes to include employees' cognitive appraisals of and adaptation strategies for IS implementations. Bala and Venkatesh (2016) extended this line of research by offering a nomological network that links IT implementation characteristics and employee job outcomes through various adaptation responses. We advance this research by (a) theoretically contextualizing as well as differentiating external and internal coping resources for intelligence augmentation, and (b) empirically examining how the interplay between these two types of coping resources shapes employees' adaptations to changes to work induced by the introduction of an intelligent system.

7.1.2 The Importance of Empowerment in Adaptation to Intelligence Augmentation

A key theoretical contribution of our work is uncovering the role of knowledge empowerment by an intelligent system as an important psychological state that facilitates employees' adaptation to changes in their work brought about by intelligence augmentation technologies such as intelligent systems. Conceptualizing IntelSys knowledge as an external coping resource, we formulate the ISK-Emp concept by elaborating employees' empowerment perceptions regarding this unique external coping resource. Our findings demonstrate the theoretical value of such empowerment perceptions in driving employees' adaptation responses and then their task performance, thus highlighting the pivotal role of ISK-Emp in engendering favorable user cognitions and performance outcomes. While prior studies have indicated the empowering potential of intelligent systems (Doherty and Doig 2003; Downing et al. 2003), this study is among the first to integrate employees' empowerment perceptions of external coping resources (ISK-Emp) into the adaptation framework, thereby explicating the role of IntelSys knowledge in empowering employees to cope. Future research can build on these insights to examine how ISK-Emp at different levels (e.g., teams, organizations) and across different technological, industrial, and national settings empowers coping responses.

7.1.3 Mediating Mechanisms through which ISK-Emp Impacts Job Performance

Consistent with prior research, we demonstrate that adaptation responses are crucial mediating mechanisms through which employees' perceptions of implemented technologies influence their job outcomes. The two mediating mechanisms discovered in this study represent important contributions to the empowerment literature. While prior empowerment studies have focused on the antecedents and contingencies that stimulate the psychological state of empowerment (e.g., Ayala Calvo et al. 2018; Hill et al. 2014; Kark et al. 2003; Liden et al. 2000; Spreitzer 1996), empowerment that generates no performance benefits for employees has little theoretical or practical value. Some researchers have therefore urged examining whether and how empowerment perceptions can lead to fruitful performance outcomes (e.g., Seibert et al. 2011; Zhang and Bartol 2010). In this study, we answer this call by examining actual performance outcomes based on customer feedback in a service context, providing evidence that employees' empowerment perceptions of IntelSys knowledge can indeed result in superior performance in the eyes of customers.

Importantly, we draw upon the coping-adaptation framework to theorize two distinct mechanisms through which a flourishing psychological state—ISK-Emp—can inspire employees to enhance their job performance. The first mechanism is an indirect effect via enhanced infusion use, while the second mechanism is an indirect effect via reduced role conflicts. By differentiating between these two mechanisms through which employees' perceptions of ISK-Emp generate positive performance outcomes (e.g., customer satisfaction), we open avenues for further research to uncover the different mechanisms linking ISK-Emp with downstream performance outcomes.

7.1.4 Importance of Mediating Mechanisms, Conditional on Work Experience

Our study also advances our understanding of intelligence augmentation by discerning how employees' endowment of work-related knowledge, a key internal coping resource from their viewpoint, plays a role in enabling them to cope with the changes to their work introduced by an intelligent system. Our work builds on and extends prior research that has indicated that work experience, while heterogeneous across employees, can play a vital role in affecting employees' adaptation to organizational changes (Ahearne et al. 2010). Specifically, employees with different levels of work experience may react in different ways to cope with IS-induced changes (Venkatesh et al. 2003). Differentiating between the cognitive schemas of novices and experienced employees, we advance a contingent role of work experience in moderating the mediation mechanisms through which employees utilize external coping resources provided by intelligent systems to accomplish their work.

By integrating work experience as a contingency in our model, we uncover how the magnitudes of the two adaptation mechanisms (i.e., benefit maximization and disturbance minimization) differ between novice and experienced employees. While scholars generally agree that novice and experienced employees have different needs for system support in their work processes (Markus 2001), we offer a schema-based explanation (Dane 2010) of how employees' empowerment perceptions of IntelSys knowledge can be leveraged differently by them.

The significance of the benefit-maximization mechanism (i.e., ISK-Emp → infusion use → job performance) for novice employees suggests that their empowerment perception of IntelSys knowledge motivates them to use an intelligent system to its fullest potential to maximize the benefits. In contrast, the salience of the disturbance-minimization mechanism (i.e., ISK-Emp → role conflicts→ job performance) for experienced employees suggests that their empowerment perception of IntelSys knowledge enables them to overcome their cognitive work entrenchment and adapt to new work routines to minimize disturbances. Although employees in general benefit from their empowerment perceptions of IntelSys knowledge and enhance their job performance, our study reveals critical differences in the mechanisms that are effective for experienced and novice employees.

The discovery of this contingent role of work experience also advances research on the success of intelligent systems. Although increasingly more organizations have been introducing IntelSys implementations, multiple studies have shown that the payoffs of IntelSys investments have been elusive (e.g., Elbashir et al. 2013; Wixom et al. 2013). To this end, recognizing the double-edged nature of work experience in terms of accumulating work-related knowledge versus creating adherence to existing work routines (Polites and Karahanna 2012, 2013), we show how work experience differentially affects the importance of the two mechanisms (benefit maximization and disturbance minimization) through which IntelSys payoffs are achieved. Above and beyond prior studies illustrating that novice and experienced employees could both benefit from intelligent systems but at different points in time (Ko and Dennis 2011), we contribute to this line of literature by revealing the relative importance of the two mechanisms through which IntelSys payoffs can be attained by novice and experienced employees. The encouraging findings about the value of ISK-Emp for different groups of users provide a promising direction that warrants further scholarly attention.

7.2 Practical Implications

This research has important practical implications for organizations that plan to implement or have already implemented an intelligent system to empower their employees and achieve intelligence augmentation. To begin with, our research delivers a core message that IntelSys implementation does not guarantee augmentation of intelligence for employees, and consequently better job performance. Rather, whether employees perceive the knowledge provided by an IntelSys as an empowering external coping resource (ISK-Emp) is crucial for superior downstream impacts, either through employees using these systems to achieve their full potential or through employees adapting their problem-solving frames and routines to minimize disturbances in their work. In practice, ISK-Emp can be influenced by managerial interventions through how the intelligent system is implemented. To foster ISK-Emp among employees, managers can design their IntelSys training programs so that employees are able to recognize the value of IntelSys knowledge and are intrinsically motivated to utilize IntelSys knowledge in their work practices for better performance.

To elaborate, given the underlying dimensions of ISK-Emp, managers can cultivate employees' empowerment through an intelligent system by taking actions on multiple dimensions. These include: (i) making algorithm-generated knowledge transparent to employees so that they can envision the big picture of a problem and meaningfully allocate time and effort to accomplish tasks in line with their job goals (*meaningfulness*); (ii) getting employees to recognize how IntelSys knowledge can extend their ability to search, learn, and generalize so that they feel competent to solve complex problems (*competence*); (iii) sharing how recommendations provided by an IntelSys can enable employees to evaluate alternative solutions, while making choices at their own discretion and pace (*self-determination*), and (iv) providing scenario-based cases and real-time solutions by the intelligent system to help employees see the impact resulting from their efforts (*impact*).

In addition, as firms strive for IntelSys implementations that provide knowledge to expand employees' cognitive capabilities (Davenport and Glaser 2002), it is reasonable that most managers will view an intelligent system as a knowledge-acquisition platform. Our study suggests, however, that it is equally important for managers to recognize the critical role of an intelligent system in addressing employees' cognitive entrenchment. Managers should develop a balanced understanding of both the benefit-maximization and the disturbance-minimization mechanisms and corresponding strategies to promote each of these.

Moreover, managers should pay attention to the differential importance of the two mechanisms for novice and experienced employees. In particular, novice employees tend to appreciate an intelligent system as a knowledge-acquisition platform in that ISK-Emp stimulates their infusion use of the system, which then translates into positive performance outcomes. In contrast, experienced employees who have accumulated more job-specific knowledge are more likely to rely on their personal experience instead of IntelSys knowledge to perform their tasks (Ko and Dennis 2011; Markus 2001). For experienced employees, the value of ISK-Emp lies more in reconciling the role conflicts associated with IntelSys implementation; ISK-Emp allows these experienced employees to perform their jobs with minimal disturbances after IntelSys implementation. Synthesizing the above, we recommend that managers focus on the *benefit-maximization and disturbance-minimization* mechanisms for novice and experienced employees, respectively, when leveraging ISK-Emp for desired performance outcomes.

7.3 Limitations and Future Research

Our study has limitations and opens exciting opportunities for future research. First, we acknowledge the boundary conditions of our research and are aware that an intelligent system used for process automation and standardization may contribute to perceptions of loss of power or control (Davison and Martinsons 2002; Lapointe and Rivard 2005). In fact, automation and augmentation are not mutually exclusive, but can be complementary and collaborative in shaping the relationship between humans and machines (Deng et al. 2016). While the duality of empowerment and the controlling nature of an intelligent system is beyond the scope of this study, investigating this duality is a promising direction for future research to better understand the nature of intelligent systems in relation to tasks and user values.

Second, we consider the misalignment between business goals and the objectives of algorithms underlying an intelligent system to be a fruitful angle from which to extend our work. It is interesting to discuss how an employee may use the insights from such a system, as such insights may focus on optimizing one core objective while overlooking others. The problem domains we explore do not reflect this type of tension between the objectives a system may seek to optimize and the pragmatic concerns that experts have to reconcile. We encourage scholars to further examine how our work extends to contexts in which business goals and the objectives of system algorithms are misaligned.

Third, while we theorize context-general mechanisms on the pathways and contingencies through which ISK-Emp enables employees' adaptation to cope with changes and achieve performance benefits, we develop the research model with constructs that capture these pathways and contingencies effectively in our investigative context where IntelSys augments human knowledge. We acknowledge that the meaningful constructs to instantiate the mediation mechanisms, contingencies, and performance outcomes may vary across contexts. For example, there could be constructs other than infusion use and role conflict that, respectively, represent the constructive and disruptive pathways linking ISK-Emp to job performance, especially in different managerial and technology settings. In addition, we focus on work experience to capture an internal coping resource that allows us to examine the tension between human knowledge and IntelSys knowledge. We suggest future research assess how other types of internal coping resources, like knowledge learned from education or friends, may play a role in intelligence augmentation. Similarly, we have used customer satisfaction as a proxy for employees' job performance. Although customer satisfaction is one of the most important performance indicators, especially in the service sector, interested scholars can look into different aspects of job performance in greater detail, such as in-role performance, extra-role performance rated by direct supervisors, and objective performance indices captured by different enterprise systems. Future studies should measure these various aspects of job performance and examine how ISK-Emp affects different performance outcomes measured from distinct perspectives.

Fourth, we tested our hypotheses in one firm in the technical service industry. We believe that the essence of employee–customer interactions is similar across many service sectors, such as financial services and insurance services, if not all sectors. However, we recognize that our model was tested using a predominantly male sample due to the demographic characteristics of our empirical setting in the ATM maintenance industry. We encourage future research to examine the model in other empirical settings where the demographic characteristics are more gender-balanced. Furthermore, we encourage interested scholars to further examine how our proposed framework and hypotheses may change in culturally or economically distinct geographic regions.

8 CONCLUSION

We advance an intelligence augmentation perspective on how generating performance payoffs from an intelligent system requires adaptation by employees to maximize benefits and minimize disturbances in their work processes, as well as coping resources for adaptation. Specifically, we develop a coping-adaptation explanation of how employees' perceptions of IntelSys knowledge as an empowering external coping resource affect the mechanisms through which they adapt to IntelSys-induced changes to their work, as well as how their internal coping resources regulate their adaptation. Our coping-adaptation explanation of intelligence augmentation integrates (i) the empowering role of external coping resources, specifically IntelSys knowledge, captured as ISK-Emp, (ii) the adaptation mechanisms of infusion use (benefit maximizing) and role conflicts (disturbance minimizing) that link empowerment to performance outcomes, and (iii) the regulating role of internal resources, specifically, employees' work experience, in influencing the importance of the adaptation mechanisms for an employee. We show that employees who perceive IntelSys knowledge as an empowering external coping resource are in a psychological state that energizes them to not only use the intelligent system to the fullest potential to support their work but also reduces misalignment in their role expectations by adjusting how they respond to the intelligent system in their work. In addition, employees' work experience, as a critical internal coping resource, plays a contingent role in determining the influential mechanisms through which ISK-Emp affects performance. ISK-Emp triggers infusion-use enhancement to a greater extent for novice employees, whereas it triggers role-conflict reduction to a greater extent for experienced employees.

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APPENDIX A. Review of Intelligence Augmentation Applications

Table A1. Review of Intelligence Augmentation Applications				
Tasks	**Generate Task Inputs**	**Perform the Task**	**Utilize Task Outputs**	**References**
Equipment maintenance at General Electric	**Intelligent System:** collect streaming operational data on normal and aberrant performance of physical equipment	**Intelligent System:** identify unexpected rotor wear and tear in a turbine, check the turbine's operational history, warn about the consequences if the rotor is not fixed, predict when a specific part in an individual machine might fail, suggest appropriate actions, provide information about the costs and financial benefits	**Human:** workers make the maintenance decisions	Wilson and Daugherty (2018)
Product design at Autodesk	**Human:** designers input design goals, along with parameters related to materials, manufacturing methods, and cost constraints, into the intelligent system	**Intelligent System**: perform the myriad calculations to ensure that each proposed design meets the specified criteria; quickly provide design alternatives by exploring a large number of solution permutations through an evolutionary learning process	**Human:** designers determine the design solutions based on their professional judgment and aesthetic sensibilities	Wilson and Daugherty (2018)
Idea generation at Symrise	**Human:** master perfumers enter customers' objectives and constraints into the intelligent system, and adjust these objectives and constraints according to the system outputs	**Intelligent System:** automatically generate fragrance formulas matching the requirements; identify correlations between specific customer demographics and different combinations of fragrance ingredients; refine the formula chosen by master perfumers **Human:** master perfumers use their expertise to confirm or reject the possible connections, create additional ones, and interact with the intelligent system to experiment with different dosages of the selected formula's ingredients. Master perfumers smell and predict how humans will perceive new fragrances or the emotions and memories they will trigger	**Human:** master perfumers use their human senses, expertise, and intuition to choose one of the machine's suggested fragrance formulas, take responsibility for its outcomes, tell a compelling story about a fragrance and its meaning for commercialization	Bergstein (2019); Goodwin et al. (2017)
Employee recruitment at Unilever	**Human:** HR managers set up the selection criteria	**Intelligent System:** assess candidates' traits through their performance in online games in the first round of the application process; analyze applicants' responses, body language, and tones in videos submitted by applicants in which they answer questions **Human:** HR managers conduct in-person interviews for the last round	**Humans:** HR managers make the final hiring decisions	Wilson and Daugherty (2018)
Employee recruitment at JP Morgan Chase	**Human:** HR managers set up the selection criteria	**Intelligent System:** identify reliable, firm-specific predictors of candidates' future job performance; assess candidates and provide options **Human:** HR managers remove statistically biased or socially vexed predictors and make the system robust	**Human:** HR managers make the final decisions through intuition and common-sense judgment, and ensure that their hiring decisions are aligned with the business strategy	Riley (2018)

Personalized service at Starbucks	**Intelligent System:** recognize customers' mobile devices and call up their ordering history	**Intelligent System:** sift through and process a large amount of data to recommend certain offerings or actions	**Human:** baristas use their intuition and judgment to make a recommendation or select the best fit from a set of choices	Wilson and Daugherty (2018)
Personalized service at Carnival Corporation	**Intelligent System:** streamline the boarding and debarking processes, track the guests' activities and connect with their credit cards	**Intelligent System:** dynamically process the data flowing from the sensors and systems throughout the ship, anticipate guests' preferences	**Human:** crew members deliver personalized service to each guest by suggesting tailored itineraries of activities and dining experiences	Wilson and Daugherty (2018)
Fraud Detection at HSBC	**Human:** bank employees set up the detection criteria	**Intelligent System:** monitor and score millions of transactions daily, analyze data on purchase locations and customer behavior, IP addresses, as well as other information to identify subtle patterns that signal possible fraud	**Human:** bank employees determine whether there is fraud and take corresponding actions	Wilson and Daugherty (2018)
Customer service	**Human:** human representatives set up the complaint patterns	**Intelligent System:** identify more implicit patterns	**Human:** human representatives identify new complaint patterns in voice recordings of customer calls	Schuetz and Venkatesh (2020)
Customer service at SEB	**Intelligent System:** receive customer requests **Human:** human representatives train and develop the intelligent system	**Intelligent System:** interact with customers to handle basic customer requests; simultaneously provide routine customer service to large numbers of people to enable scalable communication **Human:** human representatives handle more complex issues	**Human:** human representatives supervise and monitor the IntelSys performance	Wilson and Daugherty (2018)
Crop planning	**Human:** farmers formulate problems	**Intelligent System:** generate solutions and provide real-time recommendations on how to increase productivity: which crops to plant, where to grow them, how much nitrogen to use in the soil	**Human:** farmers decide whether to accept the recommendations	Wilson and Daugherty (2018)
Sentencing and parole	**Human:** domain experts program rules into the intelligent system and train the system with historical data	**Intelligent System:** predict recidivism rates and calculate "risk scores" based on structured machine learning algorithms	**Human**: Judges consider the "risk scores" when making sentencing and parole decisions	Berk (2019); Dressel and Farid (2018)
Regulation enforcement at European Union	**Human:** data compliance officers ensure that the data that are fed to the intelligent system comply with consumer-protection regulations	**Intelligent System:** generate algorithm-based decisions such as the rate offer on a credit card or mortgage	**Human:** experts provide an explanation for any algorithm-based decision	Wilson and Daugherty (2018)
Disease detection	**Human:** physicians set up the evaluation criteria	**Intelligent System:** process a large volume of unstructured data	**Human:** physicians identify anomalies in MRI scans, work with patients to understand and translate patients' symptoms, inform patients of treatment options, and guide patients through treatment plans	Ahmed et al. (2017); Schuetz and Venkatesh (2020)
Emergency services	**Intelligent System:** predict the likelihood that patients who call in will experience cardiac arrest	**Human:** physicians assess patients' condition based on their professional experience and on-site judgment	**Human:** physicians collectively interpret, justify, and ultimately build trust in IntelSys solutions	von Krogh (2018)

APPENDIX B: MEASUREMENT

Table B1. Construct Measures		
Constructs	**Measures**	**Sources**
Data from Employees		
ISK-Emp	**Meaningfulness** 1. The knowledge delivered from the system is meaningful to me. 2. The knowledge delivered from the system is very important to me. 3. The knowledge delivered from the system is personally meaningful to me. **Competence** 1. The knowledge delivered from the system makes me feel confident about my ability to do my work. 2. The knowledge delivered from the system helps me be self-assured about my capabilities to perform my work activities. 3. The knowledge delivered from the system helps me master the skills necessary for my work. **Self-Determination** 1. The knowledge delivered from the system makes me have significant autonomy in determining how I do my work. 2. The knowledge delivered from the system enables me to decide on my own how to go about doing my work. 3. The knowledge delivered from the system provides considerable opportunities for independence and freedom in how I do my work. **Impact** 1. The knowledge delivered from the system makes me have a large impact on my clients' ATM-related operations. 2. The knowledge delivered from the system makes me have a great deal of control over my clients' ATM-related operations. 3. The knowledge delivered from the system makes me have significant influence over my clients' ATM-related operations. *(Scale: 1 = "Strongly disagree" to 7 = "Strongly agree")*	Adapted from Spreitzer (1995)
Infusion Use	1. I use all capabilities of the system in the best fashion to help me on the job. 2. My use of the system on the job has been integrated and incorporated at the highest level. 3. I use the system to its fullest potential for supporting my own work. *(Scale: 1 = "Strongly disagree" to 7 = "Strongly agree")*	Jones et al. (2002), Schwarz (2003), Sundaram et al. (2007)
Role Conflict	**With the newly implemented system,** 1. I have to do things that should be done differently from my previous practice. 2. I work under incompatible policies and guidelines. 3. I work on unnecessary things. *(Scale: 1 = "Strongly disagree" to 7 = "Strongly agree")*	Rizzo et al. (1970), Speier and Venkatesh (2002)
Data from Customers		
Job Performance	**Customer Satisfaction Rated by Customers** 1. All in all, I am very satisfied with this employee. 2. The services provided by this employee meet my expectations of ideal services in this field. 3. Overall, I am satisfied with the services provided by this employee. *(Scale: 1 = "Strongly disagree" to 7 = "Strongly agree")*	Bettencourt (1997), Chan et al. (2010), Homburg et al. (2009)

Appendix C. Confirmatory Validation of the Measurement Models for Study 2

In line with the evaluation criteria suggested by Hair et al. (2006), our CFA results (summarized in Table B1) show that Model 1 and Model 2 did not fit the data well, suggesting that ISK-Emp is not a unidimensional first-order construct nor four uncorrelated first-order constructs. Model 3 had satisfactory model fit. In Model 3, the standardized factor loadings of the measurement items on their respective factors were all highly significant ($p < 0.01$), providing support for convergent validity. The superiority of Model 3 (i.e., the unconstrained model) over Model 2 (i.e., the constrained model) ($\chi^2 = 890.17$, $p < 0.01$) indicates that pairs of correlations among the first-order factors were significantly different from 0. The correlations were also below the cutoff value of 0.90 (Kline 2011; Tanriverdi 2005), demonstrating the distinctiveness of the theoretical content captured by the individual first-order factors (Law et al. 1998; Wong et al. 2008). We also evaluated discriminant validity by looking at the factor loadings. Each item loaded higher on its appropriate dimension than on any other, thus supporting discriminant validity. Following Gefen et al. (2003), we constrained the correlation between each possible pair of dimensions one at a time to unity and performed a chi-square test to compare this constrained model to the unconstrained model. In all cases, the chi-square difference was significant, indicating significant distinction between the dimensions (see Table B2).

Table C1. CFAs for the Alternative Measurement Models for ISK-Emp

Model	X^2	d.f.	X^2/d.f.	CFI	GFI	NFI	RMSEA	SRMR
1: Unidimensional First-Order Model	951.31	54	17.62	0.79	0.66	0.78	0.22	0.07
2: Uncorrelated First-Order Model	1010.31	54	18.71	0.78	0.65	0.77	0.23	0.51
3: Correlated First-Order Model	120.13	48	2.50	0.98	0.95	0.97	0.07	0.03
4: Second-Order Model	126.12	50	2.52	0.98	0.95	0.97	0.07	0.03
Recommended Threshold			< 3	> 0.9	> 0.9	> 0.9	< 0.08	< 0.08

Table C2. Constraining Pairwise Correlation for Discriminant Analysis in Study 2

Model	X^2	d.f.	$\Delta\chi^2$	P-Value of Test
Original	120.13	48	-	-
Combine Meaningfulness and Impact	357.54	49	237.41	0.00
Combine Meaningfulness and Self-Determination	385.56	49	265.43	0.00
Combine Meaningfulness and Competence	376.14	49	256.01	0.00
Combine Impact and Self-Determination	455.70	49	335.57	0.00
Combine Impact and Competence	489.48	49	369.35	0.00
Combine Self-Determination and Competence	427.58	49	307.45	0.00