Psychological Mechanisms Underlying the Adoption of Human-Machine Collaborative Enhanced Business Information Management Decision-Making

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Abstract

With the development of new technologies such as data science and cognitive intelligence, human-machine collaborative augmented business information management decision-making has gradually become the mainstream approach in organizational decision-making, attracting significant attention from numerous practitioners and researchers. Compared to the traditional manager-centered organizational decision-making paradigm, the human-machine collaborative decision-making paradigm signifies that machines, which once served as tools, have evolved into teammates with equal status and equivalent decision-making authority alongside managers. For managers, this significant role transformation of machines diminishes their own importance in the decision-making process and may even lead to potential resistance behaviors toward human-machine collaborative decision-making. To address this critical issue, this study draws on self-determination theory to systematically optimize the design of models and functionalities for human-machine collaborative augmented business information management decision-making, enhancing managers' perceptions of its "creation" (technology readiness) and "use" (technology acceptance model) to satisfy their self-determination needs, thereby improving their adoption intention toward human-machine collaborative augmented business information management decision-making.

Full Text

Preamble

Psychological Mechanisms Underlying the Adoption of Human-Machine Collaborative Augmented Business Information Management Decision-Making: A Self-Determination Theory Perspective

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Abstract: With the development of novel technologies such as data science and cognitive intelligence, augmented business information management decision-making based on human-machine collaboration has gradually emerged as the mainstream approach to organizational decision-making, attracting considerable attention from both practitioners and researchers. Unlike traditional manager-centered organizational decision-making paradigms, human-machine collaborative decision-making elevates machines from mere tools to teammates with equal status and decision-making authority. For managers, this fundamental role transformation diminishes their perceived importance in the decision-making process and may even engender resistance to human-machine collaborative decision-making. To address this critical issue, this study systematically optimizes the design of decision-making modes and functions in augmented business information management with human-machine collaboration from the perspective of self-determination theory. The objective is to enhance managers' perceptions of "creation" (technology readiness) and "use" (technology acceptance) to fulfill their self-determination needs, thereby improving their willingness to adopt augmented business information management decision-making with human-machine collaboration.

Keywords: self-determination theory, technology readiness index, technology acceptance model, augmented with human-machine collaboration

1. Problem Statement

With the advancement of new technologies such as the Internet, data science, and cognitive intelligence, augmented business information management decision-making based on human-machine collaboration is poised to become the dominant mode of organizational decision-making in the future. This approach organically integrates supportive decision-making (experience-centered) with automated decision-making (data-centered). Compared to traditional organizational decision-making paradigms that center on managers, the human-machine collaborative augmented paradigm grants machines equal decision-making status alongside managers. This significant role transformation exerts non-negligible negative effects on managers, such as undermining their self-categorization and identity as humans [**?**, **?**], consequently leading to potential resistance toward human-machine collaborative decision-making. Therefore, effectively combining human and non-human (i.e., algorithmic, statistical, machine) decision-making remains one of the most prominent and complex obstacles in the field of behavioral decision-making [**?**, **?**].

Currently, the Technology Acceptance Model and Technology Readiness Index are widely employed to explain and predict user acceptance of information systems or new technologies [?, ?, ?, ?, ?]. However, understanding the psychological motivations underlying user decision-making behavior constitutes the key to addressing prominent issues and overcoming barriers in behavioral decision-making. Particularly in the context of human-machine collaborative augmented business information management decision-making, machines' role to some extent undermines managers' inherent self-determination needs—namely, autonomy, competence, and relatedness—thereby potentially severely impacting their willingness to adopt human-machine collaborative decision-making. Based on this, from the perspective of user behavioral mechanism theory, this study aims to systematically optimize the design of human-machine system decision-making modes to enhance managers' perceptions of technology readiness and technology acceptance, thereby satisfying their self-determination needs and ultimately improving their adoption intention for human-machine collaborative augmented business information management decision-making.

2.1 Human-Machine Collaborative Augmented Business Information Management Decision-Making

In contexts empowered by new technologies, research on business information management decision-making primarily focuses on leveraging the advantages of machine intelligence technologies and tools to optimize existing organizational decision-making processes, thereby enhancing both efficiency and effectiveness. Artificial intelligence technology has attracted considerable academic attention in human decision-making domains in recent years. *Science* and *Nature* have discussed the role and prospects of AI in human decision-making from various perspectives, including economic decision-making [?, ?], moral decision-making [?, ?], healthcare decision-making [?, ?], and governmental management decision-making [?, ?]. Particularly driven by cognitive intelligence and other new technologies, AI now supports various complex tasks in organizations that previously required human cognitive capabilities, including making profound judgments and decisions [?, ?].

Recently, academia has proposed a new managerial decision-making paradigm known as augmented decision-making [?, ?, ?]. The term "augmentation" implies that humans and machines work in close collaboration and interaction to execute relevant management tasks. This approach allows human unique capabilities, such as intuition and common-sense reasoning, to complement machine capabilities. Through augmentation, the work of humans and machines becomes tightly intertwined, potentially exhibiting entirely new, emergent behaviors [?, ?]. This decision-making paradigm emphasizes human-machine collaboration, organically combining managers' knowledge with intelligent decision-making [?, ?, ?]. It ensures real-time responsiveness while employing network organization and scenario association methods to enable precise judgment tai-

lored to specific contexts [?, ?]. Since augmented decision-making remains in its early stages, only a small fraction of available data can currently be utilized to create organizational knowledge and enhance decision support [?, ?].

From the perspective of technical and process implementation, promoting and constructing an organizational framework for augmented business information management decision-making, optimizing organizational decision-making efficiency, facilitating the use of human-machine collaborative decision-making systems, and enhancing managers' adoption intention represent key issues of concern for both practitioners and academics [?, ?, ?, ?, ?, ?]. Regarding user attitudes and usage intentions toward new technologies, the Technology Acceptance Model proposed by Davis et al. (1989) based on the Theory of Reasoned Action and the Technology Readiness Index developed by Parasuraman (2000) to measure individuals' intention to use new technologies have become the theoretical foundations for domestic and international scholars to explain and predict user acceptance of information systems or new technologies. These two models represent the most influential research frameworks for studying user acceptance and adoption of information technology systems in the Internet era and the artificial intelligence era.

2.2.1 Technology Acceptance Model

With further social development, many novel phenomena have emerged, particularly various new technologies represented by information systems. The Theory of Planned Behavior and Theory of Reasoned Action have shown corresponding deviations in predicting individual behavior. Davis (1989) integrated concepts from expectancy theory and self-efficacy theory to establish the Technology Acceptance Model (TAM). In predicting individual behavioral intention, Davis (1989) eliminated the subjective norm variable and introduced two new variables: perceived usefulness and perceived ease of use, marking the initial framework of the Technology Acceptance Model. Perceived ease of use refers to users' subjective perception of the difficulty of using a technology, while perceived usefulness refers to users' subjective perception of the degree to which using a technology would be beneficial. The theory posits clear logical relationships among perceived usefulness, perceived ease of use, usage intention, and usage behavior. User acceptance behavior is influenced by acceptance intention, which is in turn influenced by acceptance attitude. Perceived usefulness and ease of use affect acceptance attitude, and the degree of perceived usefulness is closely related to the degree of perceived ease of use.

Over more than 30 years of development, the Technology Acceptance Model theory has been further refined and optimized, with its application scope gradually expanding to include information systems [?, ?], education and learning [?, ?, ?], healthcare [?, ?, ?], and economics and management-related fields [?, ?, ?, ?].

2.2.2 Technology Readiness Index

The Technology Readiness Index (TRI) is a theoretical model for measuring individuals' intention to use new technologies, representing their propensity to employ new technologies to achieve goals in both work and family life [**?**, **?**]. Technology readiness categorizes user characteristics into four dimensions involving both drivers and inhibitors that jointly influence individuals' tendency to use new technologies. The four dimensions are as follows:

Optimism represents users' positive views toward technology, primarily involving beliefs about control, convenience, flexibility, and efficiency. Dabholkar (1996) noted that individuals place great importance on whether they maintain control when using service technologies. Zeithaml et al. (2002) and Meuter et al. (2000) pointed out that convenience often signifies the use of electronic services or self-service technologies.

Innovativeness refers to users' willingness to become technology pioneers and thought leaders in a particular domain. In previous research, innovativeness is a common concept among the four dimensions, comprising both domain-general and domain-specific innovativeness. Although domain-general innovativeness was assumed to predict consumers' adoption tendencies toward innovations, empirical studies have not confirmed this relationship [**?**, **?**, **?**, **?**]. Regarding domain-specific innovativeness, Goldsmith et al. (1998) argued that consumers more actively adopt innovations in specific domains. Agarwal and Prasad (1998) also proposed that "individuals have the willingness to try any new information technology" in the IT domain. Garcia and Calantone (2002) and Roehrich (2004) noted that consumer innovativeness and product innovation represent inevitable development trends.

Discomfort represents the stress that technology imposes on users and their sense of lost control. The discomfort variable was proposed by Meuter et al. (2003) during their research on technology anxiety. They found that discomfort not only exerts a significant negative effect on customers' use of self-service technologies but also negatively impacts their actual usage intention and experience. Susskind (2004) discovered that fear induced by the Internet reduces users' online time.

Insecurity refers to users' distrust of new technologies, encompassing both doubts about the technology's work capabilities and concerns about potential harm it may cause. Hoffman et al. (1999) considered the security factor crucial because insecurity may influence and constrain the development of e-commerce. Insecurity primarily results from the gap between expected and actual innovation performance, which negatively correlates with innovation resistance [**?**, **?**].

Regarding these four dimensions, Parasuraman (2000) posited that innovativeness and optimism are "drivers" that generate stronger intentions to use new technologies, while insecurity and discomfort are "inhibitors" that may reduce such intentions. Importantly, these four dimensions exist independently, mean-

ing an individual may simultaneously exhibit multiple technology characteristics.

Technology readiness originates from individual-level characteristics and remains stable in the short term, resistant to change even with external stimuli. Parasuraman (2000) proposed that individuals are more likely to use a new technology when they exhibit characteristics of innovativeness and optimism while simultaneously displaying low levels of insecurity and discomfort. Parasuraman and Colby (2001) argued that different customer personality traits lead to very distinct Internet behaviors. Dabholkar and Bagozzi (2002) and Susskind (2004) noted that user personality traits influence their use of self-service technologies. To date, technology readiness has been widely applied in comparing consumer behavioral intentions across countries, understanding service employees' technology preparation, and explaining relationships among perceived usefulness, ease of use, and behavioral intention [**?**, **?**, **?**, **?**, **?**, **?**]. Massey et al. (2007) argued that higher perceived individual technology readiness levels increase willingness to use various advanced technologies and enhance users' experience of ease.

Although the Technology Acceptance Model and Technology Readiness Index are important indicators for examining usage intention in human-machine collaborative augmented business information management decision-making, the key to solving problems lies in whether this decision-making model truly satisfies users' psychological needs as technology advances and iterates. Therefore, this study employs Self-Determination Theory to deeply explore managers' internal needs when using human-machine collaborative augmented business information management decision-making [**?**, **?**].

2.2 Self-Determination Theory

Self-Determination Theory (SDT) primarily focuses on the degree to which human behavior is self-determined. The theory is built on the premise that humans are proactive organisms; all individuals possess constructive, intrinsic, and innate tendencies toward self-integration, with the potential for self-growth and self-actualization. Whether this potential is realized depends primarily on the interaction between individuals and social contexts. Therefore, self-determination refers to autonomous behavioral choices made by individuals based on full awareness of their psychological needs and environmental information [**?**, **?**]. SDT posits that the self plays a crucial role in human motivation formation, and behavior is continuously shaped based on the satisfaction of people's psychological needs.

Self-Determination Theory identifies three basic psychological needs: autonomy, competence, and relatedness. The theory maintains that through continuous interaction with social contexts, these three basic needs are progressively satisfied, thereby continuously stimulating the internal dynamics of individual

behavior. This process facilitates the internalization of individual values and self-integration, ultimately realizing individual well-being and potential. Simultaneously, individuals' internal growth is influenced both positively and negatively by external social environments. Consequently, a dialectical relationship exists between individuals' internal self-growth and self-integration and external social environments, termed "organismic-dialectical meta-theory" [**?**, **?**].

2.2.1 Three Basic Psychological Needs

Based on analyses of external environments and individual internal psychology, researchers of Self-Determination Theory content have identified three basic psychological needs: autonomy, competence, and relatedness. They argue that satisfying these three psychological needs forms the foundation for healthy individual growth and self-development [**?**, **?**].

Autonomy need refers to individuals' need to freely choose to engage in certain activities according to their inner will and desires. Autonomy can also be termed self-determination and self-management, representing behavior freely chosen by individuals based on full understanding of environmental information and personal needs. This self-determination potential makes people more willing to engage in behaviors beneficial to their competence development and of interest to them, constituting a condition for human intrinsic motivation. Autonomy differs from independence; specifically, autonomy represents "the degree to which individuals make autonomous choices when facing pressure from external events affecting their behavior." Autonomy also differs from free will, which implies disobedience and contempt for rules. In contrast, SDT assumes individual behavior aligns with social norms, with behavior being either controlled by external forces or guided by autonomy. The core element of self-determination or autonomy is individuals' integration based on promoting self-development; therefore, integration forms the foundation of self-determination or autonomy.

Competence need refers to individuals' need to control their environment, meaning people need to experience a sense of efficacy in their activities. **Relatedness need** refers to the sense of belonging individuals obtain when feeling supported, understood, and cared for by surrounding groups and environments. If social environments can support and continuously satisfy these needs, human motivation and nature can develop effectively, enabling healthy growth.

In Self-Determination Theory, autonomy, competence, and relatedness needs constitute the core theory. Satisfying these three basic psychological needs facilitates the continuous internalization of individuals' extrinsic motivation, ultimately forming intrinsic goal orientation and enhancing individual well-being [**?**, **?**].

2.2.2 Intrinsic and Extrinsic Motivation

Self-Determination Theory classifies behavior based on its underlying causes, with the most widely recognized distinction being between intrinsic motivation and extrinsic motivation [**?**, **?**]. Intrinsic motivation arises from the satisfaction and pleasure derived from the activity itself, without requiring external conditions. Extrinsic motivation specifically originates from factors external to the activity, representing behavioral motivation generated under the influence of external forces and demands.

Deci (1971) proposed that living organisms are the original source of intrinsic motivation. Humans are born with tendencies toward psychological development and growth, intensely desiring various spiritual or material nutrients, thereby maximizing individual potential. Under the drive of intrinsic motivation, individuals genuinely feel happiness and interest when participating in an activity or doing something, which in turn promotes psychological development and growth. Activities driven by intrinsic motivation often exhibit distinct characteristics of "novelty," "stimulation" [**?**, **?**], "flow experience," and "optimal challenge" [**?**, **?**, **?**]. Intrinsic motivation does not require external forces to promote it but is instead caused by the pleasure and satisfaction the activity itself brings to the individual.

Extrinsic motivation, conversely, is a behavioral drive formed by individuals under the influence of external environments, initiated by environmental factors external to the activity [**?**, **?**]. Deci and Ryan (1980) argued that external events influence internal motivation based on individuals' cognitive evaluation of those events. First, individuals perceive competence regarding external events. If people achieve a sense of accomplishment from external events, they experience perceived competence in the activity, which further strengthens intrinsic motivation; otherwise, intrinsic motivation decreases. Second, individuals perceive autonomy in participating in determining external events, representing self-determination perception. When people experience a sense of accomplishment, they inevitably feel that behavior originates from self-determination, at which point intrinsic motivation truly exerts its promoting effect. Therefore, the degree of self-determination and perceived competence affects intrinsic motivation, causing continuous changes—high levels of self-determination and competence increase intrinsic motivation, whereas low levels decrease it. Compared to controlling events, informational events more easily form intrinsic motivation, maximizing individuals' interest, creativity, conceptual understanding, and generating more positive emotions. Additionally, relatedness needs also influence individual intrinsic motivation. If individuals' environments provide a sense of belonging and security, they exhibit more intrinsic motivation behaviors. Research on infant curiosity demonstrates that when infants have secure attachment to their mothers, their exploratory behavior increases under the dominance of intrinsic motivation [**?**, **?**]. Although intrinsic motivation is not solely influenced by relatedness factors, secure interpersonal environments significantly impact intrinsic motivation. Ryan and Deci (2000) proposed that

humans are born with the ability for positive self-regulation and will transform social norms into content they can recognize, thereby effectively internalizing extrinsic motivation. Extrinsic motivation is a behavioral drive formed by individuals under the influence of external environments, caused by environmental factors external to the activity itself [**?**, **?**].

In classifying external events, rewards, compensation, and other external events are categorized into three types: informational, controlling, and amotivating. Different types of external events affect intrinsic motivation by influencing individuals' competence and causal perception differently. Informational events provide positive feedback to individuals, enabling self-determination in the choice process. Individuals experience competence in the activities they engage in or learn ways to master the activity. Such events promote individuals' internal causal perception, further enhancing their competence and thereby strengthening intrinsic motivation levels.

Controlling events compel individuals to think and act in certain ways, determining their behavior under control. Individuals' external causal perception is enhanced, autonomy decreases, and consequently intrinsic motivation decreases, ultimately causing strong resistance or feigned compliance, such as deadlines, external rewards, and surveillance. Researchers have conducted various studies focusing on controlling events and their impact on intrinsic motivation, demonstrating that threatening punishment [**?**, **?**], mandatory goals [**?**, **?**], deadlines [**?**, **?**], and competition [**?**, **?**] all weaken individual intrinsic motivation. Amotivating events represent invalid events where individuals experience incompetence, and intrinsic motivation consequently weakens, such as negative feedback. In summary, external events that satisfy people's competence, autonomy, and relatedness needs—such as rewards, positive feedback, freedom from degrading evaluation, and reduced separation—can all enhance intrinsic motivation for individual behavior.

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3. Research Framework: Adoption Mechanisms of Human-Machine Collaborative Augmented Decision-Making

As previously discussed, at the manager level, human-machine collaborative augmented business information management decision-making requires managers to collaborate and interact closely with machines. However, effectively combining human and non-human (i.e., algorithmic, statistical, machine) decision-making remains one of the most prominent and complex obstacles in behavioral decision-making [**?**, **?**]. To better leverage the resource advantages of artificial intelligence technology in business decision-making, this study adopts an intelligent augmented business perspective, emphasizing human-machine interactive collaboration and real-time iterative optimization thinking for intelligent business management and decision-making. Grounded in self-determination needs theory, the study proposes to explore two progressively advancing levels: (1)

Mechanism analysis level: How do human-machine collaborative mode design and augmented decision-making system function design influence managers' self-determination needs through their effects on technology readiness and technology acceptance, ultimately affecting adoption intention for business information management decision-making? (2) **Moderating effects level**: How do organizational contingency factors moderate the influence of technology readiness and technology acceptance on managers' self-determination needs? This research framework is summarized in Figure 1 [Figure 1: see original paper].

Figure 1. Overall Research Framework

3.1 Research Direction 1: Influence Mechanisms of Human-Machine Collaborative Augmented Business Information Management Decision-Making

To accelerate the organizational adoption of human-machine collaborative augmented business information management decision-making, this study examines how different designs of human-machine collaborative modes and augmented decision-making system functions can enhance managers' perceptions of "creation" and "use" of the decision-making system from the perspective of user behavioral mechanism theory, thereby satisfying their self-determination needs and improving their adoption intention.

3.1.1 Research Direction 1a: Influence of Human-Machine Collaborative Mode Design on Technology Readiness

Technology readiness refers to people's propensity to embrace and use new technologies to achieve goals in both family life and work [**?**, **?**], and also serves as an indicator for measuring technology development maturity. In recent years, the role of technology in organizations and the number of technology-based products and services have grown rapidly. Generally, when a new technology is invented, it is not easily implemented in a real system because popularizing new technologies requires extensive practical testing and iterative improvement. From an evaluation perspective, although positive and negative emotions toward technology may coexist, the relative dominance of these emotions may vary across individuals, and the combination of positive and negative emotions toward technology forms the foundation of technology readiness [**?**, **?**]. From an assessment standpoint, technology readiness comprises four sub-dimensions: (1) **Optimism**—positive views about new technology, believing it can improve people's control, flexibility, and life efficiency; (2) **Innovativeness**—the tendency to become technology pioneers and leaders; (3) **Discomfort**—a feeling of lacking control over technology and being overwhelmed by it; and (4) **Insecurity**—distrust of technology, primarily concerns about its potential harmfulness

and doubts about its work capabilities [**?**, **?**].

When designing human-machine interaction collaborative modes, we constructed four design elements according to the importance and controllability of "human" versus "machine" in human-machine collaborative augmented business information management decision-making: communication style design, interface design, task design, and intelligence level design. Each design aims to enhance managers' perception of "creation" regarding the management decision-making system.

In **communication style design**, servant-style communication can enhance control perception, while friend-style communication can establish a shared relationship between managers and machines, enhancing their cooperation intention. Additionally, presenting more leadership-related self-affirmation information can increase trust, thereby enhancing managers' optimism and innovativeness perceptions while reducing their insecurity and discomfort.

In **interface design**, managers should be granted autonomy to correct and optimize decisions, improving their control and work efficiency. Alternatively, personalized interface design can enhance the fit between the machine and the leader's self-identity. The former can improve managers' optimism and innovativeness, while the latter can reduce their negative perceptions of insecurity and discomfort toward new technologies.

In **task design**, smaller management decision-making tasks can increase user control and task flexibility, thereby enhancing managers' optimism perception. Such granular tasks can also reduce users' distrust of human-machine collaboration and concerns about potential consequences, decreasing managers' insecurity. Additionally, annotating managers' management thinking into machine-recognizable language demonstrates uniqueness and advancement, allowing managers to perceive innovativeness while also increasing their sense of belonging and reducing discomfort.

In **intelligence level design**, proprietary intelligence display should replace superintelligence display, enabling managers to maintain their sense of control and leadership perception even when making decisions with machines, reducing the sense of oppression from technology and increasing positive perceptions of technology readiness while decreasing negative perceptions.

Therefore, this study posits that these four aspects of human-machine collaborative mode design may increase managers' trust in human-machine collaborative augmented decision-making systems, generating optimism and innovativeness while reducing discomfort and insecurity, eliminating doubt and concern. In other words, this explores the influence of these functions on managers' technology readiness from the "creation" perspective.

Research Proposition 1a: The four designs of human-machine collaborative mode can increase the optimism and innovativeness dimensions of managers'

technology readiness perception while potentially reducing the discomfort dimension and enhancing security perception.

3.1.2 Research Direction 1b: Influence of Augmented Decision-Making System Function Design on Technology Acceptance

With the development of information technology, the Technology Acceptance Model has become one of the most influential models for studying consumer acceptance and use of information technology or systems. The Technology Acceptance Model explains users' degree of technology acceptance [**?**, **?**] and has been widely applied to evaluate acceptance of various information technologies. The model provides a theoretical foundation for research on new technologies and systems such as Internet technology and e-commerce websites, positing that users' evaluation and use of information technology depend primarily on two factors: perceived ease of use and perceived usefulness [**?**, **?**]. Dishaw and Strong (1999) argued that attitude and behavior are integrated; users' attitudes toward a new technology are jointly determined by their perceived ease of use and perceived usefulness of the technology. Particularly in consumer behavior research on online marketing, many researchers have analyzed the influence of consumers' perceived usefulness and ease of use on their online shopping behavior [**?**, **?**, **?**, **?**].

When designing functions for augmented decision-making systems, consistent with the design philosophy of human-machine collaborative modes, we gradually transformed from "human" functions to "machine" functions, sequentially designing joint decision-making functions, iterative optimization functions, environmental cognition functions, knowledge update functions, and big data deep mining functions to enhance managers' perception of "use" regarding the management decision-making system.

Joint decision-making function serves as the foundational function of this decision-making system, organically integrating experience-centered supportive decision-making with data-centered automated decision-making into a collaborative function that works with managers. Through this function, managers can perceive support and efficiency improvements from the decision-making system, thereby perceiving ease of use and usefulness.

Iterative optimization decision-making function primarily accomplishes rapid iteration and optimization of decision-making data and information, simplifying the summarization of decision-making experience and feedback of results, improving managers' decision-making accuracy, and increasing their perception of ease of use and usefulness.

Environmental cognition function helps managers understand the complex and ever-changing business environment by investigating, organizing, and analyzing it, preventing managers from being disturbed by extraneous information

during decision-making. This function also allows managers to experience the system's ease of use and usefulness.

In the **knowledge update function**, the emphasis is on the accumulation and transformation from information to knowledge and then to wisdom. Machines no longer simply provide basic business decision-making information but endow managers with decision-making wisdom, enhancing their decision-making capabilities and consequently bringing perceived ease of use and usefulness.

In the **big data deep mining function**, the "machine" role of artificial intelligence and big data is most evident. It can extract valuable data from large, random, noisy datasets using various methods such as neural network algorithms and genetic algorithms, and then interpret, evaluate, and classify the data to help managers obtain potential, valuable, superior, and comprehensible information results. Therefore, this function is both easy to use and useful in the decision-making process.

Thus, this study attempts to increase managers' technology acceptance perception—namely, perceived usefulness and perceived ease of use—by designing these five functions of augmented decision-making systems, exploring the influence of augmented decision-making functions on managers' usage perception from the "use" perspective.

Research Proposition 1b: The five functional designs of augmented decision-making systems can enhance managers' perceived ease of use and perceived usefulness of technology acceptance.

3.1.3 Research Direction 1c: Influence of Technology Readiness and Technology Acceptance on Managers' Self-Determination Needs

Based on Self-Determination Theory, individual intrinsic motivation is related to the social environment [**?**, **?**]. Self-determination generally refers to free behavioral choices made by individuals based on full understanding of environmental information and their own needs. SDT proposes that people have three most basic psychological needs: autonomy (the need to experience self-direction and personal endorsement in behavior), competence (the need to feel effective in interaction with the environment), and relatedness (the need to feel meaningful connections with others) [**?**, **?**]. If individuals' basic psychological needs for autonomy, competence, and relatedness are undermined by an inadequate social environment, negative consequences such as feeling controlled, alienated, and estranged will emerge. Conversely, if the environment and relationships strongly support autonomy, they will further facilitate the cultivation of personal intrinsic preferences and intrinsic motivational resources.

Users' autonomy experiences originate from the environment, such as personal will, expressing opinions, and taking initiative. When individuals have a high

degree of self-determination in an activity, they can experience internal attribution, feeling mastery over their behavior, which generates higher internal motivation. The optimism and innovativeness dimensions of technology readiness—two "drivers"—stem from users' sense of control and proactive intention toward new technologies [**?**, **?**, **?**], while discomfort and insecurity—two "inhibitors"—represent users' feelings of loss of control and distrust toward technology. Therefore, the "drivers" and "inhibitors" of technology readiness may respectively increase and decrease the satisfaction of users' autonomy needs. Additionally, perceived usefulness (users' perception of work efficiency improvement) and perceived ease of use (users' perceived difficulty of using new technology) in the Technology Acceptance Model both help users establish a sense of mastery and increase autonomy experiences.

Competence need aligns with Bandura's self-efficacy concept, representing individuals' beliefs about their ability to act and learn to reach a certain level, trusting that they can be competent in the activity. Appropriate and effective challenges can maximize motivation. Optimism in technology readiness includes users' perceptions of convenience and efficiency [**?**, **?**, **?**], while innovativeness represents users' experience of feeling like technology pioneers and leaders. Both greatly satisfy users' competence needs. Conversely, discomfort derived from technology stress and insecurity stemming from doubts about technology's work capabilities undermine users' competence needs, creating negative effects. Perceived ease of use and perceived usefulness in technology acceptance effectively increase users' self-efficacy, generating stronger competence experiences.

Relatedness need represents the understanding, care, and support individuals require from others or their surroundings, generating a sense of belonging. Under such circumstances, people generally have stronger self-regulation abilities and autonomous motivation. Optimism perception in technology readiness brings support and control perceptions to users [**?**, **?**], and innovativeness allows users to experience control and belonging in specific domains, both satisfying users' relatedness needs. Conversely, discomfort from lack of belonging control and insecurity from concerns about new technologies' harmful consequences undermine users' relatedness needs. Simultaneously, perceived ease of use (representing users' mastery of new technology) and perceived usefulness (representing the degree of usefulness of new technology in users' work) also enhance users' sense of belonging to their work tasks.

Therefore, this study argues that optimism and innovativeness in technology readiness may increase managers' self-determination need satisfaction, while discomfort and insecurity may decrease it. Perceived ease of use and usefulness in technology acceptance will enhance managers' self-determination need satisfaction.

Research Proposition 1c: The optimism and innovativeness dimensions of technology readiness can positively influence managers' self-determination needs, while discomfort and insecurity may negatively influence these needs.

Perceived ease of use and usefulness of technology acceptance may positively influence managers' self-determination needs.

3.1.4 Research Direction 1d: Influence of Managers' Self-Determination Needs on Management Decision-Making Adoption Intention

Research Proposition 1c hypothesizes that managers' autonomy, competence, and relatedness needs are positively affected by the optimism and innovativeness dimensions of technology readiness and negatively affected by discomfort and insecurity, while also being positively influenced by perceived ease of use and usefulness of technology acceptance. As the three most fundamental human needs and core content of Self-Determination Theory, these needs constitute components of individual intrinsic motivation. Intrinsic motivation is also the form of motivation with the highest degree of individual self-determination [**?**, **?**, **?**]. If individuals have very high self-determination, they develop strong interest in a particular behavior and generate firm confidence to challenge it [**?**, **?**]. In other words, higher self-determination positively predicts user engagement, susceptibility, learning tendency, and effectiveness of coping strategies [**?**, **?**, **?**, **?**]. In information systems research, many scholars believe that satisfying this intrinsic motivation will stimulate stronger intentions to purchase and continuously use an Internet product [**?**, **?**, **?**]. Additionally, Roca and Gagné (2008) found a positive correlation between self-determination needs and job satisfaction.

Through the above reasoning, this study maintains that when managers perceive that the "creation" (technology readiness) and "use" (technology acceptance) brought by human-machine collaborative augmented business information management decision-making systems satisfy their autonomy, competence, and relatedness needs, their intrinsic motivation will be stimulated, generating adoption intention for human-machine collaborative augmented business decision-making.

Research Proposition 1d: The satisfaction of managers' self-determination needs may increase their adoption intention for human-machine collaborative augmented management decision-making.

3.2 Research Direction 2: Contingency Factors Moderating the Influence of Technology Readiness and Technology Acceptance on Managers' Self-Determination Needs

In Self-Determination Theory research, Deci et al. (1980) proposed that intrinsic motivation is generated based on individuals' internal psychological needs, while satisfying external needs produces extrinsic motivation, which is initiated by external environmental factors of the activity [**?**, **?**]. If the external environment

damages autonomy and competence needs, individuals will experience strong feelings of incompetence and being controlled, which reduces their intrinsic motivation and thus decreases self-determination need satisfaction. Conversely, if the external environment satisfies or does not undermine employees' basic psychological needs, intrinsic motivation will be enhanced or not reduced, and self-determination needs will be enhanced or not reduced [**?**, **?**]. For example, Deci (1971) proposed that when external rewards with strong controlling properties (such as money) are used, employees' intrinsic motivation is likely to be reduced. However, if external rewards take the form of positive verbal feedback that enhances competence and autonomy, employees' intrinsic motivation is likely to be enhanced. In other words, extrinsic motivation formed by individuals under external environmental influence can affect their intrinsic motivation, thereby affecting self-determination need satisfaction [**?**, **?**]. Researchers have identified from these external environments that threatening punishment [**?**, **?**], deadlines [**?**, **?**], mandatory goals [**?**, **?**], and competition [**?**, **?**] all affect individuals' extrinsic motivation and weaken intrinsic motivation. Evidently, external events that satisfy people's competence, autonomy, and relatedness needs—such as rewards, positive feedback, freedom from degrading evaluation, and reduced separation—can all enhance intrinsic motivation for individual behavior. Therefore, this study proposes that four organizational contingency factors (external environments)—transformational leadership style, autonomous organizational climate, organic organization type, and personalized decision-making context—may facilitate the influence of technology readiness and technology acceptance on managers' self-determination needs.

Regarding leadership style, Bono and Judge (2003) found that transformational leaders enhance employees' work autonomy, excel at improving group identity, and increase employees' self-efficacy, effectively connecting individual values with organizational values. Consequently, subordinates of transformational leaders more easily satisfy their autonomy, relatedness, and competence needs, demonstrating higher job satisfaction and emotional attachment to the organization [**?**, **?**, **?**]. Therefore, we believe transformational management style can positively moderate the influence of technology readiness and technology acceptance on managers' self-determination needs.

Regarding organizational climate, Deci et al. (1981) experimentally studied the importance of autonomy support in workplaces, finding that autonomy-supportive organizations increase employees' control over work tasks, enhance self-efficacy during task execution, improve satisfaction with the work environment, increase trust in senior management, reduce perceived control and stress, and provide more sense of belonging. Therefore, autonomous organizational climate may positively moderate the influence of technology readiness and technology acceptance on managers' self-determination needs.

Regarding organization type, organic organizations are highly adaptive and flexible, primarily pursuing innovation through dynamic adaptation. Communication among members is collaborative, information exists in a decentralized and

shared form, and the organization emphasizes members' subjective initiative and autonomy regarding work tasks [**?**, **?**]. Therefore, organic organization type may positively moderate the influence of technology readiness and technology acceptance on managers' self-determination needs.

Regarding decision-making context, Gagné and Deci (2005) found that in personalized decision-making contexts, providing relevant information and choices in non-controlling ways and encouraging self-initiation leads to higher autonomy and initiative, greater subjective well-being, stronger organizational trust, and more stable commitment. Therefore, personalized decision-making context may positively moderate the influence of technology readiness and technology acceptance on managers' self-determination needs.

Research Proposition 2: Among organizational contingency factors, transformational leadership style, autonomous organizational climate, organic organization type, and personalized decision-making context may positively moderate the influence of technology readiness and technology acceptance on managers' self-determination needs.

Overall, because machines surpass humans in big data computing and analytical capabilities and most rational abilities, managers' self-determination needs as individuals face serious threats, often leading to resistance toward machines in human-machine collaboration. Based on this, this study will deeply investigate the following questions: (1) Can human-machine collaborative mode design enhance the perception of "creation" in management decision-making systems, i.e., enhance managers' perception of technology readiness? (2) Can augmented decision-making system function design enhance the perception of "use" in management decision-making systems, i.e., enhance managers' perception of technology acceptance? (3) Can enhanced technology readiness and technology acceptance satisfy managers' self-determination needs, i.e., meet their autonomy, competence, and relatedness needs? (4) Can managers' self-determination needs influence their adoption intention for management decision-making? (5) How do contingency factors such as managers' leadership style, organizational climate, organization type, and decision-making context interfere with the process through which technology readiness and technology acceptance affect self-determination needs?

4.1 Theoretical Contribution: A Self-Determination Theory-Based Adoption Model for Human-Machine Collaborative Augmented Decision-Making Systems

This study explores factors influencing managers' adoption intention for human-machine collaborative augmented business information management decision-making based on Self-Determination Theory. In enterprise management, managerial decision-making is crucial for organizational development, and increas-

ingly complex external environments make timely and correct decisions even more important. Simultaneously, managerial decision-making places high demands on individual capabilities, representing both an important arena for individuals to demonstrate competence and quality and a significant opportunity to pursue self-expression and personal goals. Therefore, in organizational management decision-making processes, individuals also desire opportunities to demonstrate their wisdom and capabilities to achieve personal pursuits. Moreover, individuals are born with self-determination needs; their behavioral decisions represent both external manifestations of intrinsic motivation and needs and pathways to satisfying intrinsic motivation and needs [**?**, **?**].

Empowered by new technologies such as the Internet, Internet of Things, data science, and artificial intelligence, the paradigm of organizational business information management decision-making is undergoing profound upgrades and development, gradually shifting toward human-machine collaborative augmented business information management decision-making paradigms. Although this transformation generates substantial economic benefits, machines are no longer simple tools but have become teammates working closely with managers. Since machine behavior is often elusive [**?**, **?**], ambiguous [**?**, **?**], and potentially erroneous [**?**, **?**], becoming teammates with them simultaneously reduces users' control levels [**?**, **?**], makes decisions unexplainable [**?**, **?**], decreases self-focus [**?**, **?**], and undermines users' self-categorization and identity [**?**, **?**]. Therefore, in the decision-making process, it is necessary to gradually explore reasonable division methods within the collaboration scope, and certain adjustment, probing, or even competition may be required between the two parties to achieve an ideal cooperation model. In other words, even though machines can improve decision-making efficiency, individuals' psychological needs remain the primary consideration that cannot be ignored. This study argues that Self-Determination Theory can help address users' psychological needs issues in human-machine collaborative management decision-making.

Because the human self plays an important role in motivation formation, behavior is formed based on the satisfaction of people's intrinsic psychological needs [**?**, **?**]. Only when intrinsic psychological needs are satisfied will people develop beneficial and interesting behaviors, such as adoption and usage intentions. Therefore, the key to the problem lies in how to satisfy users' three basic self-determination needs: autonomy, competence, and relatedness.

In computer system design, it is necessary to combine "technology" and "people"—that is, system design should maximize the role of new technology while considering users' habits and feelings during use. Therefore, the Technology Acceptance Model and Technology Readiness Index can serve as important indicators for examining usage intention in human-machine collaborative augmented business information management decision-making. These two models have long been widely used to explain and predict user acceptance of information systems or new technologies [**?**, **?**, **?**, **?**, **?**]. In other words, human-machine collaborative augmented business information manage-

ment decision-making requires systematic design that first aligns with users' perceptions of technology acceptance and readiness and, more importantly, satisfies users' self-determination needs, thereby enhancing managers' adoption intention for human-machine collaborative augmented business information management decision-making and facilitating the promotion of this paradigm.

Consequently, this study constructed four design elements in human-machine collaborative mode design according to the importance and controllability of "human" versus "machine" in human-machine collaborative augmented business information management decision-making: communication style design, interface design, task design, and intelligence level design. Each design aims to generate optimism and innovativeness while reducing discomfort and insecurity, providing managers with a perception of "creation" regarding technology readiness. Simultaneously, in augmented decision-making system function design, we sequentially designed joint decision-making functions, iterative optimization functions, environmental cognition functions, knowledge update functions, and big data deep mining functions to increase managers' technology acceptance perception—namely, perceived usefulness and ease of use—thereby enhancing their perception of "use" regarding technology acceptance. As technology readiness "creation" and technology acceptance "use" are enhanced—through increased optimism and innovativeness, reduced discomfort and insecurity, and enhanced perceived usefulness and ease of use—managers can experience greater behavioral mastery [?, ?], self-efficacy [?, ?, ?], and supportive control perception [?, ?], thereby satisfying autonomy, competence, and relatedness needs. At this point, managers' intrinsic motivation will be stimulated, generating adoption intention for human-machine collaborative augmented business decision-making [?, ?, ?].

Additionally, this study explores which organizational contingency factors influence the activation of managers' self-determination needs by technology readiness and technology acceptance. Since external environmental events such as threatening punishment [?, ?], deadlines [?, ?], mandatory goals [?, ?], and competition [?, ?] all affect individuals' extrinsic motivation and weaken intrinsic motivation, while external events that satisfy people's competence, autonomy, and relatedness needs can enhance intrinsic motivation, this study speculates that transformational leadership style, autonomous organizational climate, organic organization type, and personalized decision-making context may provide higher autonomy, efficacy, and belonging, thereby facilitating the influence of technology readiness and technology acceptance on managers' self-determination needs.

Overall, this study attempts to establish a theoretical model through Self-Determination Theory, systematically optimizing human-machine system decision-making mode design to enhance perceptions of "creation" and "use" in management decision-making systems, satisfying managers' self-determination needs, increasing their adoption intention for human-machine collaborative augmented business information management decision-making, thereby accelerating the promotion of this paradigm in organizations and reducing managers'

potential resistance.

4.2 Practical Implications: Pathways to Promote Managers' Acceptance of Human-Machine Collaborative Augmented Decision-Making

Currently, the mainstream decision-making models in most organizational enterprises remain decision-support or algorithmic-automation types. Constructing human-machine collaborative augmented decision-making paradigms represents an important task for contemporary organizations [**?**, **?**, **?**, **?**, **?**, **?**]. Particularly at the manager level, how to effectively promote the use of human-machine collaborative augmented paradigms in organizational practice and achieve organic integration with organizational decision-making remains a key research issue in behavioral decision-making [**?**, **?**]. Therefore, how to enhance managers' adoption intention for human-machine collaborative augmented business information management decision-making has become a question of significant practical value.

This study proposes that, influenced by self-determination needs, managers may exhibit resistance behaviors toward this decision-making paradigm when using human-machine collaborative augmented business information management decision-making. Therefore, the research systematically designs human-machine collaborative augmented business information management decision-making to address managers' self-determination needs. First, it considers managers' perceptions of technology readiness "creation" and technology acceptance "use" regarding new technologies. Specifically, through human-machine collaborative mode design (task design, interface design, communication style design, and intelligence level design), it enhances the innovativeness and optimism of technology readiness while reducing insecurity and discomfort perceptions. Simultaneously, through augmented decision-making system function design (joint decision-making, iterative optimization, environmental cognition, knowledge update, and big data deep mining functions), it strengthens the perceived usefulness and ease of use brought by the decision-making system. The enhancement of these two perceptual dimensions subsequently satisfies managers' self-determination needs [**?**, **?**, **?**, **?**, **?**, **?**, **?**].

Regarding organizational contingency factors that influence extrinsic motivation affecting self-determination needs, this study proposes that external events satisfying people's competence, autonomy, and relatedness needs—such as rewards, positive feedback, freedom from degrading evaluation, and reduced separation—can all enhance intrinsic motivation for individual behavior. Therefore, it recommends that promoting human-machine collaborative augmented business information management decision-making under four contingency factors—transformational leadership style, autonomous organizational climate, organic organization type, and personalized decision-making context—may

achieve twice the result with half the effort.

In summary, this study attempts to use Self-Determination Theory to systematically optimize the design of human-machine collaborative augmented business information management decision-making modes and functions, increasing managers' perceptions of "creation" (Technology Readiness Index) and "use" (Technology Acceptance Model) to satisfy their self-determination needs, thereby improving their adoption intention for human-machine collaborative augmented business information management decision-making and effectively promoting the use of this paradigm in organizational practice.

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