The Formation and Influence Mechanism of Service Robot-Work Environment Matching

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Abstract

The rapid development of artificial intelligence and robotics technology has enabled enterprises to apply robots to create value for customers; however, numerous instances of robots causing service failures and subsequently being decommissioned or left idle have also emerged. Existing research has primarily focused on analyzing the influence mechanisms of service robots on customers and employees, while seldom attending to their fit with the working environment. Grounded in person-environment fit theory, this study proposes the concept of service robot-work environment fit and attempts to explore its connotative structure and measurement methods. It investigates the antecedents of service robot-work environment fit from various perspectives, as well as the dual-path influence mechanism through which fit impacts both employee value creation and customer value creation. The anticipated research findings will contribute to advancing service robot theory and provide guidance for specific management issues confronting enterprises in the intelligent era, such as human-robot collaboration, value co-creation, and intelligent transformation.

Full Text

The Formation and Impact Mechanism of Service Robot-Work Environment Fit

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Abstract: The rapid advancement of artificial intelligence and robotics technology has enabled businesses to deploy robots to create value for customers. However, issues such as service failures caused by robots, forced decommissioning, and underutilization remain prevalent. Existing research has primarily focused

on the impact mechanisms of service robots on customers and employees, with little attention given to their fit with the work environment. Grounded in person-environment fit theory, this study proposes the concept of service robot-work environment fit, explores its connotative structure and measurement methods, and investigates its antecedents from multiple perspectives. Furthermore, it examines the dual-path impact mechanism of service robot-work environment fit on employee value and customer value creation. The anticipated findings are expected to advance the theoretical development of service robots and provide guidance on specific management challenges faced by enterprises in the intelligent era, including human-robot collaboration, value co-creation, and intelligent transformation.

Keywords: service robot; value co-creation; value co-destruction; person-environment fit theory
Classification Numbers: B849; C936

1. Problem Statement

Service robots are increasingly deployed in management practice, liberating employees from repetitive transactional tasks, improving organizational efficiency, reducing labor costs, and delivering novel service experiences to customers (Liu, Zhang, et al., 2024). However, robots can also cause service failures. For instance, check-in robots in hotel lobbies may malfunction; in-room assistant robots may repeatedly wake guests due to snoring sounds; and customers may perceive robot-prepared dishes as lacking "wok hei" and "soul." Chain restaurants such as "Heweilai" and "Xiaolongwang" have witnessed waves of robot layoffs, while Japan' s fully automated Henn-na Hotel dismissed over half of its robotic staff after managers realized that a completely robotized "workforce" failed to meet customer service expectations and actually increased the workload for human employees. Organizations find themselves unable to leverage robots to improve service quality and efficiency while simultaneously struggling to maintain the emotionally caring and warm service that the industry prides itself on. In many service contexts, emotional communication constitutes an essential component of service, making human-robot collaboration the dominant future of the industry (Simon et al., 2020). The insufficient adaptation or systematic misalignment between service robots and work scenarios poses non-negligible challenges for business operations and management. How to promote the fit between service robots and work environments to fully leverage their advantages and achieve value co-creation represents an urgent practical problem for managers.

Academic research on service robots has examined their definition and distinguishing features from industrial robots (Wirtz et al., 2018), with primary focus on robots' impact on customers (e.g., Guan, Zhang, et al., 2025; Yan et al., 2025) and emerging attention to employee-robot interactions (e.g., 刘欣, 谢礼珊, 2025; Guan, Zheng, et al., 2025; Liu, Zhang, et al., 2024). Despite these contributions, existing research exhibits limitations in focus, orientation, and perspec-

tive. First, studies concentrate on service robots themselves while neglecting their fit with the work environment. Research has yet to provide clear answers regarding what aspects of "compatibility" between service robots and work environments are necessary to achieve goals such as liberating employees, reducing organizational costs, and delivering services that combine high emotional and high-tech features. Second, research emphasizes impact mechanisms over organizational interventions. While clarifying how robots influence customer cognition, emotion, and behavior, studies fail to address how to more effectively leverage service robots and overlook organizational agency in the human-robot value co-creation process. Third, the predominant customer-centric perspective leaves employee-robot interaction research underdeveloped (刘欣, 谢礼珊, 2025), with scarce analysis of multi-actor interactions and their impact on value co-creation. Critical questions remain unresolved: Can service robot applications enable employees to devote more time and energy to personalized, professional, creative, and emotionally engaging deep services? Can employees successfully complete role transformations? Do customers receive warmer service from employees alongside novel experiences from robots?

This study first proposes the concept of service robot-work environment fit based on person-environment fit theory, examining its connotative structure from the perspectives of different interaction actors and exploring the formation mechanism of fit under the influence of robot characteristics and work design features from a value co-creation perspective. It further investigates the dual-path impact mechanism of fit on employee value and customer value creation. The core research question addresses the connotative structure, antecedents, and impact mechanisms of service robot-work environment fit. The findings will theoretically supplement and enrich service robot theory while practically guiding management issues concerning human-robot collaboration and value co-creation in robot-adopting service enterprises.

2.1 Definition and Characteristics of Service Robots

Service robots are machine entities that perform effective service tasks for humans or equipment, excluding industrial automation applications. Compared with industrial robots, service robots feature autonomy, adaptability, and flexibility, enabling them to interact, communicate, and exchange with employees, customers, and other actors (Wirtz et al., 2018). This definition distinguishes service robots from artificial intelligence and smart devices. While AI focuses on programs and algorithms rather than hardware—endowing robots with autonomous, flexible, and interactive attributes—its lack of physical form means it is not a service robot (Jörling et al., 2019). Smart speakers and wearable devices, though possessing physical forms, cannot work autonomously, as autonomy requires planning actions based on environmental conditions (Tuomi et al., 2021). Only machine entities with physical bodies, high autonomy in work, flexible responsiveness and adaptation to environments, and the capacity to assist customers and organizations in completing service tasks qualify as service robots.

They can use sensors to collect input data, analyze it immediately, formulate plans, and execute decisions using physical actuators. More complex service robot systems can also learn from previous interactions, adapt, and optimize future behavior.

Although foundational research has established our understanding of service robots and their characteristics, the fit between service robots and work environments has become increasingly salient as more service enterprises introduce robots, leading to problems such as ineffective customer experience enhancement, unmet customer needs, and additional work burdens for employees. However, academic research remains focused on service robots themselves and their characteristics, analyzing their impact on customers and employees while rarely addressing the fit relationship between service robots and work environments, let alone its measurement and quantitative investigation.

2.2 Research on Service Robots' Impact on Customers

Service robots influence customer evaluations and behavioral intentions by affecting customer cognition and emotion. Research has found that surface-level features such as robot appearance (anime-like, animal-like, human-like) (Milman et al., 2020; Yoganathan et al., 2021), anthropomorphism (Han et al., 2023; Xie & Lei, 2022), naming (El Halabi & Trendel, 2025), language style (Choi et al., 2019; Lu et al., 2021; Yan et al., 2025), voice pitch (Liu, Yin, et al., 2024), cuteness (Lv et al., 2021), coolness (Cha, 2020), and gender (Seo, 2022) affect customer attitudes toward service robots. Deep-level features such as robot competence (Guan et al., 2022; Guan, Zhang, et al., 2025), intelligence type (Schepers et al., 2022), social interactivity (Kim et al., 2022), service proactivity (Xie, C. Liu, & Li, 2022), and empathy (de Kervenoael et al., 2020) also influence customers. Customer demographic characteristics including gender, age, and prior experience affect human-robot interaction (Ayyildiz et al., 2022; Cha, 2020; Lee & Yen, 2023; Loureiro et al., 2021; Wang & Papastathopoulos, 2024), as do customer innovativeness (Kim et al., 2021), motivation (Hwang et al., 2020), and service expectations (Lee et al., 2021; Lv et al., 2021). These factors influence customer trust in service robots (Tussyadiah et al., 2020), responsibility attribution for service outcomes (Jörling et al., 2019), perceived service value and experience (de Kervenoael et al., 2020; Qiu et al., 2020; Mcleay et al., 2021), and subsequently affect co-creation intention (Xie, X. Liu, & Li, 2022), robot usage intention (Lin et al., 2022), customer loyalty (Belanche et al., 2021), compensatory consumption behavior (Mende et al., 2019), word-of-mouth (Guan, Zhang, et al., 2025; Santiago et al., 2024), recommendation intention (Yang et al., 2024), and purchase intention (Song & Luximon, 2021).

Robots do not always exert positive effects on customers. Their autonomous actions in open and changing environments can lead to errors such as sensor anomalies, mechanical and computational failures, and failure to respond to environmental changes (Cameron et al., 2021), thereby reducing customer evaluations of robot capability and reliability and diminishing willingness to use them.

For service failure recovery, robots can employ strategies including apologizing, explaining error causes, seeking help, and promising improvement, which affect customer evaluations of robot likability, capability, and warmth, as well as usage intention (Cameron et al., 2021; Choi et al., 2021). Different service recovery actors (employees, peer customers, robots) also influence customer evaluations of service experience through perceived role consistency (Ho et al., 2020).

While these studies have laid the foundation for understanding how service robots affect customers, achieving value co-creation among customers, employees, and robots depends on organizations' ability to effectively redesign service processes, reshape service teams, and provide support (Xiao & Kumar, 2021). Redesigning service processes requires clarifying which tasks employees and robots respectively perform and how they achieve seamless collaboration. Reshaping service teams involves hiring appropriate robots and human employees, ensuring robots function properly in various service contexts, fostering human employees'willingness to work with robots, and enabling them to handle complex service issues beyond robots' capabilities. Support activities include educating and training employees and customers, communicating that robots are intended to enhance rather than replace employees, allowing employees to decide how to interact with robots, and continuously testing and updating robot hardware and software to improve service capabilities. However, existing research focuses more on robots' surface and deep features while neglecting organizational agency in creating favorable work environments and promoting human-robot interaction. In human-robot value co-creation contexts, good fit between service robots and work environments necessitates active organizational intervention.

2.3 Research on Service Robots' Impact on Employees

The deployment of service robots has both negative and positive effects on employees' psychology and behavior. Regarding negative impacts, robots joining work teams reduce employees' team identification, with the term "robot" itself triggering negative emotions among service employees who believe service robots will increase unemployment. Factors including robots' inauthentic anthropomorphism, low usability, excessive workload, technological insecurity, and technological uncertainty cause employees to resist continuous robot usage (Fu et al., 2022) and reduce willingness to work with robots (Ali et al., 2023). Employees' AI and robotics awareness, job insecurity (such as strong threat and powerlessness perceptions), and work pressure from robot advantages all increase turnover intention (Chen & Cai, 2025; Pan et al., 2025; Zhang et al., 2023). Robotics awareness also negatively affects service innovation behavior through emotional exhaustion (Liang et al., 2022) or reduces organizational commitment, causing burnout and affecting professional competence. Research further indicates that robot anthropomorphism makes employees perceive job security threats, leading them to resist robot deployment and reducing morale (Tojib et al., 2023). Robots' competitive roles negatively affect employee well-being through identity threat and work alienation (刘欣, 谢礼珊, 2025).

Regarding positive impacts, good human-robot interaction experiences foster positive cognition, emotion, and attitudes, including reduced work fatigue, enhanced service enthusiasm, increased motivation (Guan, Zheng, et al., 2025), high human-robot collaboration willingness (Wu & Zhang, 2024), workplace inspiration (Liu, Zhang, et al., 2024), learning tension (Guan et al., 2024), and perceived value (Lin et al., 2024). These further motivate employees to take action, such as seeking help from robots, engaging in job crafting (Song et al., 2022), demonstrating higher work engagement and competitive productivity, more positive behaviors (Wu & Zhang, 2024), in-role and extra-role behaviors (Yang et al., 2024), service innovation behavior (Li et al., 2024), and learning and knowledge management behaviors (Guan et al., 2024; Guan, Zheng, et al., 2025; Liu, Zhang, et al., 2024). Employees' work autonomy increases while turnover intention decreases (Zhang et al., 2023), and their sense of work meaning and well-being improve (刘欣, 谢礼珊, 2025).

Since much service work requires emotional labor, many enterprises integrate robot service with human employee service. This integration creates substantial impacts for different actors. In human-robot value co-creation processes, different stakeholders focus on different concerns: customers emphasize functional and socio-emotional value from robots; employees perceive both costs (such as extended working hours and learning requirements) and benefits (such as increased well-being); and managers focus on organizational costs and benefits, technical learning difficulties and compatibility issues, and potential competitive advantages. Therefore, a dialectical approach is necessary to examine how service robot-work environment relationships affect value creation for different actors.

3. Research Framework

Existing service robot research largely treats robots as objective existences in the workplace, focusing on analyzing their impact on customer cognition, emotion, and behavioral intentions (刘欣, 谢礼珊, 2025). This approach neglects the relationship between robots as service actors and their work environment, failing to explain issues such as enterprises dismissing service robots or robots being idle. It also overlooks the importance of organizations in promoting robots' full potential and ignores the fact that value formation in multi-actor interaction contexts involving employees, service robots, and customers is more complex and variable, with both co-creation and co-destruction possible. Based on these gaps, this study proposes the concept of service robot-work environment fit, examining its influencing factors from two perspectives—robot characteristics and work design features—while simultaneously investigating how this fit affects value creation for both internal and external customers (i.e., employees and customers). Specifically, after clarifying the theoretical foundation, connotative structure, and measurement of service robot-work environment fit, this study constructs an antecedents and consequences model, analyzing the formation mechanism of fit, clarifying its role in employee and customer value creation, and exploring

mediating and boundary conditions.

3.1 Theoretical Foundation, Connotative Structure, and Scale Development of Service Robot-Work Environment Fit

Service robot-work environment fit is proposed based on person-environment fit theory, the service encounter triad, and compatibility and fit concepts. Person-environment fit theory emphasizes compatibility between individuals and environments (Kristof, 1996). When personal attributes align with environmental characteristics, individuals hold positive attitudes and successfully complete tasks, meaning fit produces positive outcomes. As a new type of "employee" in organizations, service robots also face fit issues with work environments. The service encounter triad (shown in left panel of Figure 1 [Figure 1: see original paper]) identifies three key elements in service delivery: the service organization, contact personnel, and customers (Bitner, 1995). When enterprises introduce autonomous, adaptable, and flexible service robots into the workplace, traditional dyadic customer-employee (or organization) interactions shift to triadic interactions among customers, employees, and service robots, or even more complex multi-actor interaction patterns (Odekerken-Schröder et al., 2021) (shown in right panel of Figure 1), indicating that service robot-work environment fit is a complex, multidimensional concept. Compatibility emphasizes that innovative technology must align with users' preferred work styles, past experiences, needs, and values (Karahanna et al., 2006). Additionally, scholars have noted robot fit issues. For example, Choi et al. (2022) proposed perceived fit to measure the alignment between new technology adoption and hotel brand image; McLeay et al. (2021) proposed perceived innovation-responsibility fit to describe customers' perceptions of apparent inconsistencies between cutting-edge technology (such as AI) innovation aspects and service providers'ethical and social responsibilities. Work fit and career fit issues exist between employees and robots (Xiao & Kumar, 2021), and robots must also fit service concepts and tasks (Tuomi et al., 2021). Based on these foundations, this study defines service robot-work environment fit as the degree of alignment and compatibility between service robots and work environments in human-robot interaction service contexts. It includes fit with service enterprises' positioning, brand, strategic development, and work tasks, as well as fit with interacting employees and customers, encompassing both complementarity-based fit from feature consistency and compatibility-based fit from feature complementarity.

This study presumes that service robot-work environment fit comprises three dimensions from the perspectives of organizations, employees, and customers who interact with service robots: (1) **Service robot-organization fit** refers to the extent to which service robots align with organizational positioning, brand, strategic development, and work tasks. When introducing robots, enterprises expect cost reduction, service efficiency improvement, and better customer experiences. Therefore, from the organizational perspective, service robots must

fit brand image and work tasks, ensuring their technical knowledge and capabilities meet specific job requirements while their appearance and internal features enhance brand image and develop competitive advantages. (2) **Service robot-frontline employee fit** refers to compatibility between service robots and frontline employees in work contexts, often occurring when robots align with employees' current work styles, preferences, and needs, or when their knowledge, technology, and capabilities complement each other. For robots to function effectively in workplaces, they must cooperate well with employees to co-create value for customers. From the employee perspective, this requires both compatibility with existing work habits and reasonable division of labor with complementary advantages, allowing each to leverage their strengths. (3) **Service robot-customer fit** refers to compatibility between service robots and served customers during service processes. This fit may be surface-level, such as gender—Seo et al. (2022) found that hotel customers exhibit higher pleasure and satisfaction with female-gendered service robots than male-gendered ones—or deep-level, such as communication style fit and knowledge compatibility.

This classification is based on the service encounter triad, indicating that service robots must achieve fit with different actors in the work environment. Fit structure research could also consider relationships between robot attributes (e.g., mechanical or emotional) and work environment attributes (e.g., simple or complex) to identify different fit types. In contexts where enterprises introduce service robots as new "employees," the specific contents and unique manifestations of service robot-work environment fit require further exploration through qualitative research. This study conducts in-depth interviews with managers, frontline employees, and customers in service enterprises to explore the connotative structure of service robot-work environment fit and develop and validate a measurement scale based on qualitative findings.

3.2 Antecedents of Service Robot-Work Environment Fit

Based on mind perception theory and work design theory, this study constructs a theoretical model of factors influencing service robot-work environment fit and analyzes boundary conditions from organizational characteristics. The conceptual model is shown in Figure 2 [Figure 2: see original paper].

3.2.1 Impact of Robot Surface-Level and Deep-Level Anthropomorphic Features on Service Robot-Work Environment Fit

Mind perception theory posits that people develop mind perception through agency and experience. Agency refers to individuals' capacity to think, reason, plan, and achieve personal intentions, while experience refers to the capacity to have sensations, consciousness, and emotional feelings (Gray et al., 2007; Yoganathan & Osburg, 2024). When non-human agents (such as service robots) exhibit human-like cues—such as natural conversation, a movable body, a head,

two arms and legs, human names and gender, and agency and emotion-related capabilities—the human brain makes associations that activate psychological content related to real humans (Epley, 2018), leading to the perception that the non-human agent possesses a certain degree of mind (Söderlund & Oikarinen, 2021). According to mind perception theory, service robots' surface-level and deep-level anthropomorphic features help employees and customers project or analogize human cognitive and emotional characteristics onto robots (Fiske et al., 2002). People perceive service robots as possessing human-like service resources, generating positive cognitive and emotional responses; conversely, robots that deviate significantly from humans may fail to respond appropriately to actors' emotions, causing negative evaluations and reducing willingness for social interaction (Luo et al., 2019).

Taking anthropomorphism as an example, individuals generally perceive highly anthropomorphic robots as friendlier, more helpful, and more trustworthy, with higher warmth and competence, performing well in functional tasks without serious errors. These features significantly enhance user engagement, positive emotions, and positive robot evaluations. Conversely, people perceive robots lacking authentic anthropomorphic features as lacking empathy, and non-humanoid robots provide less attractive services, leading to resistance toward service robot usage (Fu et al., 2022). Similarly, improving service robots' intelligence level and empathy can enhance actors' trust in robots. Service robots' empathy level influences the relationship between anthropomorphism and perceived usefulness and enjoyment (Shi et al., 2022), and their ability to recognize and proactively respond to customer emotions generates positive evaluations. Based on these arguments, we propose:

Proposition 1: Enhanced (a) surface-level anthropomorphic features (e.g., anthropomorphism) and (b) deep-level anthropomorphic features (e.g., empathy) of service robots promote the formation of service robot-work environment fit.

3.2.2 Impact of Robot-Employee Work Design Features on Service Robot-Work Environment Fit

Work design determines how work tasks are decomposed and which tasks are completed by whom to achieve work coordination and overall task completion. Work design must consider motivational characteristics such as skill variety, task identity, task significance, work autonomy, and feedback (Hackman & Oldham, 1975), as well as social characteristics (e.g., interdependence, interaction outside the organization) (Grant & Parker, 2009) and work context characteristics (e.g., physical environment, work conditions, ergonomics) (Humphrey et al., 2007). These collectively affect overall job performance.

Service robots entering the workplace means integrating robots into employee teams (Wirtz et al., 2018) to achieve human-robot synergy. This requires enterprises to redesign service processes and reshape human-robot service teams (Xiao & Kumar, 2021), such as decomposing work tasks: determining which

tasks are completed by service robots versus human employees; assessing task interdependence and its degree; arranging seamless task integration; and clarifying primary and supportive roles for robots and human employees. If robots exhibit poor work independence and frequently require employee assistance, showing high dependence on human employees' skills, this indicates insufficient intelligence to handle complex tasks (Xie, X. Liu, & Li, 2022). This leads to perceptions of low robot intelligence—that they can only perform simple, routine, and repetitive tasks rather than complex systemic tasks (Wirtz et al., 2018)—hindering service robot-work environment fit and more likely creating additional work burdens for employees and disappointing customers. Research indicates that while customers perceive robot introduction in service environments as innovative, robots working completely independently are perceived as more innovative than those supporting existing employees (McLeay et al., 2021). Based on this, we propose:

Proposition 2: Good robot-employee work design features promote the formation of service robot-work environment fit, while poor work design (e.g., high task dependence on human employees) damages fit formation.

3.2.3 Catalytic Role of Organizations in Fit Formation

Introducing service robots represents an innovative practice of reconstructing service production systems (Mingotto et al., 2021). Robot appearance design must balance anthropomorphism and professionalism, skill configuration must integrate standardized operation modules and dynamic learning capabilities, and enterprises must redesign work for human-robot collaboration (Xiao & Kumar, 2021). This complexity makes service robot-work environment fit essentially an adaptive evolution of an organization-people (including employees and customers)-technology multi-system. Its formation depends not only on robots and work design but also requires deep coupling between organizational strategic goals, resource allocation, and cultural values with robot and work environment characteristics. Based on the new relationships among actors (see Figure 1), organizations can develop strategies or tactics targeting technology, employees, and customers to promote fit formation.

For service robot technology, enterprises need innovation orientation. Innovation orientation enables organizations to acquire market information more rapidly, effectively, and timely and to exploit existing knowledge value to promote innovation activities, thus 被视为提升组织能力、创新绩效和赢得竞争优势的核心动力 (Hurley & Hult, 1998; Ordanini & Parasuraman, 2011). In service robot application contexts, innovation orientation exhibits unique catalytic value beyond traditional work scenarios. It not only represents openness to new ideas and things (Hurley & Hult, 1998) but also constitutes an organizational capability involving strategic choice, organizational adaptation, and resource reconfiguration to promote multidimensional innovation in processes, technology, products, and management (Siguaw et al., 2006). On one hand, enterprises with high innovation orientation more readily accept service robots, 倾向于将其视为创新载体而

非成本中心, thus actively adjusting resource allocation—such as deeply participating in robot appearance design, skill configuration, and iterative optimization to align with brand image and work tasks, even tolerating initial efficiency losses from technical 磨合 to secure long-term advantages. On the other hand, innovation orientation shapes an atmosphere that encourages trial-and-error and risk tolerance (Hurley & Hult, 1998), effectively alleviating anxiety from change and continuous experimentation and driving organizational practice transformation from passive technology adaptation to proactive human-robot ecosystem shaping. Based on this, we propose:

Proposition 3: Organizational innovation orientation plays a positive catalytic role in the formation of service robot-work environment fit, particularly in robot-organization fit.

For employees in changing environments, organizational investment serves as an important catalyst for promoting service robot-frontline employee fit. By providing material rewards and helping employees grow and develop, employees reciprocate organizations based on social exchange and reciprocity principles (Guan et al., 2020). Unlike previous research focusing on organizational investment' s unidirectional motivational effects in dyadic employee-organization relationships (e.g., Guan et al., 2020; Jia et al., 2014), this study examines its unique motivational role in service robot-embedded work contexts: helping employees build resource pools to cope with work environment challenges and stimulate positive behavior. On one hand, material investment—including compensation, human-robot collaboration performance rewards, and special subsidies—directly alleviates employees' economic risk perceptions and technology replacement anxiety, making them more willing to invest resources in learning human-robot collaboration skills and promoting human-robot fit. On the other hand, developmental investment—such as supportive work environments, customized human-robot collaboration training courses, cross-departmental collaboration opportunities, career development, participation in robot design and development decisions, fair treatment, respect, and care—provides employees with capability enhancement opportunities and psychological support, helping them overcome barriers such as technology fear and role modeling. Research also finds that perceived organizational support, supportive climate, and training and development programs significantly mitigate negative impacts of technological change on employees, such as turnover intention and technology anxiety (Li et al., 2019; Liu et al., 2025). This systematic organizational investment in material support, capability enhancement, and psychological empowerment helps employees view robots as collaborative agents, thereby catalyzing fit formation. Based on this, we propose:

Proposition 4: Organizational investment plays a positive catalytic role in the formation of service robot-work environment fit, particularly in robot-frontline employee fit.

For service recipients, enterprises need customer orientation to create sustained competitive advantage (Deshpandé et al., 1993; Tuominen et al., 2023).

This orientation focuses not only on meeting customer needs but also emphasizes value co-creation by integrating customers into the entire value production and delivery process (Vargo & Lusch, 2016). Unlike traditional scenarios where employees directly serve customers and customer orientation implementation depends on employee service awareness and skills, service robot introduction expands customer orientation connotation to collaborative co-creation among technology carriers, employees, and customers. Robots must match customers' functional needs through technical parameters (e.g., response speed, task completion) while aligning with customers' emotional expectations through interaction design (e.g., tone, anthropomorphic expression). In this context, the catalytic role of enterprise customer orientation in robot-customer fit exhibits uniqueness. First, customer-oriented enterprises excel at extracting value signals from customers' implicit needs, such as transforming customers' perceptions of entertainment and novelty in robot services (Borghi & Mariani, 2021) into robot functional design and interaction logic. Second, through internal cross-departmental collaboration—where marketing collects customer feedback, R&D optimizes robot programs, and service departments test human-robot interaction experiences—enterprises ensure robots remain customer-centric throughout the entire cycle from technical prototype to deployment. Third, customer orientation drives enterprises to establish closed-loop mechanisms from service to feedback to optimization, understanding customer evaluations and needs to iterate robot hardware and software accordingly. These initiatives all facilitate fit formation. Based on this, we propose:

Proposition 5: Customer orientation plays a positive catalytic role in the formation of service robot-work environment fit, particularly in robot-customer fit.

3.3 Dual-Path Impact Mechanism of Service Robot-Work Environment Fit on Value Creation

Based on value co-creation theory and supplemented by conservation of resources theory, this study focuses on the dual-path impact mechanism and boundary conditions of service robot-work environment fit on employee and customer value creation. The conceptual model is shown in Figure 3 [Figure 3: see original paper].

3.3.1 Dual-Path Effects of Service Robot-Work Environment Fit on Employee and Customer Value Creation

(1) Co-creation path of service robot-work environment fit on employee and customer value

The co-creation path operates through challenge appraisal and self-management behavior. This mechanism manifests as employees' positive evaluation of stressors motivating self-management behavior, thereby influencing value formation.

Stressors are work-related factors that force individuals to deviate from normal psychological or physiological functions. In this sense, service robot-work environment fit represents a stressor for employees—a challenge stressor. Good fit may mean adjustments to employees' work content and positions, requiring skill upgrades to adapt to new work—stressors that employees can overcome and that benefit work performance and personal growth, such as higher-level job responsibilities and complexity (Cavanaugh et al., 2000). According to stress cognitive appraisal theory (Lazarus & Folkman, 1984), employees evaluate stressors by comparing whether their resources can meet environmental demands. When employees believe their resources can meet demands, they form challenge appraisals. This cognitive appraisal emerges from stress with benefits or intrinsic growth opportunities (姜福斌, 王震, 2022), leading employees to perceive the current situation as conducive to self-development and focusing attention on potential gains, growth, or learning (Prem et al., 2017). Research also finds that challenge stressors positively correlate with challenge appraisal (Liu & Li, 2018). We can thus infer that service robot-work environment fit positively influences employees' challenge appraisal.

Challenge appraisal relates to growth, rewards, and gains, stimulating achievement feelings. Therefore, individuals generally produce positive psychology and behavior when facing challenging job demands, and self-management behavior represents positive coping behavior. Challenge appraisal means employees evaluate external stimuli as challenges, feel confident about the future, and focus on opportunities and growth in work situations, thereby stimulating positive role behavior (Bliese et al., 2017). When employees appraise pressure from service robots as challenging, they focus more on self-improvement, prompting them to adopt positive behaviors for growth and development (Mitchell et al., 2019). Challenge appraisal also enhances employee motivation and promotes problem-centered coping behavior (Searle & Auton, 2015). When employees hold positive attitudes toward service robots, believing the pressure relates to personal growth, this indicates they have resources and confidence to overcome the pressure and view collaboration with robots as personally beneficial challenging job demands, thus triggering self-management behavior for development. We can thus infer that challenge appraisal positively influences employees' self-management behavior.

Self-management behavior refers to a series of behaviors where individuals proactively apply knowledge and adopt specific action strategies to achieve expected goals (张志学 et al., 2021). Employees' self-management behavior includes multiple dimensions such as personal goal setting, autonomous learning, self-observation and evaluation, and self-reinforcement and correction (Houghton & Neck, 2002; Renn et al., 2011). Through activities like setting work plans and goals, actively participating in training, collecting work performance feedback, and conducting positive self-evaluation and reflective improvement, employees achieve higher job satisfaction, work-life quality, and individual performance (Cohen et al., 1997). Similarly, employees' self-management behavior helps customers obtain higher value because employees

set clear work goals, continuously learn to improve capabilities, actively seek performance gaps, and self-motivate and improve based on results (Houghton & Neck, 2002). These behaviors better meet customer needs, thereby creating value for them. That is, self-management behavior not only helps employees achieve work value and better adapt to changing environments and continuous growth but also plays an important role in realizing customer value. We can thus infer that self-management behavior promotes the creation of employees' psychological value (e.g., thriving, psychological well-being) and work value (e.g., job performance, innovative performance), as well as customers' functional and emotional value. In summary, we propose:

Proposition 6: Service robot-work environment fit stimulates employees' challenge appraisal, which positively influences their self-management behavior, ultimately creating employee and customer value.

(2) Co-destruction path of service robot-work environment fit on employee and customer value

The co-destruction path operates through responsibility diffusion and social loafing behavior. This mechanism manifests as employees perceiving responsibility diffusion in multi-actor service production, leading to social loafing behavior that affects value formation.

In human-robot interaction contexts, service providers consist of employees and service robots, forming a new service team (Xiao & Kumar, 2021), while customers often participate in service production (Bieler et al., 2022; Menguc et al., 2020). This makes service outcomes influenced by multiple actors including service robots, employees, and customers. Although good fit and compatibility indicate alignment between robots and organizational positioning and smooth interactions between employees, customers, and robots, fit cannot resolve ethical issues brought by technology. Research finds that while digital technology improves organizational efficiency, it also causes employee deskilling and responsibility diffusion (谢小云 et al., 2021; Raisch & Krakowski, 2021). Human-robot collaboration diffuses responsibility between individuals and robots, making "free-riding" effects more likely (黄心语, 李晔, 2024). Robots with high environmental fit deeply embed in service processes, forming human-robot responsibility communities that blur responsibility boundaries between employees and robots (Gong, 2025), making responsibility tracing difficult and diluting employees' responsibility consciousness. For example, when hotel navigation robots guide customers accurately, employees may default to assuming robots have assumed guidance responsibility, reducing their own intervention willingness and blurring service responsibility. We can thus infer that service robot-work environment fit positively influences responsibility diffusion.

Responsibility diffusion, also known as the bystander effect, describes the phenomenon where individuals in groups exhibit weaker responsibility than when alone, representing a common method of moral disengagement (Bandura et al., 1996). According to moral disengagement mechanisms, if service providers

consist solely of employees, employees clearly recognize their responsibility in customer service; when multiple actors share responsibility for service outcomes, employees perceive themselves as bearing partial rather than full responsibility, even believing other actors (e.g., service robots) should bear more responsibility. This perception induces employees' social loafing—individuals exerting less effort in team or collective work than when working alone (George, 1992)—representing an unethical behavior. When enterprises adopt work teams composed of employees and service robots to serve customers, service performance is presented as team performance, individual contributions cannot be clearly identified in team performance, and service task visibility is low, thus reducing human employees' effort willingness and causing social loafing (George, 1992; Price et al., 2006). We can thus infer that responsibility diffusion positively influences employees' social loafing behavior.

Social loafing means employees exert less effort in service, such as failing to respond to customer needs promptly, not proactively helping customers, and pushing service tasks to robots. Research indicates that social loafing phenomena including responsibility avoidance and duty shirking are more serious among frontline employees in the hospitality industry (Luo et al., 2013). Such behavior produces destructive consequences, including damaged team coordination, hindered service processes, directly reducing customers' overall service quality evaluations, and even damaging corporate brand image. Social loafing also reduces employees' workload, actively lowers work efficiency, reduces success expectations, and decreases group commitment. Since frontline employees are typically viewed as organizational representatives (Liao & Chuang, 2004), their service level, attitude, and capability critically affect customer experience and long-term organizational performance (Wu et al., 2021). We can thus infer that social loafing behavior hinders the realization of employees' psychological value (e.g., thriving, psychological well-being) and work value (e.g., job performance, innovative performance), as well as the creation of customers' functional and emotional value. In summary, we propose:

Proposition 7: Service robot-work environment fit triggers responsibility diffusion effects, fostering employees' social loafing behavior, ultimately damaging employee and customer value.

3.3.2 Moderating Effects of Individual, Interaction, and Organizational Interface Factors

Based on conservation of resources theory, this study examines factors at different interfaces as moderating variables to analyze boundary conditions of service robot-work environment fit' s impact on employee and customer value creation.

Regulatory focus strengthens the co-creation path. Promotion-focused employees pay more attention to success-related information and resources for self-development and enhancement (Higgins & Tykocinski, 1992; Lockwood et al., 2002). They view service robots as important work resources and key factors for

achieving goals, thus actively accepting work changes brought by robots, perceiving them as challenging stressors, and proactively adjusting themselves to adapt to work environment changes. They also view robots as opportunities for personal success and development, which facilitates self-management behaviors such as planning, performance monitoring, and seeking training opportunities. Conversely, prevention-focused employees strengthen the co-destruction path. Prevention-focused employees pay more attention to avoiding failure and negative outcomes (Higgins & Tykocinski, 1992; Lockwood et al., 2002), emphasize completing tasks safely, and exhibit more conservative behaviors (Förster et al., 2003). They separate their tasks from robots' tasks, strictly demarcate responsibility boundaries to ensure their own resources are not damaged, and thus are more likely to experience responsibility diffusion. Prevention focus also easily triggers negative emotions (Brockner & Higgins, 2001), making workplace changes feel more difficult and challenging, intensifying withdrawal and conservative behaviors such as reducing task quantity, exerting less effort at work, and pushing customer service tasks to robots. Based on this, we propose:

Proposition 8: (a) Employees' promotion focus strengthens the path "service robot-work environment fit → challenge appraisal → self-management behavior → value creation," promoting employee and customer value creation; (b) employees' prevention focus strengthens the path "service robot-work environment fit → responsibility diffusion → social loafing behavior → value destruction," exacerbating employee and customer value destruction.

Social support refers to spiritual support and material assistance individuals obtain from social relationship networks (e.g., family members, friends, customers, others) (Cohen & Wills, 1985) and represents an important resource for individuals coping with stress. Research finds that social support not only benefits individual physical and mental health but also plays a protective role in negative situations, enhancing individual confidence to cope with environmental challenges (Nahum-Shani et al., 2011). Social support relates to individual psychological health and life feelings such as life satisfaction and positive emotions (Chu et al., 2010; Cohen & Wills, 1985), positively affecting subjective well-being (姚唐 et al., 2017). Conversely, lack of social support directly leads to negative psychological states such as depression and distress and damages self-concept. If enterprise employees can obtain sufficient social support from social relationship networks (including colleagues, supervisors, and customers in the workplace and family, friends, or others outside the workplace), they are less likely to suffer negative effects from resource loss (e.g., job insecurity from service robots) and more willing to invest existing resources to achieve resource gain (Hobfoll, 2011). Based on this, we propose:

Proposition 9: Social support strengthens the path "service robot-work environment fit → challenge appraisal → self-management behavior → value creation"and weakens the path "service robot-work environment fit → responsibility diffusion → social loafing behavior → value destruction," promoting employee and customer value creation. That is, social support strengthens the value co-

creation path and weakens the value co-destruction path.

Developmental human resource practices refer to supportive strategies and management methods organizations invest in to meet employees' developmental needs (Jung & Takeuchi, 2018; Kuvaas, 2008). First, these practices emphasize employee career development by providing career advice and guidance to help employees adapt to changing work environments. Second, enterprises provide training opportunities that help employees master new knowledge and skills (Marescaux et al., 2019), improving their technology self-efficacy. Third, developmental HR practices provide fair and reasonable performance feedback to help employees assess and improve their technical capabilities while providing incentives that enhance employees' sense of work meaning and creative potential. Therefore, when organizations implement developmental HR practices, employees perceive that enterprises value their development and provide adequate resources, making them more likely to view work pressure as challenging and willing to assume more responsibility. Conversely, when developmental HR practices are insufficient, lack of external resource support makes employees more inclined to conserve their own resources and engage in opportunistic behavior. Research shows that supportive organizational climate and transformational leadership can significantly mitigate negative effects of human-robot interaction (Li et al., 2019; Yu et al., 2022). Developmental HR practices bring employees positive psychological experiences (唐春勇 et al., 2021), improving job satisfaction and performance. Service robot research also notes that developmental HR practices positively moderate the effect of employee-robot work engagement on psychological empowerment (Liu et al., 2025). Enterprise managers and service robot technology professionals need to interact effectively with employees in advance, including redesigning employee service roles, providing more opportunities to learn new skills, encouraging employees to upgrade their own skills (Beane, 2019), motivating employees to work with service robots, and helping employees master service robot professional knowledge to cope with technical emergencies (Tuomi et al., 2021). Based on this, we propose:

Proposition 10: Enterprise developmental human resource practices strengthen the path "service robot-work environment fit → challenge appraisal → self-management behavior → value creation" and weaken the path "service robot-work environment fit → responsibility diffusion → social loafing behavior → value destruction," promoting employee and customer value creation. That is, developmental HR practices strengthen the value co-creation path and weaken the value co-destruction path.

4. Theoretical Construction

Although robots have been widely applied in hotels, restaurants, scenic areas, airports, shopping malls, hospitals, banks, and other service contexts, many have been idled or laid off due to environmental incompatibility. Reflecting on the problems behind this phenomenon and breaking through previous research orientations that emphasized actors over relationships, impacts over in-

terventions, and customers over employees, this study argues for the necessity of proposing the concept of service robot-work environment fit, deconstructing its dimensions, and exploring its formation mechanism and impact on value creation. Based on this conception, this study constructs a theoretical framework through three interrelated and progressively layered components, with the main line of "robot and work design features → service robot-work environment fit → employee and customer value creation," and investigates boundary conditions from organizational agency and resource conservation perspectives (shown in Figure 4 [Figure 4: see original paper]). Study 1 focuses on service robot-work environment fit itself, including 梳理理论基础, defining connotative structure, and developing measurement scales. Study 2 explores how to promote service robot-work environment fit from robot and work design perspectives and analyzes the moderating effects of technology-, employee-, and customer-oriented factors from an organizational agency perspective to reveal fit formation mechanisms. Study 3 constructs a double-edged sword impact path of "fit → employee cognitive appraisal and behavior → value creation" and investigates contingency factors from individual, interaction, and organizational interfaces to reveal the impact mechanism of service robot-work environment fit.

The theoretical construction includes three aspects. First, it deconstructs service robot-work environment fit based on new interaction relationships brought by service robots, analyzing its theoretical foundation and connotative structure and developing corresponding measurement scales to advance conceptual research and measurement development. Differentiating from previous research on technology-brand image fit (Choi et al., 2022), technology innovation-corporate responsibility fit (McLeay et al., 2021), and technology-task fit (Tuomi et al., 2021), this study explores fit' s connotative structure based on the multi-actor service encounter combination and real-world contexts, deconstructing it into service robot-organization fit, service robot-frontline employee fit, and service robot-customer fit. This expands and deepens understanding of the concept' s essence, further advancing service robot theory and extending fit theory' s content and explanatory scope.

Second, this study applies work design theory and mind perception theory to service robot research, exploring antecedents and boundary conditions of service robot-work environment fit from an innovative perspective. Previous research often based analyses of service robots' impact mechanisms on customers using anthropomorphism theory, social presence theory, technology acceptance models, etc., which are insufficient for explaining service robot-work environment fit formation mechanisms, and analyses of management strategies and organizational-level factors are also inadequate (Liu et al., 2025). This study pioneeringly constructs an antecedent model of service robot-work environment fit under the influence of robot characteristics (distinguished as surface-level and deep-level features) and work design characteristics, while considering the moderating effects of organization strategies and investments oriented toward technology, employees, and customers, reflecting the complexity of fit formation. The findings not only reveal fit formation processes but also open new research

avenues for related issues in the service domain.

Third, based on value co-creation theory, this study reveals the double-edged sword effects of service robot-work environment fit on value creation. Existing research primarily focuses on service robots' impact on customer cognition, emotion, evaluation, and behavioral intentions (e.g., Santiago et al., 2024; Xie, C. Liu, & Li, 2022; Xie, X. Liu, & Li, 2022; Yang et al., 2024). Some scholars have begun analyzing challenges and opportunities robots bring to employees, such as job insecurity, negative emotions, turnover intention (e.g., Chen & Cai, 2025; Li et al., 2019; Pan et al., 2025), work engagement, job crafting, and well-being (e.g., 刘欣, 谢礼珊, 2025; Song et al., 2022), but such research remains limited. This study proposes that service robot-work environment fit may generate different employee cognitions that affect value formation. In the co-creation path, fit promotes value creation through challenge appraisal and self-management behavior; in the co-destruction path, fit hinders value creation through responsibility diffusion and social loafing behavior. If resource supplementation occurs at different levels—such as promotion focus at the individual interface, social support at the interaction interface, and developmental HR practices at the organizational interface—this helps strengthen the value co-creation path and weaken the value co-destruction path. This study provides a systematic and comprehensive research approach to deeply understanding the double-edged sword effects and mechanisms of service robot-work environment fit on value formation from cognitive and behavioral perspectives, representing a powerful supplement to individual cognition and behavior research in human-robot co-creation contexts.

In summary, service robots represent a hot topic in academia in recent years, with abundant research achievements (e.g., 刘欣, 谢礼珊, 2025; Guan et al., 2024; Liu et al., 2025; Yan et al., 2025). Based on previous achievements and interdisciplinary theoretical foundations, this study strives for breakthroughs in concept proposal and model construction. By systematically investigating the connotative structure, antecedents, and impact mechanisms of service robot-work environment fit on value creation, it provides new perspectives and theoretical tools for deeply analyzing how enterprises handle complex human-robot relationships in intelligent technology-enabled service contexts.

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Note: Figure translations are in progress. See original paper for figures.