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RESEARCH ARTICLE

Servant leadership style，team psychological safety, team potency and environmental uncertainty on Team innovation performance: An analysis of high-tech enterprise employees of China

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ABSTRACT

This study investigates the influence of servant leadership style, team psychological safety, team potency, and environmental uncertainty on team innovation performance among employees in China's high-tech enterprises. Drawing on Path-Goal Theory and High-Level Echelon Theory perspectives, the research aims to understand how leadership behaviors and contextual factors jointly shape team innovation outcomes. A total of 325 questionnaires were collected from high-tech enterprise teams across Shandong province in China using a structured questionnaire, and analyzed using structural equation modeling (SEM) with SmartPLS 4.1.1. The results reveal that servant leadership and team psychological safety positively affects team innovation performance through enhanced team team potency. Furthermore, environmental uncertainty moderates the relationship between team potency and innovation performance, indicating that high uncertainty amplifies the positive effects of potent teams. These findings provide both theoretical and practical implications: theoretically, they extend leadership and innovation research by integrating servant leadership and contextual contingencies; practically, they offer guidance for managers in fostering safe, empowered, and resilient teams capable of innovation under uncertain market conditions.

Keywords: team psychological safety; servant leadership; innovative performance and environmental uncertainty

1. Introduction

Companies form organizations to carry out certain missions. Companies form organizations to translate their mission into actionable, coordinated, and sustainable efforts. The structure helps manage people, processes, and resources efficiently while maintaining strategic focus. Businesses nowadays are up against tough competition. Organisational performance management has become a critical challenge in current times. Inadequate planning, policy changes on the fly, and incompetent administration are the key culprits for underwhelming results. Another important factor is that company executives often lack key leadership traits. A leader is someone who inspires followers to achieve a common goal by modelling the kind of justice, compassion, and self-determination that are central to the leadership ideal (Gashema, 2019). Leadership is positively correlated with organizational performance. A related management concept is the connection

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between a leader's approach and the success of their organization. In addition, they state that leadership styles should provide opportunity and belonging for employees and that businesses should prioritize transformational and democratic leadership for optimal performance (Eva et al., 2019). The leadership philosophy of servant leadership serves others instead of themselves has become more important in today's management of organizations. Servant leadership places emphasis on empathy, listening, stewardship and commitment towards the development and well-being of team members (Greenleaf, 1977; Van Dierendonck, 2011).

There is substantial evidence confirming the positive impact of servant leadership on organization performance. To begin with, Servant leaders promote high levels of job satisfaction and increase organizational commitment status among employees by creating an atmosphere where workers feel cared for and valued (Liden et al., 2008). Furthermore, the adoption of this style improves team effectiveness by encouraging collaboration and mutual respect among team members. This type of leadership style encourages open communication as well as promotes unity among team members thereby enhancing overall performance levels within teams (van Dierendonck et al., 2004). In addition, employees are more likely to engage in extra-role behaviours associated with organizational citizenship when their leaders exhibit servant leadership behaviours, for they are driven beyond the requirements of their positions towards contributing to the success of the organization (Walumbwa et al., 2010). Finally, the supportive nature of servant leadership helps to reduce turnover intentions. When employees work under servant leaders they experience lower job stress and greater job satisfaction leading to a decreased likelihood of them leaving their current organizations (Liden et al., 2008).

High-tech companies are key drivers of innovation and economic growth in the modern business environment. These firms often operate in highly competitive settings where innovation performance is vital for competitiveness (Zahra & George, 2002). Despite their potential to be innovative, many high-tech companies are reported to be grappling with achieving high levels of innovation performance. This situation calls for an examination of various elements that determine innovative behaviour within such corporations. Within this context, team innovation performance becomes particularly important, as it enables organizations to generate novel ideas, adapt quickly to emerging trends, and sustain competitive advantage. It is clear that between 2007 and 2021, China's high-tech industry demonstrated rapid and dynamic expansion, outpacing the growth of the national economy. During this period, China's total GDP increased by 324%, from CNY 2.70092 trillion to CNY 11.49237 trillion, while the high-tech industry's GDP surged by 399%, from CNY 959.115 billion to CNY 4.78489 trillion. This indicates that the high-tech sector not only grew faster than the overall economy but also steadily expanded its share of the national GDP (Greenleaf, 1977; Liden et al., 2008). Hence, High-performing innovative teams contribute directly to the development of cutting-edge technologies, efficient problem-solving, and the continuous improvement of products and processes, all of which are essential for thriving in China's dynamic high-tech landscape.

In the quest for servant leadership within high-tech companies, the author found evidence that if leaders who serve create a supportive atmosphere where employees feel trusted without any fear of reprisal, individual employee development is encouraged (Peykar, 2024). The ability to collaborate collectively among all partners helps in the establishment of an atmosphere that nurtures creativity and innovation. Servant Leadership is a potent type of leadership based on the concept that leaders should serve their teams (Greenleaf, 1977). Leaders who practice servant leadership are known to create an atmosphere that focuses on employees' needs and development, thus boosting overall team performance and morale (Spears, 2002). A number of recent studies have indicated that servant leadership has positive outcomes within institutions

including employee satisfaction and organizational commitment (Liden et al., 2008). Nonetheless, its relationship specifically with innovation performance among high-tech companies remains under-researched.

Another important aspect that can affect innovation within an organization is Team psychological safety. Psychological safety, which is understood as the shared belief between members of a team that the environment is safe for interpersonal risk-taking, is posited to enhance the extent to which strategic orientation, decision-making quality, and creativity of firms are improved (Edmondson & Lei, 2014; Frazier et al., 2017). The open communication and trust that psychological safety enables would go a long way toward the free exchange of ideas that are the very engines of innovation and effective problem-solving. Unfortunately, the advantage offered by psychological safety has not been equally substantiated by direct evidence. While some studies have indicated that psychological safety enhances creativity in employees and team performance, others have claimed that the appropriate conditions facilitate this such as leadership style, team diversity, and organizational culture (Newman et al., 2017). Drawing out this notion is the fact that psychological safety is usually perceived as rather general but needs to operate within certain conditions and combined factors, such as inclusive leadership and shared vision, to maximize benefits associated with innovating and distance strategic outcomes. Nevertheless, the processes through which team psychological safety influences innovation performance need further exploration, especially in regard to high-tech companies (Khattak et al., 2023).

This study focuses on investigating how servant leadership and team psychological safety interact with each other in influencing innovation performance, paying particular attention to the mediating and moderating impacts of Team potency and environmental uncertainty for improved comprehension of its overall impact on these business elements (Guo et al., 2024). Examples include determining whether there are direct impacts of servant leaders and psychological safety on innovation performance, looking at how team potency affects team innovation performance, as well as the moderating effects of environmental uncertainty on relationship between team potency and team innovation performance, and examining whether team potency mediates these relationships. We will further explore the net effect across all permutations of these four variables in enhancing innovation yield. This will enable high-tech companies to make improvements in their leadership practices as well as use team variety to improve innovation within their organizations which will also help in promoting competitiveness (Maynes et al., 2024). The outcomes are also useful for managers and policymakers who would like to foster an innovative environment characterized by healthy competition; deriving answers from these pertinent queries therefore helps fill this void aimed at coming up with workable solutions that will lead to success in a tough market environment that is characteristic of the twenty-first century.

2. Literature review

2.1. Servant leadership and team innovative performance

It has been hypothesized that servant leadership in firms that deal with technology has a positive contribution towards innovation. One of the priorities of servant leadership is to assist employees in developing themselves, which is indispensable to promoting creativity. They also emphasize the advancement of their workers' careers through support funds allocation and removal of obstacles to success (Greenleaf, 1977). This empowerment focus helps them to create a sense of belonging among workers; hence enhancing levels of creativity and innovation within an organisation. These activities included psychological empowerment and commitment among team members (Liden et al., 2014)

Furthermore, servant leadership advocates for open and honest communication through fostering collaboration among team members. Listening actively with understanding forms the basis for a servant leader's urge towards promoting the sharing of ideas and collaborative striving for innovation projects (Liden et al., 2014). The essence of effective communication is the promotion of fruitful association where ideas are generated thereby enhancing innovative ideas. This often results in collaborative problem-solving and brainstorming in servant-led teams and hence improved innovative performance. Servant leadership promotes a culture that values creativity and enables people to contribute their unique ideas proactively. This creates an environment where innovation thrives at all times because these leaders are humble empathetic stewards of corporate governance over other people's lives (van Dierendonck, 2011). In high-tech hi-tech enterprises, this is particularly important as such corporations rely on ongoing innovation to retain their competitive advantage. High-tech companies benefit from servant leadership because it helps in achieving strategic objectives that are consistent with both innovation and performance. In dynamic and competitive market conditions, businesses at the helm of technology need directors who will make employees' development and well-being their prime concern. This way promotes flexibility and responsiveness as well as boosts creativity through innovation according to Greenleaf (1977). This means that it supports staff efforts towards goal achievement which results in better process improvements and increased advantage.

H1: Servant leadership is positively and significantly related to team innovation performance in high-tech companies.

2.2. Team psychological safety and innovative performance

Teams with psychological safety are likely to create new ideas in high frequency where team members feel safe to expose risk-taking and voice their viewpoints without fear of being criticized or punished. In this regard, high-tech companies are well placed to benefit considerably from building a 'psychologically safe' environment. High-tech companies within the dynamic and competitive digital industries of today can harness a considerable reputational advantage by creating psychologically safe environments that encourage free or open communication and collaboration among team members (Edmondson, 1999). This may be through different theoretical insights working alongside practical, tangible interventions.

Psychological safety also reduces the risk of groupthink, where there is a preference for consensus that inhibits critical thought and creativity in the team. Such teams are likely to have members questioning assumptions, looking into different viewpoints, and challenging norms, resulting in more robust and innovative solutions (Mitchell & Boyle, 2015). An organization may create high-quality creative products to meet needs under uncertain and dynamic demand through an environment that promotes critical inquiry and collaborative decision-making (Harvard Business Review, 2009). Psychologically safe teams know their customers better and so understand their needs and preferences. Teams explore different ideas and perspectives without fear; hence they are more likely to innovate products and services intended for very different customers (Cox & Blake, 1991). Such a style in high-tech companies doing global business creates a psychological edge in activating the brain work of teams to develop those very solutions that can be marketed for minority or specific customer segments.

H2: Team psychological safety positively and significantly related to team innovation performance in high-tech companies.

Servant leadership significantly enhances team potency in high-tech companies by cultivating a team environment rooted in trust, empowerment, development, and shared purpose. In high-tech industries such as software engineering, biotechnology, and artificial intelligence—where rapid innovation and complex problem-solving are constant—teams must believe in their ability to perform effectively across tasks (Carroll,

2022). Servant leaders contribute to this belief by empowering team members with autonomy and decision-making authority. For instance, in an agile software development team, a servant leader who allows developers to select tools, define sprint goals, and lead retrospectives fosters a sense of ownership and competence (Jiang et al., 2024). This increases the team's confidence in handling future projects. Additionally, servant leaders create psychological safety, which is crucial in high-stakes environments like cybersecurity or machine learning, where trial-and-error and experimentation are necessary for progress. When a leader supports open dialogue and treats failure as a learning opportunity—as in the case of a data science team testing flawed models—they reduce anxiety and increase the team's collective belief in their resilience and problem-solving ability.

Moreover, servant leaders actively invest in skill development, which is essential in sectors like robotics or cloud computing where technologies evolve rapidly (Sfetcu, 2021). For example, a leader who funds certifications in cloud infrastructure or organizes weekly learning sessions ensures the team remains competent and prepared, reinforcing their confidence. Servant leaders also foster cross-functional collaboration, which is especially important in high-tech companies where projects often involve engineers, designers, and product managers (Hassan & Raheemah, 2021). This boosts the team's synergy and belief in their collective capability. Lastly, servant leaders help teams connect their technical work to a broader purpose. This sense of purpose strengthens the team's collective belief that their work matters and that they can accomplish meaningful goals together. Through these mechanisms—empowerment, psychological safety, development, collaboration, and purpose—servant leadership plays a direct and powerful role in enhancing team potency in high-tech organizations.

H3: Servant leadership positively and significantly related to Team potency in high-tech companies.

Team psychological safety—the shared belief among team members that it is safe to take interpersonal risks—has a direct and powerful impact on team potency, which is the group's collective confidence in its ability to succeed across a range of tasks (Ren & Shen, 2024). In high-tech companies, where innovation, rapid iteration, and complex problem-solving are daily requirements, psychological safety is essential for fostering a team environment where learning, collaboration, and resilience flourish. When team members feel psychologically safe, they are more likely to share ideas, ask questions, and admit mistakes without fear of ridicule or punishment. This openness leads to more frequent and higher-quality knowledge exchange, which in turn reinforces the team's ability to solve problems and adapt quickly—key ingredients of team potency. This increases the team's ability to foresee and solve issues together, boosting their collective belief in their competence. Psychological safety also encourages inclusion and diversity of thought, which is critical in multidisciplinary high-tech teams. For example, in a biotech company, a team composed of data scientists, biologists, and product designers is more effective when each member feels safe to bring their domain-specific knowledge forward. When people feel heard and respected, they contribute more fully, leading to more creative and effective outcomes, and a stronger belief that the team can succeed together (Sfetcu, 2021).

Moreover, psychological safety contributes to emotional resilience during high-pressure situations, such as tight product launch deadlines or technical crises. In a cloud infrastructure team managing a live system outage, members who feel safe are more likely to stay calm, communicate clearly, and offer support instead of assigning blame (Patil et al., 2023). These behaviors not only solve immediate problems but also build trust and reinforce the team's belief in its ability to overcome future challenges—an essential aspect of team potency. This makes psychological safety a foundational driver of team potency in environments that demand constant innovation, collaboration, and adaptability.

H4: Team psychological safety positively and significantly related to Team potency

Where team members undertake coordinated work tasks, TP predicts organizational citizenship behaviour (AlMazrouei et al., 2020). The positive energy produced by this can encourage citizenship behaviour and mutual employee support. TP, thus, is similar to self-efficacy at the individual level. Team potency, defined as a team's shared belief in its collective capability to perform effectively, plays a critical role in driving innovation performance, especially in high-tech companies where innovation is central to competitive advantage. High team potency fuels the confidence, commitment, and risk-taking behaviors that are essential for innovation in dynamic and complex environments such as software development, biotechnology, artificial intelligence, and advanced manufacturing. When a team strongly believes in its collective ability, members are more likely to engage in proactive behaviors like proposing novel ideas, experimenting with new technologies, and challenging the status quo (Lee et al., 2021). Team potency also promotes persistence in the face of obstacles, which is crucial when dealing with the trial-and-error nature of innovation. A high-potency team is more likely to remain motivated and resilient through repeated iterations, believing that they can eventually succeed. This perseverance leads to better outcomes and increases the likelihood of breakthrough innovations.

Moreover, team potency enhances collaborative synergy—the ability of the team to combine their diverse expertise effectively toward a shared goal. In high-tech environments, where teams are often interdisciplinary (e.g., software engineers, data scientists, UX designers, and domain experts), belief in the team's collective strength encourages more open knowledge sharing and integration of ideas (Islam et al., 2024).

H5: Team potency positively and significantly related to Team innovation performance

Employees with a high sense of team potency are more likely to take risks, face resistance calmly and are thus more likely to initiate and support innovative decisions and activities within the organization. This results in higher innovation performance at both the individual and organizational levels and has a positive impact on company performance. The mutual respect and service orientation inherent in servant leadership contribute to boosting innovation self-efficacy. Consequently, improved innovation team potency enhances innovation efficiency and employee productivity. High-quality servant leadership significantly enhances both organizational performance and individual outcomes. First, a positive top-down relationship between team-level servant leadership and individual-level OCB is required. This is likely because servant leadership behaviors create a social context within the team that positively affects individual-level attitudes and behaviors, including individual-level OCB (Eva et al., 2019). Individual-level OCB is a likely direct outcome of servant leadership because unlike some other leadership approaches in which leader-follower relationships of different levels of quality are found, servant leaders are likely to bond with each one of their team members (Eva et al., 2019) and recognize their unique needs (Eva et al., 2019). The resulting strong dyadic relationships (Liden et al., 2014) should trigger reciprocation in the form of individual-level OCBs directed to peers and the team as a whole (Sousa & van Dierendonck, 2017). Finally, it is notable that the intrinsically driven modeling of virtue also provides a basis for linking leadership and individual-level OCB.

Support for our mediation hypothesis also requires a positive bottom-up link between team potency and team performance. This is likely because team performance is an emergent construct that "originates in the behaviors of individuals, is amplified by their interactions, and manifests as a high-level, collective phenomenon" (Kozlowski & Klein, 2000, p. 55) and is likely to be crystallized through bottom-up impacts, including team performance. Because individual-level OCB is typically a positive for individual-level task performance, team performance, in the aggregate, will also tend to be benefited (Spitzmuller et al., 2008).

Thus, individual-level OCB (e.g., suggestions to improve individual performance, provision of help to colleagues with work-related problems) is a likely positive for team-level performance (Podsakoff et al., 1997).

H6: Team potency mediates the relationship between servant leadership and team innovation performance in high-tech companies in China

In high-tech companies in China, team potency serves as a key psychological mechanism that mediates the relationship between team psychological safety and team innovation performance (Agarwal & Anantatmula, 2021). Team psychological safety—defined as a shared belief that the team is safe for interpersonal risk-taking—creates a foundational environment where team members feel comfortable speaking up, sharing novel ideas, and challenging existing practices.

In the Chinese high-tech sector—characterized by fast-paced growth, intense competition, and hierarchical cultural norms—psychological safety allows teams to overcome traditional power distances and express unconventional thinking. For example, in a Shenzhen-based AI company, a psychologically safe environment enables junior engineers to contribute new algorithmic ideas during team discussions. However, whether those ideas are pursued and translated into innovative outcomes depends on the team's potency—their shared confidence that they can collaboratively implement those ideas (Sun et al., 2022). Thus, team potency acts as a bridge between the conditions that support idea generation (psychological safety) and the actual performance outcomes (innovation). When psychological safety fosters team potency, it leads to greater confidence, resilience, and collective effort, resulting in stronger innovation performance (Xiaohong, 2023). If the team also has high potency, they are more likely to implement experimental architecture designs, adopt emerging technologies, and iterate rapidly—leading to higher innovation performance. This mediating effect is particularly important in China, where organizational success is closely tied to the team's ability to balance cultural norms (e.g., respect for authority) with the demands of agile, collaborative, and innovation-driven work structures. In high-tech Chinese companies, team psychological safety encourages the free exchange of ideas, but it is team potency that transforms that openness into innovation performance. Therefore, team potency plays a mediating role, turning a supportive team climate into concrete innovative actions and outcomes.

H7: Team potency mediates the relationship between team psychological safety and team innovation performance in high-tech companies in China

In China's high-tech industry, environmental uncertainty—characterized by rapidly changing technologies, unstable market demands, and shifting government regulations—moderates the strength of the relationship between team potency (the shared belief in a team's effectiveness) and team innovation performance (the team's ability to generate and implement novel ideas). While team potency generally promotes innovation performance, its impact is significantly stronger under conditions of high environmental uncertainty (Zaman et al., 2024). In highly uncertain environments, such as in AI startups in Shenzhen or quantum tech firms in Hefei, companies face unpredictable developments in global standards, fast-moving competitors, and evolving government funding priorities. Under these conditions, a high-potency team—one that believes in its own capability—can maintain motivation and coordinated effort despite ambiguity. As a result, they are better positioned to turn uncertainty into opportunity, achieving higher innovation performance.

This moderating effect is especially relevant in China, where macro-level shifts in policy (e.g., "new quality productive forces"), geopolitical pressures, or changes in local funding schemes create instability. High-tech teams must often develop new products quickly, navigate uncertain supply chains, or anticipate

shifting compliance standards (Gong et al., 2025). In such a context, team potency becomes a critical buffer, helping teams manage pressure and uncertainty creatively. The higher the environmental uncertainty, the more essential team potency becomes for achieving innovation. In Chinese high-tech companies, environmental uncertainty strengthens the positive impact of team potency on innovation performance (Zhang et al., 2023). When external conditions are volatile—such as in AI, chip design, or biotech—high-potency teams are more resilient, adaptive, and innovative. But in stable, low-uncertainty environments, even teams with average potency can manage, and the performance gap between high and low potency narrows. Therefore, the more uncertain the environment, the more vital it is for teams to have strong belief in their collective capabilities in order to innovate effectively.

H8: Environmental uncertainty moderates the relationship between team potency and Team innovation performance in high-tech companies in China

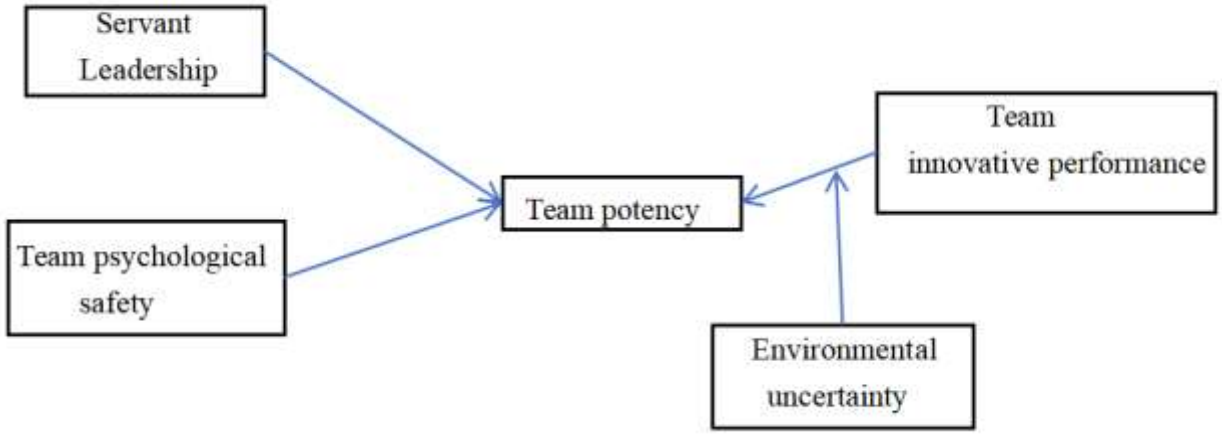

Figure 1.1. Proposed conceptual framework.

3. Methodology

The study was conducted using a quantitative research approach, with a descriptive-cross-sectional methodological design.

3.1. Population, sample and sampling

The population consisted of employees from four companies based in Shandong, china, operating in the high-tech sector. The sample comprised a total of 325 workers. The three inclusion criteria—workers in high-tech companies, employees with more than 10 years of working experience, and degree qualification holders—were selected to ensure the study captures a highly relevant and capable sample for examining team innovation performance. To approach these respondents, the researcher will first contact organizational HR departments and team leaders through professional networks, corporate directories, and formal email invitations. Organizations that agree to participate will be asked to nominate eligible teams that meet the study criteria. Surveys will be distributed electronically via email or secure online survey platforms, allowing respondents to complete them conveniently and anonymously. To encourage participation, the researcher will emphasize the academic purpose of the study, ensure confidentiality of responses, and clearly communicate that the findings may contribute to improving leadership and team practices within the high-tech industry. Additionally, incentives such as summary reports of key findings or small tokens of appreciation may be offered, and participants will be informed that their input is valuable in shaping future management strategies in innovation-driven work environments. Prepare a structured questionnaire with

clear and concise questions that conform to the objectives of the study which are used in collecting statistical information through asking participants structured questions. Employ close-ended questions, such as Likert scale items, to measure specific variables of interest, for example, servant leadership, and Team Climate Inventory. Ensure questions are unambiguous and relevant to minimize response bias (Creswell & Creswell, 2017). The purposive sampling technique is used to deliberately select individuals who possess direct experience and relevant knowledge about the variables being studied.

3.2. Measurement Technique and Instrument

The Likert scale is an efficient tool for assessing subjective responses like opinions, perceptions, and attitudes, among others. This scale is based on a set of statements related to a given construct for which respondents indicate their degree of disagreement or agreement on any scale having such notations as 'strongly agree' and 'strongly disagree' (Likert, 1932).

Servant leadership. We assessed servant leadership with a 18-item form (i.e., five subdimensions) as adapted by Kulachai et al. (2018).

Team psychological safety was originally developed by Edmondson, A. (1999). Sample items from the scale are "Members of this team are able to bring up problems and tough issues".

Team potency. To assess team potency, we used the eight-item scale from (Guzzo et al., 1993). Sample items included "This team believes it can become unusually good at producing high-quality work".

Environmental uncertainty adopted by (Atif et al., 2011) and it was measured by four items. Sample items from the scale are "It is hard to know customers' needs and It is hard to understand competitors' strategies".

Team innovative performance. To assess team innovative performance, we used the four-item scale from (Pirola-Merlo and Mann, 2004). Sample items included "My Team's recent output is new".

4. Results

4.1. Profile of respondents

The respondents in this study were classified on the basis of several demographic and behavioral characteristics, including gender, age, occupation, and working experience.

In terms of gender, there were 150 (46.2) male respondents compared to 175 (53.8%) female respondents. Almost of respondents were staff from high-tech companies between 36 and 45 years of age, 32 years (18.9%), 35 to 39 years, 39 (23.1%), 46 to 55 years, 82 (25.2%) and 25 more than years, 57 (17.5). Most have a high level of education with a bachelor's degree 124 (38.2%), and phd students 52 (16), and have working experience of more than 21 years (24) and 11 to 15 years (23.1) in the current company. **Table 1.1** lists the respondents' demographic characteristics, and a more detailed account can be found.

Table 1.1. Profile of respondents.

Variables	Categories	Frequency	Percentage (%)
Gender	Male	150	46.2
	Female	175	53.8
Age	Above 25	57	17.5
	26-35	44	13.5
	36-45	96	29.5

Variables	Categories	Frequency	Percentage (%)
	46-55	82	25.2
	55 above	46	14.3
Years of experiences	0-5 years	66	20.3
	6-10 years	58	17.8
	11-15 years	75	23.1
	16-20 years	48	14.8
	21 years above	78	24.0
Educational level	College	48	14.8
	Undergraduate	124	38.2
	Full time graduate	51	15.7
	Working graduate	50	15.4
	Phd student	52	16.0

Table 1.1. (*Continued*)

4.2. Descriptive statistics

The findings of the descriptive analyses show that environmental uncertainty (m = 3.164), servant leadership (m = 3.243), team climates (m = 3.235), team innovative performance (m = 3.231), team potency (m = 3.315), and team psychological safety (m = 3.326). **Table 1.2** presents the descriptive statistics for the variables used in this study.

Table 1.2. Descriptive Statistics of the study variables.

	Mean	Median	Standard deviation
Affiliation	3.245	3.000	1.185
Humility	3.307	3.000	1.041
Authenticity empowerment	3.225	3.000	1.029
Empowerment	3.206	3.007	0.943
Environmental uncertainly	3.164	3.111	1.048
Innovativeness	3.297	3.000	1.207
Servant leadership	3.243	3.325	0.811
Standing back	3.279	3.010	1.047
Stewardship	3.240	3.000	1.066
Team innovative performance	3.231	3.000	0.951
Team potency	3.315	3.241	0.944
Team psychological safety	3.326	3.270	0.945
Trust	3.189	3.000	1.160

4.3. Measurement model

Construct validity in this study demonstrates the extent to which the questionnaire items accurately capture the theoretical concept of team innovative performance among high-tech employees, as suggested by Sekaran (2003) and Hair et al. (1998). All factor loadings exceeded the threshold value of 0.5 (**Table 1.3**), confirming that each indicator reliably reflects its intended latent construct, such as flexibility, problem-

solving ability, or responsiveness to change. Following Nunnally's (1978) guideline, items with factor loadings below 0.50 were considered for deletion because of their limited explanatory contribution and potential bias to parameter estimates. In this study, however, all items exceeded the minimum threshold of 0.50. This means that each indicator explained at least 50% of the variance of its corresponding latent variable (Hair et al., 2011; Nunnally & Bernstein, 1994; Bagozzi & Yi, 1988). Overall, the strong loadings and clear separation across constructs established both convergent and discriminant validity for the measurement model, confirming that each set of indicators uniquely represented its intended latent variable.

Convergent validity was assessed to ensure that the measurement items accurately represented their respective constructs in the study, including servant leadership, team psychological safety, team potency, team innovative performance, and environmental uncertainty. Following Hair et al. (2010), factor loadings, composite reliability (CR), and average variance extracted (AVE) were examined. The factor loadings of all items ranged from 0.673 to 0.928, exceeding the minimum threshold of 0.50, indicating that each questionnaire item strongly reflected its intended construct. Composite reliability values for all constructs were above 0.70, confirming strong internal consistency. The AVE values further demonstrated that the latent constructs explained a sufficient portion of the variance in their observed indicators, with values of 0.516 for servant leadership, 0.716 for team psychological safety, 0.733 for team potency, 0.763 for team innovative performance, and 0.769 for environmental uncertainty. Although the AVE for servant leadership and team climate were relatively close to the 0.50 benchmark, they still satisfied the criteria proposed by Fornell and Larcker (1981) and Bagozzi and Yi (1988). Overall, these results confirm that all constructs in this study exhibit adequate convergent validity, meaning that the survey items consistently and reliably captured the theoretical dimensions of team and organizational dynamics relevant to innovative performance in high-tech companies.

Convergent validity was confirmed by examining factor loadings, which were all statistically significant and ranged from 0.673 to 0.928, exceeding the minimum threshold of 0.50, indicating that each item reliably reflected its intended construct. Composite reliability (CR) values for all constructs were above 0.70, demonstrating strong internal consistency, while the average variance extracted (AVE) values also met the recommended benchmark of 0.50, specifically: 0.516 for servant leadership, 0.716 for team psychological safety, 0.733 for team potency, 0.763 for team innovative performance, and 0.769 for environmental uncertainty. These findings show that more than half of the variance in each observed indicator was explained by its corresponding latent variable, confirming the stability and consistency of the measurement instrument (Hair et al., 2012; Nunnally & Bernstein, 1994; Bagozzi & Yi, 1988). According to Anderson and Gerbing (1988), these results indicate that the instrument effectively captures the theoretical meaning of each construct, providing strong empirical support for convergent validity.

Table 1.3. Measurement model.

First-Order Construct	Second-Order Construct	Items	Factor loading	CR	AVE
Empowerment		A1	0.864	0.950	0.759
		A2	0.889		
		A3	0.862		
		A4	0.886		
		A5	0.862		
		A6	0.862		
Humility		A7	0.912	0.936	0.830
		A8	0.916		
		A9	0.905		

First-Order Construct	Second-Order Construct	Items	Factor loading	CR	AVE
Standing back	Servant leadership	A10	0.904	0.935	0.828
		A11	0.912		
		A12	0.914		
Stewardship		A13	0.906	0.932	0.822
		A14	0.914		
		A15	0.900		
Authenticity empowerment		A16	0.897		
		A17	0.905		
		A18	0.902		
		Empowerment	0.792	0.898	0.637
		Humility	0.823		
		Standing back	0.773		
		Stewardship	0.807		
		Authenticity empowerment	0.794		
Innovativeness		H1	0.924	0.923	0.857
		H2	0.928		
Affiliation		H3	0.892	0.933	0.823
		H4	0.922		
		H5	0.907		
Trust		H6	0.908	0.927	0.810
		H7	0.891		
		H8	0.901		
		Innovativeness	0.293	0.903	0.537
		Affiliation	0.473		
		Trust	0.472		
Team psychological safety		B1	0.857	0.946	0.716
		B2	0.815		
		B3	0.831		
		B4	0.821		
		B5	0.844		
		B6	0.860		
		B7	0.893		
Team potency		D1	0.840	0.956	0.733
		D2	0.866		
		D3	0.868		
		D4	0.853		
		D5	0.848		
		D6	0.852		
		D7	0.861		
		D8	0.859		
Environmental uncertainty		F1	0.878	0.930	0.769
		F2	0.868		
		F3	0.881		
		F4	0.880		
Team innovation performance		C1	0.871	0.928	0.763
		C2	0.876		

First-Order Construct	Second-Order Construct	Items	Factor loading	CR	AVE
		C3	0.874		
		C4	0.875		

Table 1.3. (*Continued*)

4.4. Discriminant validity

Discriminant validity in this study was examined to confirm that each construct—servant leadership, team psychological safety, team potency, team innovative performance, and environmental uncertainty—is empirically distinct from the others. This ensures that each latent variable shares more variance with its own indicators than with other constructs, indicating that the items measure unique theoretical dimensions. Following Fornell and Larcker (1981), the square root of the AVE for each construct was compared with its correlations with all other constructs. As presented in **Table 1.4**, the square root of AVE for each construct exceeded its correlations with all other constructs, demonstrating that each construct is more closely related to its own items than to other constructs in the model. In addition, the loadings of individual indicators were examined according to Chin (1988), showing that each item loaded highest on its intended construct rather than on any other construct. The squared correlations among constructs ranged from 0.286 to 0.849, below the recommended maximum of 0.85 (Kline, 2005), further supporting discriminant validity. Overall, these results confirm that the constructs in this study are conceptually and empirically distinct, satisfying both convergent and discriminant validity, and demonstrating the reliability and robustness of the measurement model (Hulland, 1999; Trochim, 2006; Fornell & Larcker, 1981).

4.5. Reliability analysis

The internal consistency of the measurement model was evaluated to ensure that the items reliably measured their intended constructs, including servant leadership, team psychological safety, team potency, team innovative performance, and environmental uncertainty. According to Nunnally (1978), a Cronbach's alpha value greater than 0.70 indicates acceptable reliability, while Carmines and Zeller (1979) recommend a more conservative threshold of 0.80. Following these guidelines, and consistent with Hair et al. (2012) and Nunnally and Bernstein (2007), a value of 0.70 or higher was used as the benchmark for acceptable internal consistency. In this study, the composite reliability (CR) values for all constructs ranged from 0.903 to 0.956, well above the 0.70 threshold, indicating that the items within each construct were highly consistent. Table 1.3 details the factor loadings and the number of items per construct, further demonstrating that the measurement instrument is both stable and dependable. These results confirm that the survey instrument provides reliable measurement across all constructs, supporting the robustness and credibility of the data used for subsequent analyses.

Table 1.4. Discriminant validity of constructs HTMT.

	Affiliation	Humility	authemticity empowerment	empowerment	environmenal uncertainly	innovativeness	servant leadership	standing back	stewardship	team climates	team innovative performance	team potency	team psychological safety	trust	environmenal uncertainly x team potency	team climates x servant leadership	team climates x team psychological safety
Affiliation																	
Humility	0.202																
authemticity empowerment	0.078	0.589															
empowerment	0.124	0.634	0.598														
environmenal uncertainly	0.211	0.078	0.153	0.141													
innovativeness	0.512	0.098	0.067	0.044	0.172												
servant leadership	0.176	0.861	0.852	0.910	0.145	0.073											
standing back	0.182	0.591	0.605	0.555	0.148	0.067	0.819										
stewardship	0.153	0.662	0.670	0.558	0.052	0.039	0.849	0.595									
team innovative performance	0.166	0.531	0.473	0.485	0.100	0.060	0.591	0.456	0.473	0.143							
team potency	0.103	0.487	0.431	0.462	0.051	0.034	0.577	0.498	0.491	0.084	0.533						
team psychological	0.182	0.474	0.384	0.499	0.067	0.129	0.560	0.449	0.447	0.153	0.406	0.467					

	Affiliation	Humility	authemticity empowerment	empowerment	environmenal uncertainly	innovativeness	servant leadership	standing back	stewardship	team climates	team innovative performance	team potency	team psychological safety	trust	environmenal uncertainly x team potency	team climates x servant leadership	team climates x team psychological safety
safety																	
trust	0.522	0.061	0.034	0.035	0.262	0.580	0.049	0.035	0.041	0.947	0.101	0.054	0.061				
environmenal uncertainly x team potency	0.041	0.168	0.145	0.158	0.087	0.097	0.180	0.107	0.149	0.072	0.415	0.085	0.098	0.051			
team climates x servant leadership	0.115	0.071	0.023	0.037	0.077	0.071	0.044	0.020	0.027	0.088	0.022	0.252	0.134	0.026	0.055		
team climates x team psychological safety	0.152	0.066	0.102	0.091	0.060	0.112	0.120	0.091	0.147	0.141	0.087	0.247	0.097	0.076	0.003	0.422	

Table 1.4. (*Continued*)

4.6. Structural model

This study tested a total of eight hypotheses, of which five examined the direct relationships between the latent constructs. The results of these direct hypotheses, summarized in **Table 1.5**, reveal that the estimated path coefficients for all significant relationships ranged between 0.101 and 0.675, falling within the theoretical range of 0 to +1. The bootstrapping procedure in PLS SEM revealed that the relationships between servant leadership and team innovative performance (β = 0.297, t-value = 5.095), servant leadership and team potency (β = 0.420, t-value = 7.803), team potency and team innovative performance (β = 0.275, t-value= 5.206), team psychological safety and team innovative performance (β = 0.062, t-value = 3.314) as well as team psychological safety and team potency (β = 0.208, t-value = 4.069) were significant at α = 0.01. These results testify that, H1, H2, H3, H4, and H5 were supported. Additionally, the BCa bootstrap confidence intervals for all these path coefficients did not straddle a zero, affirming the significance of the relationships (Hair et al., 2022). This study applied bootstrapping the indirect effect technique for mediation analysis, which is known for generating a more rigorous result than the conventional causal procedures (Hayes, 2009). The findings of the mediation analysis using a one-tailed bootstrapping procedure with 10,000 subsamples are illustrated in **Table 1.5**. The results showed that the indirect effect of servant leadership on team innovative performance through team potency is statistically significant (β = 0.115, t-value =4.113, p <0.01). Similarly, team potency also significantly mediates the relationship between psychological safety and team innovative performance (β = 0.057, t-value=3.184, p < .001). According to Preacher & Hayes (2004, 2008), the existence of mediation effect is assured when the 95% bootstrapped confidence intervals do not straddle a zero. As indicated in **Table 1.5**, the lower limits and upper limits of BCa confidence intervals did not straddle a zero; thus, H6 and H7 were supported. **Table 1.5** presents the R^2 value for each endogenous construct of the present research model. Based on the findings, servant leadership and team psychological safety explained 39.7% of the variance in team potency. Subsequently, team psychological safety, servant leadership and team potency collectively explained 45.2% of the variance in team innovative performance construct. Following the guideline by Cohen (1988), both the R^2 values indicated a substantial predictive accuracy by exceeding the threshold of 0.26. Based on Cohen's (1988) guideline, f^2 values of 0.02, 0.15 and 0.35 can be interpreted as small, medium and substantial effects, respectively. Thus, as reported in **Table 1.5**, servant leadership shows a medium effect on team potency, whilst Servant leadership indicates a small effect on team innovative performance. Also, team psychological shows a small effect on team innovative performance and team potency. Next, team potency indicates a small effect on team innovative performance. Overall, servant leadership reported a higher f^2 value in team potency, indicating a relatively greater contribution to the R^2 value of team innovative performance compared with other predictors.

Table 1.5. Assessment of structural model.

	Relationship	Std.beta	Std. error	p-value	t-value	BCI LL	BUI UL	f^2	Effect size
H1	Servant leadership->team innovative performance	0.115	0.028	p <.001	4.113	0.200	0.391	0.093	small
H2	Team psychological safety->team innovative performance	0.062	0.047	p <.001	3.314	0.013	0.142	0.081	small
H3	Servant leadership->team potency	0.420	0.054	p <.001	7.803	0.330	0.506	0.193	medium
H4	Team psychological safety->team potency	0.208	0.051	p <.001	4.069	0.123	0.293	0.046	small

	Relationship	Std.beta	Std. error	p-value	t-value	BCI LL	BUI UL	f^2	Effect size
H5	team potency->team innovative performance	0.275	0.053	p <.001	5.206	0.189	0.363	0.092	small
H6	Servant leadership->team potency->team innovative performance	0.115	0.028	p <.001	4.113	0.074	0.168	0.0132	small
H7	Team psychological safety->team potency->team innovative performance	0.057	0.018	p <.001	3.184	0.032	0.092	0.0032	none
H8	Environmental uncertainly x Team potency->team innovative performance	0.317	0.059	p <.001	5.346	0.237	0.406	0.176	Medium
	Coefficient of Determination Endogenous variables	R^2							
	Team potency	0.397							
	Team innovative performance	0.452							

Table 1.5. (*Continued*)

The bootstrapping procedure with one-tailed test and 10,000 subsamples in this study insinuated significant results for all moderation relationships as reported in **Table 1.5**. Therefore, H8 were supported. To further examine the moderating effects of team climate and environmental uncertainty, this study followed the approach suggested by Dawson (2014), which recommends plotting interaction effects to visually demonstrate how moderators influence the relationships between constructs. As shown in **Figure 1.2**, the relationship between team potency and team innovative performance was stronger when environmental uncertainty was low. This suggests that in more stable environments, confident and capable teams are better able to channel their potency into innovative outcomes, whereas under high uncertainty, external turbulence may weaken this translation. Collectively, these interaction plots confirm the presence of moderation effects, demonstrating that both team climate and environmental uncertainty shape the strength of key relationships in the model. However, the empirical evidence shows that the moderating influence of environmental uncertainty is not fully consistent with initial expectations, as its effect was significant only under conditions of low uncertainty. This highlights the importance of contextual factors in determining how leadership, team dynamics, and external conditions interact to drive team innovation.

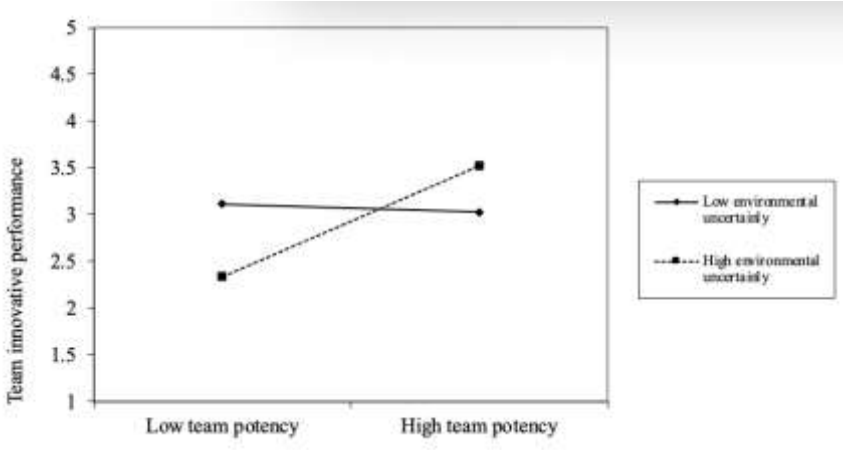

Figure 1.2. Interaction Plot for environmental uncertainty x team potency-> team innovative performance.

4.7. Discussion and findings

The findings of this study provide a comprehensive understanding of how servant leadership and team psychological safety contribute to team innovation performance among high-tech enterprise employees in China, highlighting the mediating role of team potency and the moderating effect of environmental uncertainty. Using structural equation modeling, the results reveal that servant leadership significantly enhances both team psychological safety and team potency, which in turn positively influence team innovation performance. These results are consistent with the principles of Path-Goal Theory, which posits that leaders play a key role in clarifying goals, removing obstacles, and fostering a supportive environment that enables teams to perform effectively. Servant leaders, by prioritizing employee development, empathy, and empowerment, create a culture of trust and inclusion that encourages creative collaboration and innovation.

The findings further confirm that team psychological safety acts as a crucial mechanism linking servant leadership to innovation. Teams led by servant leaders tend to experience higher levels of interpersonal trust and openness, allowing members to express ideas, challenge existing assumptions, and take calculated risks without fear of negative consequences. This aligns with previous research emphasizing that psychological safety is essential for stimulating creativity and learning behaviors within knowledge-intensive and dynamic sectors such as China's high-tech industry. Through servant leadership, employees feel valued and supported, which lowers interpersonal barriers and promotes collective experimentation—key drivers of innovation.

Team potency was found to play a mediating role between servant leadership and team innovation performance. Specifically, servant leadership fosters a shared belief among team members in their collective ability to achieve goals and overcome challenges. This heightened sense of efficacy and confidence encourages teams to pursue innovative ideas, persist through difficulties, and coordinate efforts more effectively. The mediating effect of team potency suggests that leadership influences innovation not only by shaping team attitudes but also by strengthening collective capability and motivation. This finding supports the High-Level Echelon Theory, which emphasizes that leaders' values and behaviors influence team cognition and performance outcomes.

Furthermore, environmental uncertainty was found to moderate the relationship between team potency and team innovation performance. Under conditions of high environmental uncertainty—such as rapid technological change, shifting market demands, and competitive pressures—the positive impact of team potency on innovation becomes stronger. This indicates that when the external environment is unstable, teams with high confidence and adaptability are more likely to innovate successfully. Conversely, in stable environments, the importance of team potency may diminish as standardized processes dominate. This moderating effect underscores the need for leadership and team resilience in uncertain contexts, which are characteristic of China's high-tech sector.

Overall, the study provides empirical evidence that servant leadership indirectly enhances team innovation performance through its impact on psychological safety and team potency, with environmental uncertainty amplifying the influence of collective efficacy on innovation outcomes. These findings contribute to leadership and innovation research by integrating Path-Goal and High-Level Echelon perspectives, demonstrating how servant leaders build psychological safety and team confidence that drive innovation in volatile environments. In the context of China's high-tech enterprises, where rapid technological advancements and global competition prevail, servant leadership emerges as a strategic approach for cultivating empowered, cohesive, and innovative teams capable of sustaining competitive advantage.

4.8. Theoretical contribution

This study makes several important theoretical contributions to the existing literature on leadership and team innovation, particularly within the context of China's high-tech enterprises. First, it extends the application of Path-Goal Theory by empirically demonstrating how servant leadership functions as a facilitative leadership style that enhances team innovation performance through the creation of supportive psychological and motivational conditions. Traditional applications of Path-Goal Theory have focused primarily on directive or achievement-oriented leadership behaviors; however, this study positions servant leadership as a distinct path-clarifying approach that empowers employees by emphasizing empathy, ethical behavior, and shared purpose. By highlighting the indirect pathways through psychological safety and team potency, the research deepens understanding of how servant leaders remove barriers and provide resources that promote collective creativity and performance.

Second, the study contributes to the High-Level Echelon Theory by illustrating how leadership behaviors at the upper level influence team cognition and efficacy beliefs. Specifically, servant leadership was found to strengthen team potency—a shared belief in the team's competence—which subsequently drives innovation. This finding broadens the theoretical scope of High-Level Echelon Theory by identifying servant leadership as a leadership form that not only shapes cognitive alignment but also fosters collective confidence, resilience, and adaptability in uncertain environments. It provides empirical evidence that leader values emphasizing service and development can translate into shared psychological resources that enhance team-level innovation outcomes.

Third, the integration of team potency as sequential mechanisms contributes to a more nuanced understanding of the internal dynamics linking leadership to innovation. Previous research has often examined these constructs independently; this study demonstrates their interconnectedness within a unified framework. Servant leadership promotes psychological safety, which encourages open communication and experimentation, and this safe environment strengthens team potency by reinforcing members' collective confidence in their ability to execute innovative ideas. The identification of this mediating chain enriches existing leadership and innovation models by clarifying how interpersonal and cognitive team processes jointly mediate leadership effects.

Fourth, by introducing environmental uncertainty as a moderating factor, the study advances contextual leadership theory by demonstrating that external conditions can amplify or attenuate the impact of team-level variables on innovation. The finding that team potency has a stronger positive effect on innovation under high uncertainty provides empirical support for the contingency perspective of leadership, suggesting that the effectiveness of internal team resources depends on the surrounding environmental context. This offers a more dynamic theoretical view that integrates both internal (team) and external (environmental) factors in shaping innovative performance.

Finally, the study makes a contextual contribution by validating these theoretical relationships within China's high-tech industry—an environment characterized by rapid technological change, intense competition, and collectivist work values. By doing so, it expands the cultural boundary of servant leadership and team innovation theories, illustrating that the relational and empowering aspects of servant leadership are highly effective in collectivist and innovation-driven contexts. This cross-cultural evidence enriches global leadership theory by showing how servant leadership can align with both Chinese cultural norms and the strategic demands of high-tech enterprises.

Environmental uncertainty plays a crucial role in shaping the relationship between servant leadership, team psychological safety, team potency, and team innovation performance, particularly in high-tech

enterprises operating within China's rapidly changing business environment. Drawing upon Dynamic Capabilities Theory (DCT), environmental uncertainty heightens the need for teams to continuously sense opportunities and threats, seize emerging possibilities, and reconfigure resources to sustain innovative performance. Servant leadership facilitates these dynamic capabilities by fostering an environment of trust, empowerment, and support, enabling team members to share information freely, experiment with new ideas, and adapt to change effectively. In such uncertain environments, team psychological safety becomes essential for encouraging open dialogue and learning from failure, while team potency enhances collective confidence to act decisively on opportunities. From the lens of Contingency Theory, the effectiveness of leadership and team processes is contingent upon environmental conditions. Under low uncertainty, stable routines and hierarchical control may suffice, but as uncertainty intensifies, the value of servant leadership and psychologically safe, potent teams increases. In high-uncertainty contexts, servant leaders play a pivotal role in buffering teams from external pressures, clarifying goals, and motivating proactive learning and adaptation. Consequently, environmental uncertainty acts as a boundary condition and moderator that strengthens the indirect effects of servant leadership on team innovation through psychological safety and team potency. In the high-tech industry of China—characterized by technological turbulence, rapid market evolution, and institutional transitions—these dynamics are particularly salient. By integrating Dynamic Capabilities Theory and Contingency Theory, this study positions environmental uncertainty not merely as a contextual backdrop but as a central theoretical mechanism that amplifies the pathways from servant leadership to innovation performance through enhanced team adaptability, collective efficacy, and a safe climate for exploration.

In summary, this study offers a comprehensive theoretical framework that connects servant leadership, psychological safety, team potency, and environmental uncertainty to explain team innovation performance. It bridges motivational, cognitive, and contextual perspectives, thereby advancing the understanding of how leadership shapes team innovation in complex and uncertain organizational environments.

4.9. Practical contribution

The practical contributions of this study offer valuable insights for managers, organizational leaders, and policymakers in China's high-tech industry seeking to enhance team innovation performance. First, the findings highlight the importance of adopting a servant leadership style to cultivate innovation-driven teams. Leaders who emphasize serving others, supporting employees' development, and prioritizing collective success can effectively build trust, empowerment, and open communication within their teams. High-tech enterprises should therefore integrate servant leadership training into leadership development programs to strengthen leaders' ability to foster creativity and collective problem-solving under dynamic market conditions.

Second, the study underscores that team psychological safety is a critical mechanism through which servant leadership enhances innovation. Managers should create environments that encourage idea sharing and constructive dialogue, where employees feel safe to challenge assumptions and voice unconventional solutions. Practical measures—such as open feedback systems, non-punitive error reporting, and recognition of risk-taking behaviors—can strengthen psychological safety and, in turn, stimulate innovation.

Third, the results reveal that team potency significantly contributes to innovation performance, particularly when supported by servant leadership behaviors. Organizations should focus on developing team confidence and collective efficacy by setting clear goals, providing skill-building opportunities, and celebrating team achievements. By reinforcing a shared belief in the team's capabilities, leaders can motivate

employees to pursue ambitious innovation goals and sustain high performance even in uncertain environments.

Fourth, the moderating role of environmental uncertainty suggests that high-tech firms must enhance their adaptability and resilience strategies. Managers should regularly assess environmental changes and equip teams with flexible structures and decision-making autonomy to respond swiftly to technological or market shifts. Servant leaders who empower teams to act independently while maintaining strong communication channels can help the organization remain innovative and competitive amid volatility.

Finally, this study provides guidance for organizational policymakers. Firms should institutionalize leadership and team development practices that align with servant leadership principles—such as participative decision-making, continuous learning, and employee well-being programs—to build a culture that supports sustained innovation. In the context of China's rapidly evolving high-tech sector, these practices can help enterprises navigate uncertainty, maintain employee engagement, and achieve long-term innovation success.

4.10. Limitations and future directions

Despite providing valuable theoretical and practical insights, this study has several limitations that should be acknowledged. First, the research is cross-sectional in nature, which limits the ability to infer causal relationships among servant leadership, team psychological safety, team potency, environmental uncertainty, and team innovation performance. Future studies employing longitudinal or experimental designs could provide stronger evidence of causality and better capture the dynamic evolution of leadership influence and team innovation over time.

Second, the data were collected solely from high-tech enterprises in China, which may restrict the generalizability of the findings to other industries or cultural contexts. The unique organizational culture, hierarchical structures, and collectivist values prevalent in Chinese high-tech firms may have influenced the relationships observed in this study. Comparative studies across different sectors or countries could help determine whether these findings hold true in other cultural and industrial settings.

Third, this study relied on self-reported data from employees, which raises the potential for common method bias and social desirability effects. Although statistical measures were used to minimize these biases, future research should incorporate multi-source data—such as leader evaluations, peer assessments, or objective innovation indicators—to enhance the robustness of the results.

Fourth, environmental uncertainty was measured at the perceptual level rather than using objective indicators such as market volatility or technological disruption indices. This may not fully capture the complexity of external environmental dynamics affecting innovation. Incorporating both subjective and objective measures in future studies could yield a more comprehensive understanding of how uncertainty interacts with leadership and team factors.

Finally, the model did not include other potential mediators or moderators that may influence the relationship between servant leadership and team innovation performance, such as team diversity, learning orientation, or organizational support. Future research could expand the model to include these variables to provide a more holistic view of the mechanisms driving innovation in high-tech teams.

While this study contributes significantly to understanding how servant leadership and team dynamics foster innovation in uncertain environments, its limitations suggest opportunities for further refinement through broader samples, diverse methods, and more longitudinal perspectives.

Conflicts of Interest

The authors declare no conflicts of interest.

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