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The impact of coworker support toward team cohesion and transactive memory system collaboration: Moderating roles of intergenerational affect in the mining industry

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Abstract Intergenerational communication within the coal mining industry poses significant challenges because employees from diverse age groups must collaborate effectively in environments characterized by high risk and limited physical interaction. This study examines how instrumental and emotional support from coworkers influences team cohesion and collaboration within a transactive memory system, while also examining the moderating influence of positive intergenerational affect. Data were collected from 349 employees across the plant, engineering, and operations departments and analyzed using partial least squares structural equation modeling (PLS-SEM). The results show that instrumental support consistently exerts a positive impact on both team cohesion and collaboration, underscoring its role as a reliable mechanism for promoting coordination in technical and safety-sensitive industries. Interestingly, this positive effect remains stable even when moderated by intergenerational affect, suggesting that practical support is universally valued regardless of emotional conditions. In contrast, emotional support does not significantly enhance team cohesion or collaborative processes, and when moderated by positive intergenerational affect, its effect may even become negative, indicating that excessive emotional involvement can complicate team dynamics in multigenerational contexts. These findings address a notable gap in the literature by demonstrating that emotional support, often considered beneficial, can in fact hinder collaboration when overemphasized in environments where efficiency and accuracy are critical. Conversely, instrumental support proves to be a resilient driver of knowledge sharing and coordination. The study contributes theoretically by integrating social mindfulness theory and socioemotional selectivity theory into the mining context and provides practical implications for managers, who should prioritize structured, task-oriented support while managing emotional exchanges carefully. Ultimately, the research offers new insights into intergenerational work dynamics, emphasizing that balancing cognitive and emotional resources is crucial to enhancing team performance and organizational resilience in high-risk industries.

Keywords: knowledge sharing, team performance, workplace efficiency, high-risk industries

1. Introduction

The dynamics of intergenerational communication in the workplace have become an increasingly significant concern across various industries, including the coal mining industry (Sallay et al., 2024; Mărginean, 2021). Differences in age, experience, and communication preferences can challenge intergenerational workplace interactions, affecting team effectiveness and collaboration (Fasbender & Gerpott, 2022; Pugliese et al., 2024; McKee et al., 2024; Lyngdoh et al., 2023; Aggarwal et al., 2022). Understanding the psychological and social factors underlying intergenerational interactions is crucial for ensuring smooth workflows and enhancing organizational productivity (van Zoonen, 2023; ter Hoeven & van Zoonen, 2023; Pfrombeck et al., 2023; Becker et al., 2023).

Previous research has highlighted the importance of intergenerational communication in the workplace. However, many studies have focused on structural and organizational hierarchies without exploring the sociocognitive and emotional factors influencing communication patterns and team collaboration (Pfrombeck et al., 2023). For example, the study by Fasbender and Gerpott (2022) emphasized the importance of knowledge transfer between generations but did not elaborate on how social and emotional aspects can strengthen or hinder intergenerational collaboration. Another essential factor to consider is how generational differences in communication and social interaction can lead to miscommunication and decreased team effectiveness (Fasbender & Rudolph, 2023; van Zoonen, 2023; Diehl et al., 2021; Vickerstaff & Van der Horst, 2021). Therefore, a gap remains in the literature regarding how emotional and instrumental support from colleagues can facilitate

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more harmonious communication and enhance team cohesion in a multigenerational workplace environment (El Khawli et al., 2023; Puglise et al., 2024; ter Hoeven & van Zoonen, 2023; Rudolph & Zacher, 2021).

This study considers social mindfulness theory and socioemotional selectivity theory as its primary conceptual frameworks to fill this gap. The present study is expected to contribute to the body of knowledge by understanding how positive intergenerational affect influences mining industry workers, who require team cohesion and collaboration. Given the exposure to high risks, the mining context is crucial to explore; therefore, collaboration is essential to avoid mistakes that could lead to negative impacts. How does coworkers' support (emotional and instrumental) influence team cohesion and knowledge sharing in a multigenerational environment?

Social mindfulness theory explains how individuals consider others' perspectives in social interactions, making it highly relevant in the context of emotional support. It emphasizes social awareness and empathy in interpersonal interactions (Pfrombeck et al., 2024; El Khawli et al., 2023; Fasbender & Gerpott, 2022). Socially mindful individuals offer more emotional support to colleagues by listening, expressing empathy, and creating a supportive workplace. This mindfulness helps team members in intergenerational groups better understand emotional needs, improving relationships and strengthening team cohesion (El Khawli et al., 2022; Voci & Hewstone, 2003). Socioemotional selectivity theory explains instrumental support, illustrating how social preferences change with age. Older individuals focus on meaningful relationships, whereas younger individuals prioritize relevant information for work goals (Carstensen, 2021).

Socioemotional selectivity theory explains that generations give and receive instrumental support differently; younger individuals focus on technical help, whereas older individuals prioritize the sharing of experiential knowledge (Ng & Sorensen, 2008; Shin et al., 2020). Organizations can recognize these differences and improve communication strategies to cater to generational support preferences.

This study examines how instrumental and emotional support fosters team cohesion and collaboration in coal mining while evaluating how positive views of intergenerational interactions influence these dynamics. By applying social mindfulness theory and socioemotional selectivity theory, this research deepens the understanding of intergenerational communication and offers strategies for effective communication in multigenerational workplaces. Van Doesum et al. (2013) define social mindfulness as an orientation that considers the needs of others, consisting of perspective-taking (cognitive) and empathetic concern (emotional). Perspective-taking helps individuals understand their colleagues' thoughts, and empathetic concern enables them to feel others' experiences.

On the other hand, the socioemotional selectivity theory (SST) proposed by Carstensen (1991, 1992, 2006) explains how individuals' perceptions of time change with age and influence their priorities. As people grow older, they tend to have a more limited sense of time, which motivates them to seek more meaningful social interactions and positive emotional experiences in the present. In the workplace context, this theory suggests that older employees who perceive their remaining work time as increasingly limited are more likely to support their colleagues through high-quality interactions.

Accordingly, this study seeks to examine how instrumental and emotional coworker support influence team cohesion and collaboration within a transactive memory system in the coal mining industry. It further aims to analyze the moderating role of positive intergenerational affect in these relationships and to investigate the extent to which team cohesion and collaboration contribute to team performance in high-risk work settings. Beyond empirical testing, the study also intends to extend theoretical understanding by applying social mindfulness theory and socioemotional selectivity theory to intergenerational workplace dynamics, while at the same time offering practical insights for managers to design strategies that balance instrumental and emotional support in order to strengthen teamwork and organizational resilience.

1.1. Instrumental Coworkers' Support

Instrumental coworker support refers to tangible assistance provided by colleagues through resources, information, or technical guidance that aids in task completion (Shin et al., 2020; Wang et al., 2024). This type of support is crucial for enhancing work effectiveness, reducing task-related obstacles, and accelerating team goal achievement.

In previous research, Fasbender et al. (2020) and El Khawli et al. (2023) reported that instrumental support from coworkers is crucial in reducing work stress and role conflict, positively impacting individual performance. Furthermore, Xu et al. (2017) and Harris et al. (2024) reported that a work environment that provides strong instrumental support enables employees to navigate job challenges more efficiently, improve task efficiency, and foster stronger working relationships among team members.

Schei et al. (2023) also highlighted that tangible support from coworkers improves work coordination and collaboration. In line with these findings, Hundschell et al. (2024) revealed that a high level of instrumental coworker support within a team enhances individual productivity and strengthens bonding and a sense of unity among team members, directly influencing team cohesion.

Team cohesion refers to bonding and collaboration among team members in working toward a common goal (Schei et al., 2023). High team cohesion enables better coordination, synergy in decision-making, and enhanced teamwork within the group.

Instrumental support from coworkers can strengthen team cohesion through various mechanisms. When team members receive tangible assistance from information, resources, or technical support, they feel more supported in completing their tasks (van der Voet & Steijn, 2021). This sense of mutual assistance fosters a more supportive work environment, enhances trust among team members, and improves coordination in achieving shared goals (Xu et al., 2017; Umar & Ko, 2022; Gonzalez-Mulé et al., 2020; Yang & Lin, 2022).

With a high level of instrumental support, each team member can adapt more quickly to work dynamics, strengthening a sense of unity and enhancing team cohesion. Therefore, we hypothesize the following:

H1: Instrumental coworker support is positively related to team cohesion.

1.2. Emotional Coworkers' Support

Coworker support is crucial in creating a positive and harmonious work environment. Emotional coworker support refers to psychosocial support, such as empathy, recognition, attention, and mutual trust among team members (Xu et al., 2017). Fasbender et al. (2019) emphasized that emotional support can enhance employee well-being by fostering a sense of security and connection within the team.

Additionally, Iweins et al. (2013) highlighted that in multigenerational teams, emotional support can strengthen interpersonal relationships, reduce misunderstandings, and build trust among team members from different backgrounds. Emotional coworker support fosters a collaborative work environment by enhancing social relationships, improving well-being, and promoting teamwork (Clercq & Pereira, 2021; Baumler & Piercy, 2024; ter Hoeven & van Zoonen, 2023; Mathieu et al., 2019; Xu et al., 2017; Xu et al., 2015; Ng & Sorensen, 2008; Tam et al., 2007). Strong emotional coworker support encourages solidarity and more profound team attachment.

Emotional support from coworkers enhances employee resilience in dynamic work environments. Fasbender et al. (2020) reported that when individuals feel supported by teammates, they manage work pressure better and remain motivated. This support fosters open communication and an inclusive atmosphere where everyone feels valued (Schei et al., 2023). Consistent emotional coworker support makes team members more likely to assist each other and strengthen work relationships (Hundschell et al., 2024).

High emotional coworker support strengthens team cohesion, fosters belonging, enhances trust, and promotes collaboration (Xu et al., 2017). Therefore, team members receiving emotional support from coworkers are more motivated to collaborate and maintain harmony (Tolan et al., 2023). Therefore, we hypothesize the following:

H2: Emotional coworker support is positively related to team cohesion.

1.3. Transactive Memory System (TMS) Collaboration

Transactive memory system (TMS) collaboration is a knowledge-sharing system within a team that enables members to identify, store, and access information on the basis of their understanding of each individual's expertise (Zhang et al., 2024). This system involves task distribution and work coordination on the basis of the team's awareness of "who knows what" or who possesses specific knowledge within the group (Leo et al., 2023). With this understanding, team members can collaborate more effectively, enhance work efficiency, and support team-based innovation (Schei et al., 2023).

One key factor in strengthening TMS Collaboration is instrumental coworker support. Instrumental support refers to concrete assistance provided by colleagues in the form of resources, information, or technical help needed to complete tasks (Xu et al., 2017). In a teamwork context, this support enables individuals to access relevant information more easily, accelerating knowledge sharing and enhancing team coordination effectiveness.

According to Shin et al. (2020), when coworkers provide a high level of instrumental support, team members become more capable of relying on one another in task allocation and information management. This strengthens trust in colleagues' competencies and promotes the development of a more effective transactive memory system. Furthermore, Leo et al. (2023) added that strong instrumental support enhances team credibility and accelerates information flow, thereby strengthening coordination in TMS Collaboration.

With optimal instrumental support, team members can more easily integrate and utilize the available knowledge within the group, enhancing work efficiency and supporting the development of a more responsive transactive memory system in addressing organizational challenges (Zhang et al., 2024; Rahmani et al., 2023; van Zoonen et al., 2023; Dietz et al., 2022; Wion et al., 2022; Mariano et al., 2020; Salthouse, 1996). When team members receive assistance from resources or relevant information, they become more capable of relying on the transactive memory system to improve team coordination and effectiveness (Shin et al., 2020). Additionally, a smoother flow of information helps team members understand their colleagues' expertise and optimize specialization within the team (Leo et al., 2023; Estrich et al., 2022). Therefore, we hypothesize the following:

H3: Instrumental coworker support has a positive relationship with TMS collaboration.

Emotional support from coworkers plays a crucial role in strengthening transactive memory system (TMS) collaboration by fostering a more supportive and harmonious work environment. Emotional support includes expressions of empathy,

attentiveness, and psychological encouragement provided by team members to their colleagues, helping reduce work-related stress and enhancing the emotional well-being of individuals within the team (Xu et al., 2017). When team members feel emotionally supported, they are more likely to share information, build trust, and demonstrate openness in collaboration, ultimately reinforcing the transactive memory system within the team.

Fasbender et al. (2020) and Shin et al. (2020) emphasized that a work environment with high levels of emotional support can enhance interpersonal relationships within the team, contributing to more effective communication and better coordination. Open communication enables team members to recognize each other's expertise and understand who possesses the specific information needed for task completion, which is the core of the transactive memory system (Sullivan & Short, 2011).

Additionally, research by Leo et al. (2023) suggests that emotional support from coworkers enhances collective efficacy and team cohesion, motivating team members to actively contribute to knowledge-sharing and coordination processes. In this context, individuals can more easily access the cognitive resources available within the team, enhancing work efficiency and improving the team's responsiveness to challenges.

Thus, emotional support from coworkers plays a crucial role in strengthening TMS Collaboration by increasing trust, increasing openness in information sharing, and increasing team coordination. Therefore, we hypothesize the following:
H4: Emotional coworker support has a positive relationship with TMS Collaboration.

1.4. Positive Intergenerational Affectivity

Positive intergenerational affect reflects comfort and affection in interactions among coworkers of different generations (Pfrombeck et al., 2024). It strengthens bonds between older and younger workers and reduces worries about negative evaluations when sharing knowledge. This effect helps diminish ageism perceptions, fostering harmonious relationships (King & Bryant, 2017).

In intergenerational workplaces, coworker support is essential for collaboration. Instrumental support involves task-oriented help, such as sharing resources and information (Fasbender et al., 2020; Bertolotti et al., 2015). It enhances team effectiveness by streamlining tasks, although its impact on cohesion may depend on the level of positive intergenerational affect within the team (Voci & Hewstone, 2003). Fasbender et al. (2023) and Doesum et al. (2013) highlighted that positive intergenerational affect has significant emotional and psychological benefits, particularly in improving the quality of workplace relationships across generations. Positive affect fosters more genuine and cooperative interactions among team members, ultimately enhancing employee engagement and reinforcing social bonds within the team.

Emotional connections among coworkers across generations foster openness, enhance information sharing, and promote a collaborative environment. Schei et al. (2023) underline the role of effective intrateam communication in strengthening cohesion, especially in intergenerational interactions. Positive intergenerational affect makes team members more comfortable collaborating, increasing the importance of instrumental coworker support for team cohesion. Thus, positive intergenerational affect reinforces the link between instrumental coworker support and team cohesion, ensuring that adequate support fosters collaboration, trust, and coordination. Therefore, we hypothesize the following:
H5: Positive intergenerational affect moderates the relationship between instrumental coworker support and team cohesion.

Emotional support from coworkers can strengthen team cohesion by creating a work environment filled with empathy and trust (Xu et al., 2017; Han et al., 2014). When team members feel emotionally supported by their colleagues, they are more likely to engage in positive interactions, enhance social bonds, and strengthen teamwork (Xu et al., 2017). However, the impact of emotional support is not always the same in every situation, as it depends on the extent to which team members feel comfortable interacting with coworkers from different generations.

Positive intergenerational affect can strengthen the relationship between emotional coworker support and team cohesion by enhancing comfort and trust in intergenerational interactions (Pfrombeck et al., 2024). When team members have a positive effect on colleagues from different generations, they are more open to receiving emotional support and find it easier to build interpersonal connections (Pfrombeck et al., 2024).

Conversely, in situations where positive affect is low, the emotional support provided by coworkers may not be well received or may even be ignored, thereby limiting its impact on team cohesion (Ng & Sorensen, 2008; King & Bryant, 2017).

Research by Bai et al. (2023) indicates that positive intergenerational affect strengthens team social relationships, enhances communication openness, and reinforces trust and collaboration. Additionally, Schei et al. (2023) emphasized that effective intrateam communication can amplify the impact of emotional support on team cohesion, especially in teams with members from different generations. When positive intergenerational affect is high, emotional support from coworkers becomes more effective in strengthening team cohesion, as individuals feel more valued, supported, and accepted within their workgroup (Yetkili et al., 2018).

On the basis of these findings, positive intergenerational affect strengthens the relationship between emotional coworker support and team cohesion by ensuring that the emotional support provided within the team is more effective in fostering a sense of unity, trust, and coordination among team members. Therefore, we hypothesize the following:

H6: Positive intergenerational affect moderates the relationship between emotional coworker support and team cohesion.

Bertolotti et al. (2015) reported that collaborative technologies and social networks enhance team effectiveness among diverse members. These tools allow members to access information and strengthen collaborative relationships efficiently. The transactive memory system (TMS) helps store, access, and share information, improving team efficiency (Yan et al., 2020). TMS collaboration relies on team members' ability to identify resources and share knowledge openly (Thomas & Finkelstein, 2023; Yan et al., 2021). Instrumental coworker support boosts TMS collaboration by providing assistance that helps team members access information and complete tasks efficiently (Ng & Sorensen, 2008). This support may include technical help, relevant resources, or guidance. Leo et al. (2018) highlight that a robust TMS enhances team effectiveness by integrating individual knowledge. This support is vital in intergenerational teams, enabling members of different ages to complement each other in terms of task completion and strengthening the knowledge-sharing system.

Positive intergenerational affect can strengthen the impact of instrumental coworkers' support on TMS collaboration. Zhang et al. (2024) highlighted that comfortable and supportive interactions among team members are crucial factors in the success of the TMS. When there is positive affect in intergenerational relationships, team members are more open to receiving assistance and find it easier to access and share information. Conversely, if positive affect is low, individuals may be reluctant to seek or accept help from coworkers of different generations, which can hinder the effectiveness of TMS Collaboration (Yuan et al., 2010).

Dulebohn and Hoch (2017) state that warm and supportive interactions within a team strengthen the mechanisms of trust, specialization, and coordination, which are core elements of the TMS. Therefore, positive intergenerational affect acts as a moderator that strengthens the relationship between instrumental workers' support and TMS collaboration. When positive affect is present, the assistance provided within the team is more easily accepted and integrated into the collective knowledge-sharing system, ultimately enhancing the effectiveness of intergenerational team collaboration. Therefore, we hypothesize the following:

H7: Positive intergenerational affect moderates the relationship between instrumental coworker support and TMS Collaboration.

Emotional coworker support is crucial for enhancing the effectiveness of transactive memory system (TMS) collaboration by fostering a supportive and empathetic work environment. Emotional support from coworkers, such as psychological encouragement and recognition of individual contributions, motivates team members to share information more openly and collaborate more effectively (King & Bryant, 2017). When team members feel valued and emotionally supported, they are more likely to participate in knowledge-sharing processes, rely on each other's expertise, and trust the information exchanged within the TMS system (Fasbender et al., 2021).

However, the effectiveness of emotional coworker support in strengthening TMS Collaboration may depend on the level of positive intergenerational affect within the team. Positive intergenerational affect refers to individuals' positive feelings toward coworkers from different generations, which shape the quality of intergenerational interaction and communication (Leo et al., 2018).

When individuals positively affect colleagues from different generations, they tend to be more receptive to emotional support and more trust in the information shared in collaborative processes (Zhang et al., 2024). This positive effect fosters a more inclusive environment where team members from different generations can support each other emotionally without psychological barriers or generational biases (Yan et al., 2021).

Conversely, in situations where intergenerational positive affect is low, the emotional support provided by coworkers may not be well received or may even be ignored. This can hinder the effectiveness of emotional coworker support in strengthening TMS Collaboration, as team members may be less motivated to share knowledge or trust information obtained from colleagues of different generations (Dulebohn & Hoch, 2017).

Thus, positive intergenerational affect is a moderating factor that strengthens the relationship between emotional coworker support and TMS collaboration, increasing the effectiveness of coworker emotional support in facilitating transactive memory system-based collaboration in multigenerational teams. Therefore, we hypothesize the following:

H8: Positive intergenerational affect moderates the relationship between emotional coworker support and TMS Collaboration.

1.5. Team Cohesion

Dulebohn et al. (2017) state that team cohesion is a condition in which team members feel bonded and committed to achieving common goals. It is crucial for enhancing interaction and developing solid relationships among team members. This is further reinforced by Gaute Schei et al. (2023), who argue that team cohesion is a dynamic process reflecting the group's tendency to remain united in achieving shared objectives and fulfilling the affective needs of its members.

Umar et al. (2022) explained that team cohesion is the strength of interpersonal relationships among team members that can enhance performance, increase satisfaction, and increase motivation. With strong cohesion, team members feel more

motivated and committed to achieving common goals, which in turn can improve overall learning effectiveness and experiences. This demonstrates the importance of building strong relationships within a group to achieve optimal outcomes.

Team cohesion is a multidimensional construct encompassing three dimensions: interpersonal attraction, commitment to tasks, and group pride (Van der Voet et al., 2021). This cohesion is considered a crucial prerequisite for fostering innovation within teams, as a cohesive team creates a psychologically safe environment for members to experiment, take risks, collaborate, and openly exchange ideas (Schei et al., 2023; Aziz et al., 2020). This enables the team to leverage complementary resources and collectively overcome challenges.

High team cohesion supports optimal team performance because strong collaboration results in more effective communication, reduces miscommunication, and accelerates decision-making processes. This allows the team to work more efficiently and remain focused on shared goals.

1.6. Team Performance

Team performance is the extent to which a team achieves its goals and executes tasks efficiently and effectively, reflecting the collective contributions of team members interacting with one another (Kurdi et al., 2020; Wang et al., 2024). Cohesion strengthens interpersonal relationships, builds trust, motivates members to perform better, and encourages efficient collaboration (Bertolotti et al., 2015). In this context, Schei et al. (2023) emphasize that strong team cohesion is key in enhancing team performance by fostering effective communication and seamless coordination among team members. This cohesion creates a harmonious work environment where members can easily share information and resolve conflicts.

Team cohesion is a key factor in team effectiveness and achieving organizational goals. Oh and Yoo (2023) reported that communication and team cohesion enhance the relationship between transformational leadership and performance, reinforcing the role of team cohesion in improving team effectiveness. In line with this, Pugliese et al. (2024) state that high team cohesion can generate a greater sense of belonging among team members, ultimately leading to improved work productivity. Team cohesion fosters a supportive, collaborative atmosphere in which members are motivated to work toward shared goals. This highlights that positive social dynamics within a team are crucial in predicting optimal performance outcomes.

Bertolotti et al. (2015) add that using collaborative technology and social networks in highly cohesive teams can support team effectiveness. Cohesion strengthens interpersonal relationships, builds trust, motivates members to perform better, and encourages efficient collaboration (Bertolotti et al., 2015). Strong team cohesion is influenced by factors such as team size and tenure, which can either enhance or weaken the impact of cohesion on team performance (Kurdi et al., 2023; Gonzalez-Mulé et al., 2020). When team members feel emotionally connected and maintain positive working relationships, high team cohesion can improve a team's effectiveness in completing tasks and achieving shared goals.

Alshurideh and Al Kurdi (2023) described team cohesion as facilitating smooth communication and helping teams constructively manage conflicts. Furthermore, team cohesion motivates members to contribute their best efforts toward achieving common objectives, directly impacting overall team performance improvement (Kipfelsberger et al., 2022). Therefore, we hypothesize the following:

H9: Team cohesion has a positive relationship with team performance.

Team cohesion and transactive memory system (TMS) collaboration interact to create a compelling and innovative work environment. Team cohesion, defined as the state in which team members feel connected and committed to achieving shared goals (Dulebohn et al., 2017), is crucial in fostering strong interactions and solid relationships among members. This dynamic process creates an environment where members feel motivated and engaged, ultimately enhancing learning effectiveness and overall team experience (Schei et al., 2023; Umar et al., 2022).

On the other hand, TMS Collaboration functions as a knowledge-sharing system that involves task allocation and collaboration on the basis of team members' understanding of each other’s expertise (Zhang et al., 2024). The quality of coworker interactions is key in building an effective TMS, where positive and empathetic interactions strengthen mutual trust among team members (Leo et al., 2023). When team cohesion is strong, effective intrateam communication can occur, enabling members to share information openly and support the development of a robust TMS.

Thus, high cohesion facilitates a TMS that is responsive to challenges, allowing team members to integrate their knowledge and collaborate to achieve common goals. Emotional connectedness and high-quality communication within the team enhance collective efficacy and team performance and create a psychologically safe environment for members to experiment and innovate. This highlights that team cohesion and TMS Collaboration are essential components in achieving optimal team performance and addressing complex challenges in the workplace. Therefore, we hypothesize the following:

H10: Team cohesion has a positive relationship with TMS collaboration.

The transactive memory system (TMS) contributes to team effectiveness by facilitating knowledge sharing and task specialization among team members. Yang and Lin (2022) highlighted that strong team cohesion and knowledge sharing enhance project success, reinforcing the role of the TMS in fostering synergy within teams. Members can optimize expertise, reduce redundancy, and improve decision-making by leveraging the TMS.

Transactive memory system (TMS) collaboration encompasses coordination and knowledge sharing among team members, which is crucial in enhancing team performance. Leo et al. (2023) reported that an effective TMS can strengthen team coordination, build trust among team members, and facilitate better information flow, all of which contribute to improved team performance. Yan et al. (2020) explained that communication within a TMS enables teams to access proper knowledge at the right time, thereby increasing task completion efficiency.

Zhang et al. (2024) further stated that effective knowledge management within the TMS supports the more coordinated achievement of team goals, accelerates decision-making processes, and reduces errors that may affect work outcomes. In this context, Dulebohn and Hoch (2017) highlighted that the TMS's ability to support coordination and information integration among team members is crucial, particularly in dynamic and virtual work environments where direct communication is limited.

A well-functioning TMS enables teams to operate optimally by leveraging each member's collective potential, enhancing collaboration, and improving overall team outcomes (Kurdi et al., 2023). With a strong TMS mechanism, teams can manage knowledge more effectively and create synergies that significantly improve team performance. Therefore, we hypothesize the following:

H11: TMS collaboration has a positive relationship with team performance.

Based on the literature review and hypotheses development, the conceptual framework of this study is proposed as shown in Figure 1.

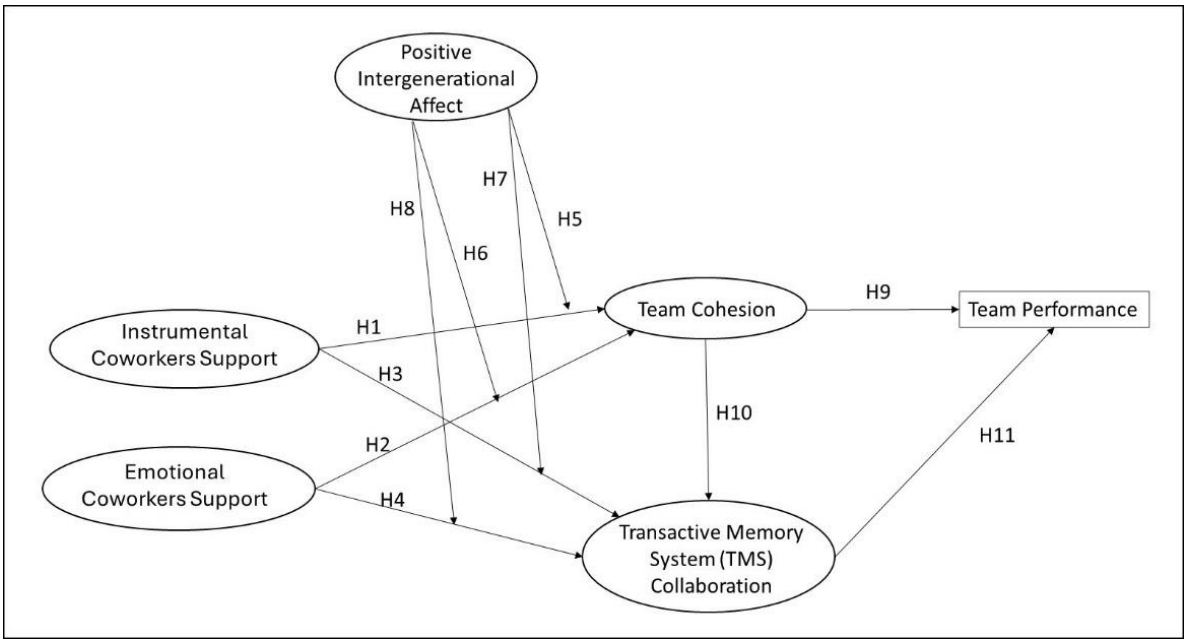

Figure 1 Theoretical Framework.

2. Materials and Methods

This research methodology implements a quantitative approach through online surveys that include closed-ended questions and Likert scales to measure communication preferences and perceptions of intergenerational challenges. Data are collected through purposive sampling. The unit of analysis of this study is individual workers from different generations in the coal mining industry, as well as generational groups (e.g., Generation X, Millennials, and Generation Z), to understand communication patterns within specific groups and across generations.

Descriptive statistics were used to analyze quantitative data through statistical measures such as the mean, minimum value, maximum value, and standard deviation. Data were collected cross-sectionally in Indonesia over three months (November 2024 to January 2025). Additionally, a preliminary test (pretest) was conducted with 40 respondents to validate the questionnaire, where feedback regarding clarity and potential ambiguities was used to refine the questions.

2.1. Variable Measurement

Responses were collected via convenience sampling and systematically structured on a 5-point Likert scale through the Google Forms platform. Instrumental and emotional coworker support were measured via scales adapted from Darke et al. (2024), with five and six indicators, respectively. Positive intergenerational affect was assessed via four indicators from King & Bryant (2016). Team cohesion was evaluated via five indicators adapted from Sullivan & Short (2011). Transactive memory system (TMS) collaboration was measured via six items from Leo et al. (2018). Team performance was assessed via four items adopted from Bertolotti et al. (2015). A summary of the variable measurements is presented in Table 1.

Table 1 Operationalization of Variables.

Variable	Code	Measured Item
Instrumental Coworkers Support	ICS 1	My coworkers help me when things get demanding
	ICS 2	My coworkers help me even I do not directly ask for help
	ICS 3	My coworkers assist me with heavy workloads
	ICS 4	My coworkers help me when I am running behind in my work
	ICS 5	My coworkers go out of their way to help me with work problems
Emotional Coworkers Support	ECS 1	My coworkers listen to me when I must get something off my chest
	ECS 2	My coworkers take time to listen to my concerns
	ECS 3	My coworkers take a personal interest in me
	ECS 4	My coworkers try to cheer me up when I am having a bad day
	ECS 5	My coworkers try to make me feel welcome in the work group
	ECS 6	My coworkers treat me as one of the team
Positive Intergenerational Affect	PIA 1	I feel comfortable when coworkers outside my generation try to make conversation with me
	PIA 2	I enjoy interacting with coworkers of different generations
	PIA 3	My coworkers outside my generation are interesting and unique individuals
	PIA 4	People work best when they work with others their same age
Team Cohesion	TC 1	When our team communicates, we get all problems out in the open
	TC 2	When our team communicates, we trust each other
	TC 3	When our team disagreements arise, we try to communicate directly with those (with whom) we have a problem
	TC 4	When our team communicates, we share thoughts with one another
	TC 5	Our team is united in trying to reach its goals for performance
Transactive Memory System (TMS) Collaboration	TMSC 1	Each team member has specialized knowledge of some aspect of our play
	TMSC 2	Different team players are responsible for expertise in different phases of the game
	TMSC 3	I feel comfortable accepting suggestions from my teammates about the game
	TMSC 4	I am clear that the skills and efforts of my colleagues are adequate
	TMSC 5	Our team worked together in a well-coordinated fashion
	TMSC 6	We are training and competing effectively and without problems
Team Performance	TP 1	Completing work on time
	TP 2	Completing work within budget
	TP 3	Satisfaction of the client with the quality of team output, and
	TP 4	Satisfaction with overall performance

Source: (Darke et al., 2024; King and Bryant, 2016; Sullivan and Short, 2011; Leo et al., 2018; Bertolotti et al., 2015).

2.2. Data analysis

Data analysis was conducted via partial least squares–structural equation modeling, which employs a two-step approach (Hair Jr. et al., 2021): (a) assessing the measurement properties of the constructs and (b) testing the proposed hypotheses in the structural model. Hypothesis testing was performed after ensuring that the measurement met the reliability and validity criteria. A bootstrapping technique with 5,000 subsamples was used to test the hypotheses on the basis of the research model presented in Figure 1. A one-tailed test was employed to verify the hypotheses. Additionally, moderation effects were tested via the interaction method and simple slope analysis.

3. Results

3.1. Respondent characteristics

Among the 493 survey respondents, 426 met the screening criteria, and after further data cleaning, 349 responses were used for analysis. The majority of respondents were from the Operations/Production Department (50.9%), followed by the Plant Department (31.8%) and the Engineering Department (17.2%). The largest age group among the respondents was 28–43 years (72.5%), followed by 18–27 years (18.4%) and 44–59 years (7.9%), and the remaining respondents were over 60 years.

Most respondents held positions as officers/group leaders (83.4%), followed by section heads (10.1%), department heads (4%), managers (2%), and general managers (0.4%). With respect to work experience in the mining industry, 59.6% had worked for more than 10 years, while the rest had less than 10 years of experience.

With respect to educational background, the majority of the respondents held a high school diploma (54.7%), followed by a bachelor's degree (25.6%), a diploma (17%), and a master's degree. Among all the respondents, 90.5% had team members, with most teams consisting of more than seven members (72.2%), followed by teams with 4–6 members (16.3%) and teams with 1–3 members (11.5%).

3.2. Measurement model

The validity and reliability of the measurement items were tested before the questionnaire was distributed. The validity test results indicate that all the items have factor loadings exceeding 0.6 and are statistically significant, with an average variance extracted (AVE) ≥ 0.5. The reliability test results show that all the items meet the Cronbach's alpha (CA) and composite reliability (CR) criteria, which exceed 0.7.

These results confirm that all the variables meet the reliability and validity test requirements (Hair Jr. et al., 2021), as presented in Table 2.

Table 2 Construct Reliability and Validity.

Variable	Items	Factor Loading	CA (> 0.7)[a]	CR (> 0.7)[b]	AVE (> 0.5)[c]
Instrumental Coworkers Support	ICS 1	0.722		0.882	0.600
	ICS 2	0.769			
	ICS 3	0.789	0.833		
	ICS 4	0.816			
	ICS 5	0.773			
Emotional Coworkers Support	ECS 1	0.675		0.868	0.524
	ECS 2	0.703	0.818		
	ECS 3	0.809			
	ECS 4	0.679			
	ECS 5	0.787			
	ECS 6	0.681			
Positive Intergenerational Affect	PIA 1	0.753		0.829	0.548
	PIA 2	0.773	0.725		
	PIA 3	0.730			
	PIA 4	0.703			
Team Cohesion	TC 1	0.743		0.874	0.583
	TC 2	0.826	0.821		
	TC 3	0.711			
	TC 4	0.788			
	TC 5	0.744			
Transactive Memory System (TMS) Collaboration	TMSC 1	0.716		0.877	0.543
	TMSC 2	0.717	0.832		
	TMSC 3	0.704			
	TMSC 4	0.706			
	TMSC 5	0.817			
	TMSC 6	0.755			
Team Performance	TP 1	0.822		0.898	0.687
	TP 2	0.823	0.848		
	TP 3	0.825			
	TP 4	0.844			

Note: CA = Cronbach's alpha[a]; CR = composite reliability[b]; AVE = average variance extracted[c].

Discriminant validity was assessed by demonstrating that the heterotrait-monotrait (HTMT) values do not exceed the threshold of 0.85 (Henseler et al., 2015), as detailed in Table 3. These results confirm the discriminant validity of the measurement items for each construct.

Table 3 Discriminant validity assessment via the HTMT matrix.

Construct	ECS[a]	ICS[b]	PIA[c]	TC[d]	TMSC[e]	TP[f]
ECS						
ICS	0.838					
PIA	0.650	0.632				
TC	0.559	0.582	0.747			
TMSC	0.614	0.677	0.710	0.729		
TP	0.368	0.421	0.438	0.629	0.799	

Note: ECS = Emotional coworker support[a]; ICS = instrumental coworker support[b]; PIA = positive intergenerational affect[c]; TC = team cohesion[d]; TMSC = transactive memory system collaboration[e], and TP = team performance[f].

3.3. Structural model

This model was further developed via a structural approach to ensure explanatory relationships through testing with the PLS-SEM application (Hair Jr et al., 2021). The results of the PLS–SEM analysis (Figure 2 and Table 4) indicate that positive intergenerational affect, instrumental coworker support, and emotional coworker support contribute 43% of team cohesion (R^2 = 0.430). Additionally, 52.8% of the transactive memory system collaboration is explained by instrumental coworker support, emotional coworker support, and positive intergenerational affect (R^2 = 0.528). Finally, team cohesion (TC) and transactive memory system collaboration (TMSC) account for 49.4% of the variance in team performance (TP) (R^2 = 0.494).

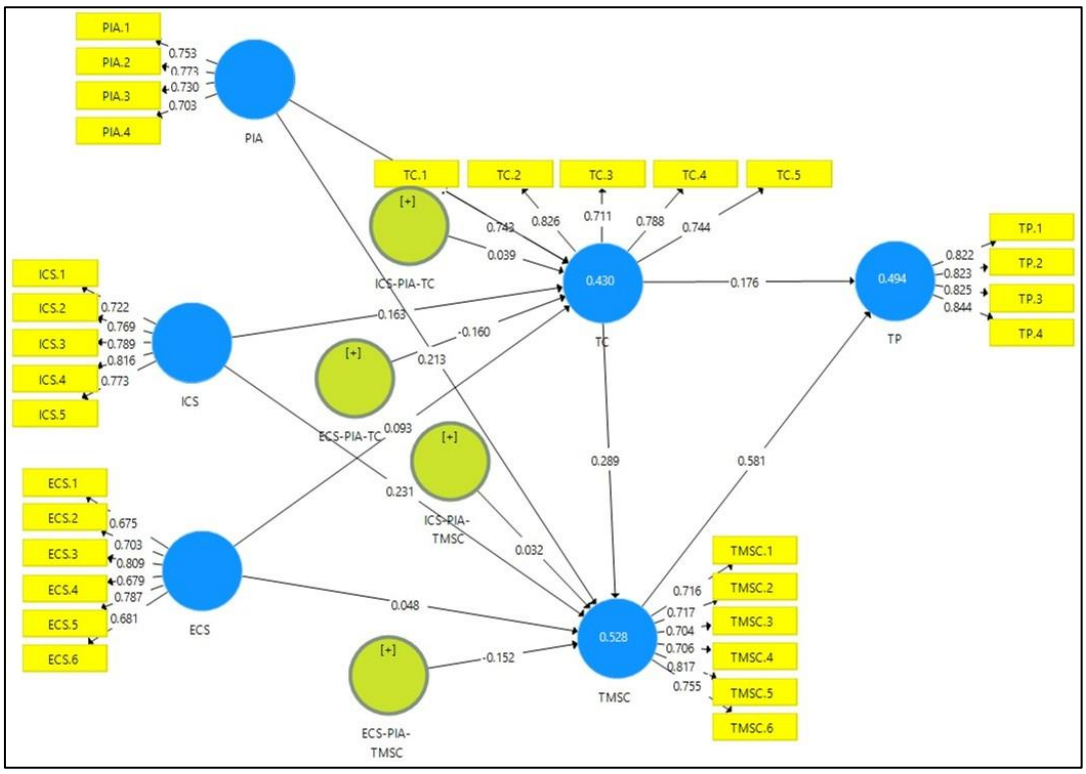

Figure 2 PLS Results and Structural Model (Factor Loading and R-Square).

On the basis of the data processing results via PLS-SEM, Hypothesis H1, which focuses on the relationship between instrumental coworker support (ICS) and team cohesion (TC), is accepted, with a p value = 0.018 and t = 2.091. This finding indicates that instrumental support from coworkers positively contributes to team cohesion, although with a relatively small effect (f-square = 0.022). Conversely, Hypothesis H2, which examines the relationship between emotional coworker support (ECS) and team cohesion (TC), is not supported, with p = 0.099 and t = 1.290. This result suggests that emotional support from coworkers does not significantly influence team cohesion in this study's context.

For Hypothesis H3, it was found that ICS positively affects TMS Collaboration (TMSC), with a p value = 0.000 and t = 3.620, leading to acceptance. This finding indicates that instrumental support from coworkers enhances the effectiveness of the transactive memory system within teams. However, hypothesis H4, which states that ECS influences TMSC, is not supported (p value = 0.202, t = 0.834). This result suggests that emotional support from coworkers does not significantly contribute to collaboration within the TMS.

Furthermore, hypothesis H5, which tests the moderating role of positive intergenerational affect (PIA) in the relationship between ICS and TC, is not supported (p value = 0.315, t = 0.482). Similarly, hypothesis H7, which proposes that PIA moderates the relationship between ICS and TMSC, is also not supported (p value = 0.246, t = 0.687). This finding indicates that positive intergenerational affect does not strengthen the relationship between instrumental support and collaboration aspects within the team.

Conversely, hypothesis H6 is accepted, where PIA significantly moderates the relationship between ECS and TC (p value = 0.024, t = 1.972), with a negative path coefficient (-0.160). This means that under conditions of high positive intergenerational affect, the influence of emotional support from coworkers on team cohesion weakens. Additionally, H8 is supported, indicating that PIA significantly moderates the relationship between ECS and TMSC (p value = 0.003, t = 2.758), with a negative path coefficient (-0.152). This result suggests that in the presence of high positive intergenerational affect, the impact of emotional support from coworkers on the effectiveness of collaboration within the transactive memory system is reduced.

Furthermore, hypothesis H9 is accepted, demonstrating that TC positively influences team performance (TP) (p value = 0.002, t = 2.817). Hypothesis H10 is also supported, with findings showing that TC positively affects TMSC (p value = 0.000, t = 4.871). Finally, hypothesis H11 is accepted, with p = 0.000 and t = 8.959, indicating that TMSC significantly impacts TP with a considerable effect (f-square = 0.417).

These findings suggest that instrumental coworker support significantly influences team cohesion and transactive memory system collaboration. In contrast, emotional support does not significantly impact team cohesion or collaboration within the transactive memory system. Additionally, not all interactions with positive intergenerational affect yield significant effects. Moreover, team cohesion and transactive memory system collaboration play crucial roles in enhancing team performance. These findings are summarized in the hypothesis testing results presented in Table 4.

Table 4 Hypothesis Testing Results.

Hypothesis	Path	Path Coefficient	T statistik	f square	P Values	Conclusion
H1	ICS → TC	0.163	2.091	0.022	0.018*	supported
H2	ECS → TC	0.093	1.290	0.007	0.099	not supported
H3	ICS → TMSC	0.231	3.620	0.053	0.000*	supported
H4	ECS → TMSC	0.048	0.834	0.002	0.202	not supported
H5	ICS x PIA → TC	0.039	0.482	0.002	0.315	not supported
H6	ECS x PIA → TC	-0.160	1.972	0.021	0.024*	supported
H7	ICS x PIA → TMSC	0.032	0.687	0.001	0.246	not supported
H8	ECS x PIA → TMSC	-0.152	2.758	0.023	0.003*	supported
H9	TC → TP	0.176	2.817	0.038	0.002*	supported
H10	TC → TMSC	0.289	4.871	0.101	0.000*	supported
H11	TMSC → TP	0.581	8.959	0.417	0.000*	supported

Note: *p < 0.05.
Emotional coworkers Support (ECS), instrumental coworkers support (ICS), positive intergenerational affect (PIA), team cohesion (TC), transactive memory system collaboration (TMSC), and team performance (TP).

4. Discussion

The study results indicate that emotional coworker support (ECS) does not significantly affect team cohesion (TC). However, the interaction between ECS and positive intergenerational affect (PIA) has a negative effect on TC. This finding suggests that excessive emotional dependence within an intergenerational team can create relational tension, reduce individual autonomy, and hinder team synergy. Older employees, who rely more on experience-based interactions, may find it challenging to adapt to the more transactional and efficiency-driven communication styles commonly preferred by younger generations, potentially weakening team cohesion.

Conversely, instrumental coworker support (ICS) positively influences team cohesion (TC), confirming that structured and task-oriented support strengthens teamwork and cohesion. However, the moderating effect of perceived intergenerational affect (PIA) on the ICS-TC relationship is insignificant, indicating that task-based support mechanisms remain effective regardless of differences in intergenerational affect. This finding highlights the importance of goal-oriented communication over excessive emotional dependence in fostering team cohesion (Fasbender et al., 2019; El Khawli et al., 2023).

Contrary to expectations, this study finds no evidence that emotional coworker support (ECS) directly influences transactive memory system collaboration (TMSC). However, the interaction between the ECS and PIA significantly affects TMSCs but in a negative manner. While ECS strengthens interpersonal bonds, it does not necessarily enhance knowledge sharing or collaborative memory systems within the team. These findings indicate that ECS alone may not improve team collaboration unless it is supported by precise knowledge exchange mechanisms (Zhang et al., 2024).

In contrast, ICS positively influences TMSC, indicating that practical support, such as resource provision and guidance, plays a more direct role in facilitating knowledge-sharing processes (Dietz et al., 2022). The lack of significance of PIA's moderating effect on the ICS-TMSC relationship further suggests that knowledge sharing is most effective when driven by clearly defined roles and responsibilities rather than solely by emotional attachment (Pfrombeck et al., 2024).

The results of one-way ANOVA with Tukey's post hoc test, conducted via SPSS software, support these findings. The analysis reveals significant differences in ECS and ICS across departments, with p values of 0.000 for ECS and 0.016 for ICS. These results suggest that the experience of emotional support varies across work units. However, no significant differences were found in terms of age, generation, or tenure (p > 0.05). This strengthens the notion that emotional and instrumental support may be perceived differently depending on the work context but are not strongly influenced by generational differences or work experience.

Furthermore, this study confirms that team cohesion (TC) significantly enhances team performance (TP). Teams with high cohesion demonstrate better coordination and efficiency, resulting in higher performance levels (Schei et al., 2023). Additionally, TC positively influences team memory system collaboration (TMSC), indicating that cohesive teams are more likely

to develop effective collaborative memory systems, improving work efficiency (Umar & Ko, 2022). Finally, TMSC significantly boosts TP, reinforcing the importance of effective knowledge-sharing mechanisms for achieving high-performance outcomes (Zhang et al., 2024).

5. Conclusions

These findings highlight the distinct roles of instrumental and emotional coworker support in shaping team cohesion and collaboration within the transactive memory system. Instrumental support positively influences team cohesion and collaboration in the transactive memory system. In contrast, emotional support does not significantly impact team cohesion or knowledge sharing. Furthermore, when emotional support interacts with positive intergenerational affect (PIA), its effect on team cohesion and collaboration within the transactive memory system tends to be negative. This finding indicates that excessive emotional dependence in intergenerational teams may hinder synergy and effective knowledge sharing.

Furthermore, this study confirms that team cohesion significantly enhances team performance (TP) directly and through improved knowledge-sharing effectiveness within transactive memory system collaboration (TMSC). This finding reinforces that cohesive teams can better develop strong information-sharing systems, leading to greater efficiency and improved team performance. Therefore, organizations should prioritize strengthening instrumental support, ensuring precise knowledge exchange mechanisms, and balancing emotional attachment within intergenerational teams to maximize team effectiveness (Fasbender et al., 2023; El Khawli et al., 2023; Schei et al., 2023; Matsunaga, 2022).

This study provides empirical insights into the role of instrumental and emotional coworker support in shaping team cohesion and transactive memory system (TMSC) collaboration in an intergenerational workplace. The findings highlight that instrumental coworker support positively contributes to team cohesion and knowledge-sharing collaboration, whereas emotional coworker support does not significantly impact these aspects. Furthermore, when emotional support interacts with positive intergenerational affect (PIA), its effect on team cohesion and TMSC tends to be negative. This suggests that excessive emotional dependence in intergenerational teams may hinder synergy and effective knowledge sharing.

Additionally, the study confirms that team cohesion significantly improves team performance (TP) directly and indirectly through enhanced knowledge-sharing processes in TMSC. This underscores the importance of fostering team cohesion to strengthen collaborative knowledge systems, ultimately leading to higher team efficiency and performance. From a practical perspective, organisations should prioritize instrumental support mechanisms, establish clear knowledge-sharing frameworks, and carefully balance emotional connections within intergenerational teams to optimize teamwork effectiveness. These findings contribute to a broader understanding of intergenerational workplace dynamics and offer valuable recommendations for improving communication and collaboration across different generations in the coal mining industry.

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Ethical considerations

Respondents in this study were not required to provide their personal information or IDs, and all participated freely and openly. Respondents were free to stop at any time during the completion of questionnaires, and all responses are made by anonymity. The data collected from these voluntary responses has been compiled into a dataset, which is publicly available on Mendeley Data, DOI: 10.17632/w36pwt8t6c.1 to support transparency and further research.

Conflict of Interest

The authors declare no conflicts of interest

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