ISSN 1648-0627 / eISSN 1822-4202

VILNIUS TECH
Vilnius Gediminas Technical University

BUSINESS: THEORY & PRACTICE

2026
Volume 27
Issue 1
Pages 45–55
https://doi.org/10.3846/btp.2026.22722

DEVELOPMENT OF INNOVATION CAPABILITY THROUGH INTELLECTUAL CAPITAL, PSYCHOLOGICAL CAPITAL, AUTHENTIC LEADERSHIP, AND KNOWLEDGE MANAGEMENT IN THE TRADING INDUSTRY

Wisnu YUWONO[1]✉, Jeremy Kent SEPUTRA[2], Mulyaningrum MULYANINGRUM[3], Erilia KESUMAHATI[4]

[1, 2, 4]*Faculty of Business and Management, Universitas Internasional Batam, Batam, Indonesia*
[3]*Faculty of Economics and Business, Universitas Pasundan, Bandung, Indonesia*

Article History:
- received 20 November 2024
- accepted 24 October 2025

Abstract. Innovation capability is increasingly critical for organizations facing technological disruption and global competition. In Indonesia, particularly in Batam City's trading industry, firms struggle to enhance innovation despite the growing availability of digital technologies such as Radio Frequency Identification (RFID), e-commerce platforms, and automation systems. This study investigates how intangible resources – intellectual capital, psychological capital, authentic leadership, and knowledge management – contribute to the development of innovation capability in this context. Data were collected from 306 employees in trading companies and analyzed using partial least squares structural equation modeling (PLS-SEM). The results show that intellectual capital strongly influences knowledge management, while psychological capital, authentic leadership, and knowledge management significantly enhance innovation capability. Knowledge management also mediates the relationship between intellectual capital and innovation capability. The study contributes to the knowledge-based view by integrating human, leadership, and knowledge perspectives, and extends prior research to the trading sector of an emerging economy. For managers, the findings highlight the importance of investing in intellectual and psychological capital, adopting authentic leadership practices, and strengthening knowledge management systems to maximize the benefits of technological tools such as RFID.

Keywords: intellectual capital, psychological capital, authentic leadership, knowledge management, innovation capability.

JEL Classification: O34, D9, M12, D83, O31.

✉Corresponding author. E-mail: ***wisnu@uib.ac.id***

1. Introduction

The Global Innovation Index (GII) ranked Indonesia 85th out of 131 countries in 2020 (Yudhistira, 2021). This position has not changed since 2018, but Indonesia's index value has decreased. Indonesia's index reached 26.49 points in 2020, although the previous year it reached 29.72 points. Indonesia ranks seventh in Southeast Asia, with Singapore remaining at the top with 56.61 points, followed by Malaysia with 42.42 points and Vietnam with 37.12 points. Myanmar has the lowest score of 17.74 points, and Laos has 20.65 points. This condition shows that although Indonesia has maintained its position at number 85 in the Global Innovation Index (GII) from 2018 to 2020, Indonesia's innovation index performance has decreased in terms of score. The drop from 29.72 points in 2019 to 26.49 points in 2020 indicates challenges in maintaining or improving innovation capacity in various sectors, such as technology, research, and product development.

In the context of Southeast Asia, Indonesia's seventh-place position also indicates that other countries in the region are better able to improve their innovations (theglobaleconomy.com, 2025). Singapore, which ranks first in Southeast Asia with a score of 59.9 points, shows that the country has a highly supportive ecosystem for innovation, including good infrastructure, education, and pro-innovation policies. Malaysia and Vietnam also performed better than Indonesia, scoring 40.6 and 37.1 points, respectively. This presents a challenge for Indonesia to improve its competitiveness in innovation, especially amidst rapid global change and the need to adapt new technologies. Increasing investment in research and development, strengthening collaboration between academia and industry, and improving the quality of STEM (Science, Technology, Engineering, and Mathematics) education can be some

important steps to take. This will help Indonesia improve its future innovation rankings and scores and advance its high-tech sectors.

According to Kanike and Robinson (2023), many cases occur in trading companies such as food or beverage distributors, which still do not rely on technology to grow their business. They should also consider the commerce industry in the face of changes in regulations related to online commerce, consumer protection, and data privacy (Fu et al., 2021). Companies must ensure that they comply with these rules, which often change as technology evolves (Ishii, 2021). Technology also plays a role in finding solutions to sustainability issues in the trade industry (Al-Hazmi, 2020). Many companies are looking for ways to reduce their environmental impact by using technology to manage supply chains and production processes more efficiently (Mohsen, 2023). As more trade transactions are being carried out online, the protection of customer data and transaction information has become crucial for companies (Aryani et al., 2020). Along with the development of this technology, Radio Frequency Identification (RFID) technology emerged, which has developed until now (Casella et al., 2022). This technology can help companies in accurately tracking goods, increasing operational efficiency, monitoring product authenticity, accurate inventory management, and others (Tan & Sidhu, 2022). If RFID can be implemented, then companies can solve problems that often occur, such as inaccuracies in checking goods (Hamadneh et al., 2021). Companies can also save some labor, use GPS *tracking* for shipping goods, manage sales more easily, and have many more advantages if there is an RFID implementation (Raad et al., 2021). RFID plays an important role in improving the competitiveness of companies in an increasingly complex and rapidly changing trading environment (Duan & Cao, 2020). There are still few companies that use RFID technology. Thus, it is not ideal. Consequently, it becomes a challenge for companies (Abugabah et al., 2020).

Digital transformation and innovation have become a global focus in the trade industry. However, as explained in the previous paragraph, Indonesia is still experiencing significant stagnation in innovation performance. This study offers a new perspective by linking low innovation not only to macro policies but also to the use of RFID in trade companies. Unlike previous studies that focused more on technological barriers (Abugabah et al., 2020), this study introduces intellectual capital and authentic leadership as driving forces for the adoption of RFID innovation technology (Purwanto et al., 2021; Putra et al., 2021; Munizu et al., 2024). The novelty of this study lies in the human resource-based factors, specifically knowledge management and leadership orientation, as determinants in overcoming resistance to technology implementation (Torre et al., 2020). This study also fills a significant literature gap, particularly on innovation in developing countries, and provides practical recommendations for strengthening the innovation agenda within organizations.

2. Literature review

To date, MSME-scale food and beverage companies have not optimally utilized innovation, particularly technology, to grow their businesses. This is despite the rapid development of technology. Technology utilization is strongly influenced by intellectual capital, with knowledge management as a mediating variable. Intellectual capital within a company will be optimal when knowledge management is channeled and implemented to foster innovation capabilities. Psychological capital will also foster innovation capabilities by increasing employee motivation in the workplace, and authentic leadership will increase employee trust and openness in adopting company-defined technologies.

Innovation Capability

According to Le and Lei (2019), *innovation capability* is a competency needed by an organization to gain a competitive advantage in the market. This competency serves as a tool used by entrepreneurs to steer their organizations toward success (Freije et al., 2022). Through innovation in developing new products and services, organizations can foster growth, boost sales, enhance profits, and strengthen their corporate position. Innovation is seen as the most effective strategy to achieve competitive advantage and deal with major competitors (Bahta et al., 2020). With this ability, companies can better meet consumer needs, stay ahead of the competition, and align their strengths with existing market opportunities (Mendoza-Silva, 2020), and create value (Purwianti, 2023). *Innovation capability* encompasses the process and management of new ideas for products and services, which contribute to unprecedented national economic growth, increased employment opportunities, and profit creation for the innovating firms (Somwethee et al., 2023). In addition, innovation also promotes increased competitiveness among companies in the global market, enables adaptation to changes in the business environment, and creates sustainable added value for all stakeholders (Vu, 2020).

Intellectual Capital and *Knowledge Management*

Intellectual capital, according to Hayaeian and Hesarzadeh (2023), is a company resource that consists of the most specialized knowledge, which is able to increase the company's potential through value addition, and is an *intangible* resource (Hesniati et al., 2019). *Intellectual capital*, which is also a matter of concern in related fields such as accounting, management, sociology, and information, is a general approach to valuing and measuring assets that have no form (Di Vaio et al., 2020). Cisneros et al. (2023) stated that *intellectual capital* has a significant positive effect on *knowledge management*. There are three types of *intellectual capital*, namely human, relationship, and structural. According to Sari et al. (2019), *intellectual capital* has a significant positive effect on *knowledge* management, as effective knowledge management can enhance the ability

to innovate. According to Karunarathne et al. (2023), *intellectual capital* has a significant positive effect on *knowledge management* because its enhancement within a company can strengthen knowledge management. This, in turn, can increase the company's ability to create quality corporate value. According to Aghel et al. (2024), *intellectual capital* has a significant positive effect on *knowledge management* because with effective *knowledge management*, *intellectual capital* can be optimized to support the flow of information, communication, and innovation. In their research, Syahchari and Sahban (2019) also stated that *intellectual capital* has a significant positive effect on *knowledge management*. This occurs because enhancing the correct and suitable intellectual capital model can benefit the company, with the improvement achieved through knowledge management.

H1: Intellectual capital has a significant positive effect on knowledge management.

Psychological Capital and Innovation Capability

According to Ii (2020), *psychological capital* is a combination of a person's positive traits that can drive creative behaviors. This set of traits must be well harmonized so that each trait supports the other. *Psychological* capital refers to psychological factors such as confidence, hope, optimism, and mental resilience that motivate employees to innovate. Psychological capital includes optimism, hope, resilience, and self-efficacy, which can improve individual and team performance (Andersson et al., 2020). In the research conducted by Peng and Chen (2023), *psychological capital* has a significant positive effect on *innovation capability* because high *psychological capital* can help teams be more open to sharing knowledge, which supports innovation. According to Liu et al. (2023), *psychological capital* has a significant positive effect on *innovation capability* because employees with strong *psychological capital* can better face challenges and innovate effectively. According to Hu et al. (2023), *psychological capital* has a significant positive effect on innovation capability because good *psychological capital* management increases task dependence in teams, accelerates the innovation process, and increases company competitiveness. Lei et al. (2020) show that *psychological capital* has a positive effect on *innovation capability* because it can expand leadership theory by examining how *leadership* affects the *psychological capital of* workers to increase their capacity to innovate. According to Novitasari et al. (2020), *psychological capital* plays a positive role in *innovation capability* because it can be proven by an increase in employee performance, as seen in the completion and emergence of alternative solutions to solve existing problems.

H2: Psychological capital has a significant positive effect on innovation capability.

Authentic Leadership and Innovation Capability

According to Gao et al. (2021), *authentic leadership* positively impacts *psychological capital* and work. In contrast, they found that *authentic leadership* does not partially affect organizational behavior; rather, *authentic leadership* and employee organizational commitment affect the organization as a whole. One of the factors that also has a significant impact on employee performance is *authentic leadership* (Lei et al., 2020). By creating a work culture based on honesty, trust, respect, and support, authentic leaders lay a strong foundation for innovation. Thus, *authentic leadership* not only creates an environment that supports innovation, but also motivates, inspires, and guides employees toward the creation of new and different solutions (Grošelj et al., 2020). *Authentic leadership* has a significant positive effect on *innovation capability* in organizations because it creates an environment that supports innovation and creativity (Purwanto et al., 2021).

Purwanto et al. (2021) show that *authentic leadership* has a positive effect on *innovation capability* because it increases innovative work behavior. According to Novitasari et al. (2020), *authentic leadership* has a positive effect on *innovation capability*. This is because *authentic leadership* can increase the satisfaction of their subordinates and strengthen their identity positively towards the organization. Laguna et al. (2019) found that *authentic leadership* positively affects *innovation capability*. This is because leaders who are considered more authentic can evoke positive emotions (courage and enthusiasm), which in turn leads to the proposal of innovative solutions in the workplace.

Based on Li et al.'s (2020) research, the relationship between *authentic leadership* (*ethical leadership* in this study) and *innovation capabilities* (*innovative work behavior* in this study) is positive. This is because entrepreneurial leaders can redesign their members' perceptions of their competence by involving them in developing new and innovative ideas. According to Iqbal et al. (2020), *authentic leadership* (*ethical leadership*) has a positive effect on *innovation capabilities* (*innovative work behavior*) because *ethical leadership* encourages employees to channel their energy and skills into their performance and consequently become innovative.

H3: Authentic Leadership has a significant positive effect on innovation capability.

Knowledge Management and Innovation Capability

Knowledge management is the management of *intellectual* assets (*intellectual capital*) and corporate knowledge to increase the range of business characteristics and improve corporate performance through the process of creation, structuring, dissemination, and application. *Knowledge management* is considered an important tool for maintaining competitive advantage and improving performance in current competitive world. It is an important way for companies to achieve one of their goals (Delshab et al., 2022). Organizations with a robust *knowledge management* system will tend to have higher *innovation capability* because they can optimize the use of existing knowledge to create added value and solve problems in new and creative ways

(Edeh et al., 2022). *Knowledge management* is also very effective in helping organizations optimize existing knowledge to create new and innovative ideas, enable better decision-making, and improve overall innovative performance.

Bataineh (2023) stated that *knowledge management* has a significant positive impact on *innovation capability*. This is because *knowledge management* provides information and experience support for the company's human resources, which increases the company's innovation capability. According to Lam et al. (2021), *knowledge management* has a significant positive impact on *innovation capability*. This is because the development of innovation capability in the company's operational activities can be carried out through practical *knowledge management*. According to Iqbal et al. (2019), *knowledge management* positively impacts *innovation capability*. Because innovation is considered a determinant of competitiveness in the academic field, knowledge management plays an important role in producing innovations that serve to improve the academy's performance. Edeh et al. (2022) also stated that *knowledge management* has a significant positive impact on *innovation capability*. This is because *knowledge management* in companies is proven to increase *innovation capability* in terms of capacity for marketing innovation and product innovation. According to Migdadi (2021), *knowledge management* has a positive effect on *innovation capability* because it has a beneficial effect and can contribute to the innovation process.

H4: Knowledge management has a significant positive effect on innovation capability.

Intellectual Capital and Innovation Capability through Knowledge Management

Yuwono (2021) stated that *Intellectual capital* affects innovation. He added that *Knowledge sharing* is a mediating variable in the relationship between *intellectual capital* and innovation. *Intellectual capital* includes the knowledge, skills, and experience possessed by organizational members. If this knowledge is properly managed through knowledge management practices, organizations can ensure that it is available and accessible to organizational members who need it to generate innovation (Edeh et al., 2022). Iqbal et al. (2021) also stated that the relationship between *intellectual capital* and *innovation capability* is through knowledge management, *because intellectual capital* also includes knowledge about the world outside the company, such as industry trends, customer behavior, and market progress. Li et al. (2019) found that *intellectual capital* through *knowledge management* (*knowledge sharing* in this study) has a significant positive effect on *innovation capability* (*innovation performance* in this study). This is because innovation performance can be improved by a company's *intellectual capital*, assisted by various types of knowledge. According to Dinu et al. (2023), *intellectual capital* through *technology management* (*knowledge management* in this study) has a significant positive effect on *innovative performance* (*innovation capability* in this study); because their study shows that recruiting the most qualified employees or increasing employee competencies and skills through technological capabilities in knowledge management can provide, maintain, or increase the *innovation capability* of a company.

Psychological capital includes aspects such as self-efficacy, hope, resilience, and optimism (Gom et al., 2021). According to Wirawan et al. (2020), good psychological capital can increase employees motivation and ability to face challenges at work. This *psychological capital* also positively impacts creativity, work engagement, and organizational commitment, which can help companies achieve their goals more effectively. Zhen and Mansor (2020) and He et al. (2019) state that there are several factors that affect employee performance, such as a sense of security at work, salary, a conducive work environment, appreciation of achievements, and fair treatment of all employees. *Psychological capital* supports optimal performance; therefore, through a combination of *intellectual capital*, *psychological capital*, *authentic leadership*, and *innovation capability*, companies can increase productivity and achieve greater success (Demartini & Beretta, 2020; Novitasari et al., 2020; Purwanto et al., 2021).

Ii (2020) stated that most of the current research on *psychological capital* focuses on the employees, while the *psychological capital of* a *leader* is rarely involved. Therefore, this study combined all the elements involved. The involvement of all elements encourages a strong relationship between leaders and employees, which, in turn, encourages employees to perform more productively (Zeb et al., 2020). Research on *intellectual capital*, *psychological capital*, and *authentic leadership* on innovation and their interaction can increase *innovation capability* is still limited, and it is possible to include knowledge sharing as a mediator that facilitates the relationship between *intellectual capital* and *innovation capability* (Udin et al., 2022). The contribution of this research will provide valuable input for the trading industry in improving its innovation capability through the above variables, and companies will be able to apply them.

H5: Intellectual capital has a significant positive effect on innovation capability through knowledge management.

3. Research model

Based on the previous sub-chapter, the research model proposed in this study is presented in Figure 1. The structural model, which describes the relationship between variables.

4. Research methodology

This study employs a quantitative approach, utilizing data analysis derived from online surveys conducted via social media targeting employees, managers, and supervisors who have been actively working for at least one year in

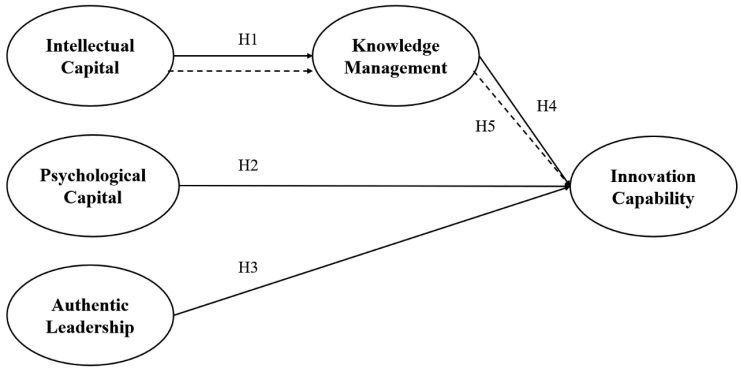

Figure 1. Research model

specialty food and beverage trading companies located in Batam City. Batam stands out as the sole industrial city in Indonesia that benefits from Free Trade Zone facilities. The questionnaire was administered through a Google Form. Sampling was carried out from November 2023 to June 2024. This study comprised a total of 55 questions. The *intellectual capital* variable is assessed through a questionnaire from Muda et al. (2020), encompassing 5 variables. *Psychological capital* is evaluated using a questionnaire created by Setyandari et al. (2020), comprising 24 variables. *Authentic leadership* is measured based on the work of Hadian Nasab and Afshari (2019) which includes 8 variables. *Knowledge management* is derived from the framework established by Shamim et al. (2019) consisting of 12 variables. Lastly, *innovation capability* is based on the model proposed by Park et al. (2018) which includes 6 variables. The questionnaire utilizes a Likert scale ranging from strongly disagree (1) to strongly agree (5). The study included a sample size of 306 respondents, as established by the insights of Hair et al. (2019). The presence of 55 questions necessitates a minimum sample size of 275 respondents, and the figure of 306 surpasses this minimum requirement. The collected data was subsequently analyzed and evaluated utilizing SmartPLS software version 3.0.

5. Results and discussion

5.1. Results

This study reveals that the majority of respondents, totaling 164 or 53.6%, are male. This predominance can be attributed to the nature of work in trading companies, which often requires more male participation in physically demanding roles. The majority of respondents in this study are aged 25–34 years, comprising 55.23%. This demographic is likely to be in a productive phase of life, actively engaged in the workforce. The predominant level of education among participants in this study is undergraduate (bachelor) degree, comprising 197 respondents or 64.38%. This trend is attributed to the fact that numerous trading companies set a minimum requirement of an undergraduate (bachelor) degree for job applications within their organizations. The findings indicate that the majority of job position in this study consist of staff, accounting for 217 respondents or 70.91%. This prevalence is expected, as there are typically more staffs than individuals in other positions, and the questionnaire was primarily distributed to this group. A more detailed respondent profile can be seen in Table 1.

Table 1. Respondent profile (source: results of research data processing)

Category	Description	Total	Percentage
Gender	Male	164	53.6%
	Female	142	46.4%
Age	18–24 Years Old	61	19.94%
	25–34 Years Old	169	55.23%
	35–45 Years Old	70	22.87%
	46 Years Old and Above	6	1.96%
Last Education	Postgraduate (Master or Doctoral) Degree	27	8.83%
	Bachelor Degree	197	64.38%
	Diploma	39	12.74%
	High School or Equivalent	43	14.05%
Job Position	Staff	217	70.91%
	Supervisor	67	17.98%
	Manager	34	11.11%

Table 2. Validity test results (source: results of research data processing)

Variables	AVE	Description
IC	0.557	Valid
PC	0.531	Valid
AL	0.623	Valid
KM	0.597	Valid
ICP	0.729	Valid

Note: IC = Intellectual Capital, PC = Psychological Capital, AL = Authentic Leadership, KM = Knowledge Management, ICP = Innovation Capability.

According to Ketchen (2022), validity testing on data employs convergent validity, requiring the AVE value to exceed 0.5. Table 2 indicates that all variables have demonstrated valid results, confirming that they meet the specified requirements and successfully pass the validity test.

Table 3. Reliability test results (source: results of research data processing)

Variables	Composite Reliability	Description
IC	0.790	Reliable
PC	0.888	Reliable
AL	0.832	Reliable
KM	0.855	Reliable
ICP	0.843	Reliable

Note: IC = Intellectual Capital, PC = Psychological Capital, AL = Authentic Leadership, KM = Knowledge Management, ICP = Innovation Capability.

Ketchen (2022) states that reliability testing on data should have a minimum value of 0.7. The results of this test indicate that all variables have achieved scores of no less than 0.7, signifying that the findings are reliable and meet the established criteria for passing the reliability assessment (see Table 3).

Table 4. *Direct Effect* test (source: results of research data processing)

Path Relationship	Sample Mean	P-Values	T-test	Description
IC -> KM	0.738	0.000	20.748	H1: Significant
PC -> ICP	0.430	0.000	5.853	H2: Significant
AL -> ICP	0.258	0.000	3.897	H3: Significant
KM -> ICP	0.144	0.036	2.147	H4: Significant

Note: IC = Intellectual Capital, PC = Psychological Capital, AL = Authentic Leadership, KM = Knowledge Management, ICP = Innovation Capability.

5.2. Discussion

This *direct effect* test is to determine the effect between variables. Table 4 and Figure 2 show the relationship between variables. The result of hypothesis 1 testing, namely the effect of *intellectual capital* on *knowledge management*, shows a sample mean value of 0.258 and p-values whose value is below 0.05, namely 0.000. This indicates that the effect of *intellectual capital* on *knowledge management* is significant and also in line with previous studies (Aghel et al., 2024; Cisneros et al., 2023; Karunarathne et al., 2023; Sari et al., 2019; Syahchari & Sahban, 2019). This relationship is significant because *intellectual capital* is the foundation of efficient *knowledge management*. Companies with good knowledge can effectively organize, store, and disseminate information. This is also reinforced by prior research, which has demonstrated the value of *intellectual capital* in enhancing *knowledge management* in businesses. However, this results diverge from Suparwadi et al. (2024), who reported a weaker direct link between IC and innovation. This difference may be attributed to the specific context of trading companies, where structural and relational capital are directly tied to customer networks and supply chain agility, making the IC–innovation relationship more salient. The result of hypothesis 2 testing, namely the effect of *psychological capital* on *innovation capability*, shows a sample mean value of 0.430 and p-values whose value is below 0.05, namely 0.000, thus indicating that the effect of *psychological capital* on *innovation capability* is significant and also in line with research conducted by Peng and Chen (2023), Hu et al. (2023), Lei et al. (2020), Liu et al. (2023), and Novitasari et al. (2020). This result shows that with high *psychological capital*, employees can have a greater drive to innovate and find new solutions. *Psychological capital* can increase employees' resilience and confidence in facing challenges, which in turn strengthens innovation in the company. Previous studies support this view, linking *psychological capital* to innovative outcomes.

The result of hypothesis 3 testing, namely the effect of *authentic leadership* on *innovation capability*, shows a sample mean value of 0.258 and p-values whose value is below 0.005, namely 0.000, thus indicating that the effect of *authentic leadership* on *innovation capability* is significant and also in line with research conducted by Iqbal et al. (2020), Laguna et al. (2019), Li et al. (2020), Novitasari et al. (2020), Purwanto et al. (2021). This relationship is significant because authentic leaders tend to create an environment that supports creativity and innovation, where employees feel safe to express new ideas. *Authentic leadership* that supports innovation can increase the company's ability to adapt and find better solutions, according to the results of previous studies.

The result of hypothesis 4 testing, namely the effect of *knowledge management* on *innovation capability*, shows a sample mean value of 0.144 and p-values whose value is below 0.005, namely 0.036. Thus indicating that the effect of *knowledge management* on *innovation capability* is significant and also in line with previous studies (Bataineh, 2023; Edeh et al., 2022; Iqbal et al., 2019; Lam et al., 2021; Migdadi, 2021). This relationship is significant because good *knowledge management* allows employees to access relevant and important information, which facilitates the innovation process. When knowledge is easily accessible, employees are more likely to combine existing ideas into new innovations. Previous research also supports that strong knowledge management contributes significantly to a company's innovation capabilities.

Table 5. *Indirect Effect* test (source: results of research data processing)

Path Relationship	Sample Mean	P-Values	Description
IC -> KM -> ICP	0.107	0.039	H5: Significant

Note: IC = Intellectual Capital, KM = Knowledge Management, ICP = Innovation Capability.

This *indirect effect* test is conducted to determine the influence between variables. Table 5 shows the relationship between variables for hypothesis 5, namely the effect of *intellectual capital* on *innovation capability* through *knowledge management*. It shows a sample mean value of 0.107 and p-values whose value is below 0.05, namely 0.039. Hence, the effect of *intellectual capital* on *innovation*

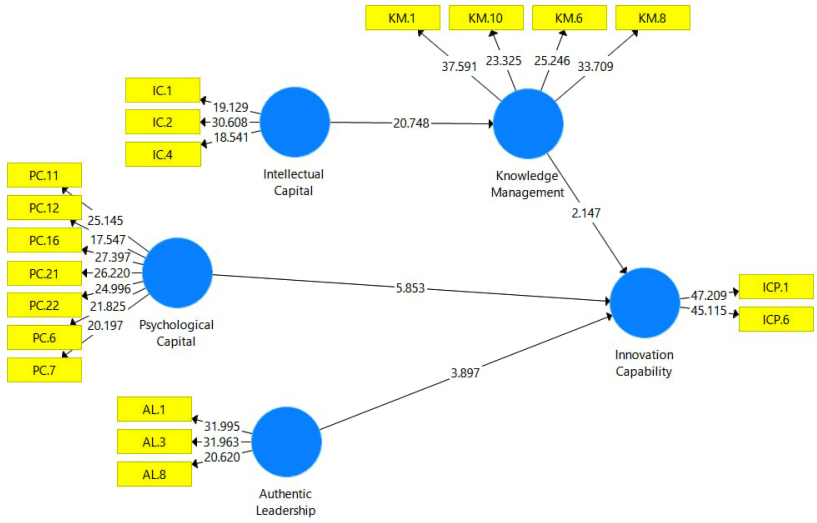

Figure 2. Research results

capability through *knowledge management* is significant and also in line with previous studies (Edeh et al., 2022; Garncarz & Mierzejewski, 2019; Iqbal et al., 2021; Migdadi, 2022). *Intellectual capital* is a collection of intellectual assets, such as knowledge, skills, and experience, owned by employees in the organization. These assets do not necessarily produce innovation without a good management and dissemination mechanism, which is carried out by *knowledge management*. In other words, for *intellectual capital* to contribute to innovation, there needs to be *knowledge management* that allows the information to be accessed and utilized optimally throughout the organization. This relationship is vital because when companies have a good *knowledge management* system, *intellectual capital* can be utilized more effectively for innovation. The *knowledge management* process makes knowledge better distributed, so that more employees can use this knowledge as a basis for innovation. This is in line with previous research findings that emphasize the importance of *knowledge management* in optimizing the role of *intellectual capital* to support innovation.

Leaders need to understand the need for *intellectual capital*, then they can show attention to individual development by providing the *intellectual capital* needed by employees to develop *innovation capability*, accompanied by *knowledge management* to enable improved performance and the ability to innovate workers (Paoloni et al., 2020). The results of this study reveal that *intellectual capital*, *psychological capital*, *authentic leadership*, and *knowledge management* significantly affect *innovation capability* in the food and beverage trading industry in Batam City. These findings are consistent with previous research showing that intellectual, psychological, and authentic leadership resources play an important role in enhancing organizational *innovation capability* (Le & Lei, 2019; Liu et al., 2023).

Knowledge management can act as a mediator that facilitates the relationship between *intellectual capital* and *innovation capability* (Udin et al., 2022). Therefore, understanding the complex dynamics between *intellectual capital*, *psychological capital*, and *authentic leadership* with *knowledge management* as the link is key to unlocking greater innovation potential in the *trade* industry (Garncarz & Mierzejewski, 2019). Good knowledge management can enhance *innovation capabilities* through improved information flow and communication within firms. Good *knowledge management* allows companies to utilize *intellectual capital* more effectively, support the innovation process, and solve problems in creatively (Cisneros et al., 2023). In addition, the finding that *psychological capital* has a significant effect on *innovation capability* indicates that psychological factors such as optimism, self-confidence, and resilience are very important in encouraging innovative behavior. This result is consistent with the research conducted by Andersson et al. (2020), which emphasizes the importance of *psychological capital* in creating a work environment that supports innovation.

Ultimately, this study concludes that innovation capability in the food and beverage trade industry in Batam City is strongly influenced by intellectual capital, psychological capital, authentic leadership, and knowledge management, all working together. New findings related to knowledge management as a mediator of intellectual capital and innovation indicate that knowledge alone is not sufficient; it must be internalized and utilized optimally to generate innovation. The adoption rate of RFID indicates an organization's readiness and ability to manage and implement its knowledge resources into tangible innovations. The low adoption of RFID indicates the need for support from a knowledge management system and authentic leadership for the adoption of this technology to flourish, along with the support of intellectual capital and employee psychological potential to manage resistance to technology adoption. This will serve as a foundation for sustainable innovations in the trade sector.

6. Conclusions and recommendations

The findings of this research suggest that the variables of *intellectual capital*, *psychological capital*, *authentic leadership*, *knowledge management*, and *innovation capability* have a substantial impact. This research offers valuable insights for trading companies in Batam City, emphasizing the significance of high *intellectual capital*, good *psychological capital*, *authentic leadership* with a good and effective leadership spirit, adequate *knowledge management*, and a strong innovation ability. This will enable all employees to effectively and correctly utilize RFID technology for the benefit of the company and its employees.

The managerial contributions of this research are as follows: 1) Intellectual capital, psychological capital and authentic leadership significantly influence innovation capability. For managers, this underscores the importance of investing in human capital development, particularly in training and mentoring. 2) Knowledge management acts as a mediator. Managers should prioritize the implementation of effective knowledge management systems, particularly structured documentation and digital tools such as RFID-based, and 3) Organizations should implement leadership programs that cultivate these traits psychologically safe environments conducive to innovation.

This research is limited to the food and beverage trade industry in Batam City, thus limiting its generalizability to other regions with different cultures. However, replication of the research is still possible in the same business sector. This cross-sectional research design does not capture long-term dynamics and causal processes, even though innovation is also influenced by the time context. Although this study presents a strong conceptual framework for the influence of intellectual and psychological capital, authentic leadership, and knowledge management on innovation capabilities, it does not include other variables such as culture and cultural intelligence, technological readiness, and the role of RFID technology in supporting knowledge management and innovation. These are still conceptual and therefore require a deeper empirical analysis.

Acknowledgements

Thank you to the Rector of Universitas Internasional Batam and all personnel for the research grant in 2024, which was awarded under the inter-institutional research scheme between Universitas Internasional Batam and Universitas Pasundan. Furthermore, we extend our gratitude to the Research and Community Service Institute (LPPM) and the Faculty of Business and Management of Universitas Internasional Batam, as well as the trading companies in Batam that are willing to provide support for this research.

References

Abugabah, A., Nizamuddin, N., & Abuqabbeh, A. (2020). A review of challenges and barriers implementing RFID technology in the Healthcare sector. *Procedia Computer Science*, *170*, 1003–1010. https://doi.org/10.1016/j.procs.2020.03.094

Aghel, M., Ferdous Azam, S. M., & Azalina Kassim, M. A. (2024). Impact of intellectual capital and organisational culture on financial performance: Mediation by knowledge management in higher education institutions in Libya. *Journal of Business and Social Review in Emerging Economies*, *10*(2), 193–202. https://doi.org/10.26710/jbsee.v10i2.2996

Al-Hazmi, N. M. (2020). The impact of information technology on the design of distribution channels. *Uncertain Supply Chain Management*, *8*(3), 505–512. https://doi.org/10.5267/j.uscm.2020.4.002

Andersson, M., Moen, O., & Brett, P. O. (2020). The organizational climate for psychological safety: Associations with SMEs' innovation capabilities and innovation performance. *Journal of Engineering and Technology Management*, *55*, Article 101554. https://doi.org/10.1016/j.jengtecman.2020.101554

Aryani, Y., Andari, W., & Suhindarto, S. (2020). The influence of information technology and e-commerce on Indonesian trade with ASEAN countries. *Jurnal Ekonomi Indonesia*, *9*(1), 53–66. https://doi.org/10.52813/jei.v9i1.30

Bahta, D., Yun, J., Islam, M. R., & Ashfaq, M. (2020). Corporate social responsibility, innovation capability and firm performance: Evidence from SME. *Social Responsibility Journal*, *17*(6), 840–860. https://doi.org/10.1108/SRJ-12-2019-0401

Bataineh, K. A. (2023). Can business intelligence promote the radical and incremental innovation? Knowledge management and agility organization in a moderated mediation model. *International Journal of Academic Research in Business and Social Sciences*, *13*(9), 1289–1305. https://doi.org/10.6007/IJARBSS/v13-i9/17925

Casella, G., Bigliardi, B., & Bottani, E. (2022). The evolution of RFID technology in the logistics field: A review. *Procedia Computer Science*, *200*, 1582–1592. https://doi.org/10.1016/j.procs.2022.01.359

Delshab, V., Winand, M., Sadeghi Boroujerdi, S., Hoeber, L., & Mahmoudian, A. (2022). The impact of knowledge management on performance in nonprofit sports clubs: The mediating role of attitude toward innovation, open innovation, and innovativeness. *European Sport Management Quarterly*, *22*(2), 139–160. https://doi.org/10.1080/16184742.2020.1768572

Demartini, M. C., & Beretta, V. (2020). Intellectual capital and SMEs' performance: A structured literature review. *Journal of Small Business Management*, *58*(2), 288–332. https://doi.org/10.1080/00472778.2019.1659680

Di Vaio, A., Hassan, R., & Palladino, R. (2020). Digital innovation and disruptive technologies in the Intellectual Capital (IC) and Knowledge Management Systems (KMS) disclosure: A bibliometric analysis. In *2020 IEEE International Conference on Technology Management, Operations and Decisions* (*ICTMOD*) (pp. 1–6). IEEE. https://doi.org/10.1109/ICTMOD49425.2020.9380581

Dinu, E., Vătămănescu, E. M., Stăneiu, R. M., & Rusu, M. (2023). An exploratory study linking intellectual capital and technology management towards innovative performance in KIBS. *Sustainability*, *15*(2), Article 1356. https://doi.org/10.3390/su15021356

Duan, K., & Cao, S. (2020). Emerging RFID technology in structural engineering – A review. *Structures*, *28*(October), 2404–2414. https://doi.org/10.1016/j.istruc.2020.10.036

Edeh, F. O., Zayed, N. M., Nitsenko, V., Brezhnieva-Yermolenko, O., Negovska, J., & Shtan, M. (2022). Predicting innovation capability through knowledge management in the banking sector. *Journal of Risk and Financial Management*, *15*(7), Article 312. https://doi.org/10.3390/jrfm15070312

Freije, I., de la Calle, A., & Ugarte, J. V. (2022). Role of supply chain integration in the product innovation capability of servitized manufacturing companies. *Technovation*, *118*, Article 102216. https://doi.org/10.1016/j.technovation.2020.102216

Fu, Y., Hou, Y., Wang, Z., Wu, X., Gao, K., & Wang, L. (2021). Distributed scheduling problems in intelligent manufacturing systems. *Tsinghua Science and Technology*, *26*(5), 625–645. https://doi.org/10.26599/TST.2021.9010009

Gao, W., Wang, L., Yan, J., Wu, Y., & Musse, S. Y. (2021). Fostering workplace innovation through CSR and authentic leadership: Evidence from SME sector. *Sustainability*, *13*(10), Article 5388. https://doi.org/10.3390/su13105388

Garncarz, J., & Mierzejewski, M. (2019). The impact of crises on the intellectual capital of companies in the food sector. *E-Finanse*, *15*(3), 1–9. https://doi.org/10.2478/fiqf-2019-0015

Gom, D., Yew, L. T., Jiony, M. M., Tanakinjal, G. H., & Sondoh, S. (2021). The role of transformational leadership and psychological capital in the hotel industry: A sustainable approach to reducing turnover intention. *Sustainability*, *13*(19), Article 10799. https://doi.org/10.3390/su131910799

Grošelj, M., Černe, M., Penger, S., & Grah, B. (2020). Authentic and transformational leadership and innovative work behaviour: The moderating role of psychological empowerment. *European Journal of Innovation Management*, *24*(3), 677–706. https://doi.org/10.1108/EJIM-10-2019-0294

Hadian Nasab, A., & Afshari, L. (2019). Authentic leadership and employee performance: Mediating role of organizational commitment. *Leadership and Organization Development Journal*, *40*(5), 548–560. https://doi.org/10.1108/LODJ-01-2019-0026

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Hamadneh, S., Keskin, E., Alshurideh, M., Al-Masri, Y., & Al Kurdi, B. (2021). The benefits and challenges of RFID technology implementation in supply chain: A case study from the Turkish construction sector. *Uncertain Supply Chain Management*, *9*(4), 1071–1080.

Hayaeian, S., & Hesarzadeh, R. (2023). Knowledge management strategies, intellectual capital, and ambidextrous innovation capability in SMEs: Are they relevant? *Journal of the Knowledge Economy*, *15*, 6832–6859. https://doi.org/10.1007/s13132-023-01172-5

He, C., Jia, G., McCabe, B., Chen, Y., & Sun, J. (2019). Impact of psychological capital on construction worker safety behavior: Communication competence as a mediator. *Journal of Safety Research*, *71*, 231–241. https://doi.org/10.1016/j.jsr.2019.09.007

Hesniati, H., Margaretha, F., & Kristaung, R. (2019). Intellectual capital, knowledge management, and firm performance in Indonesia. *European Journal of Business and Management Research*, *4*(6), 4–7. https://doi.org/10.24018/ejbmr.2019.4.6.133

Hu, R., Li, Y., Huang, J., Zhang, Y., Jiang, R., & Dunlop, E. (2023). Psychological capital and breakthrough innovation: The role of tacit knowledge sharing and task interdependence. *Frontiers in Psychology*, *14*, 1–13. https://doi.org/10.3389/fpsyg.2023.1097936

Ibarra-Cisneros, M. A. I., Vela Reyna, J. B., & Hernándes-Perlines, F. (2023). Interaction between knowledge management, intellectual capital and innovation in higher education institutions. *Education and Information Technologies*, *28*, 9685–9708. https://doi.org/10.1007/s10639-022-11563-x

Iqbal, A., Latif, F., Marimon, F., Sahibzada, U. F., & Hussain, S. (2019). From knowledge management to organizational performance: Modelling the mediating role of innovation and intellectual capital in higher education. *Journal of Enterprise Information Management*, *32*(1), 36–59. https://doi.org/10.1108/JEIM-04-2018-0083

Iqbal, S., Rasheed, M., Khan, H., & Siddiqi, A. (2021). Human resource practices and organizational innovation capability: Role of knowledge management. *VINE Journal of Information and Knowledge Management Systems*, *51*(5), 732–748. https://doi.org/10.1108/VJIKMS-02-2020-0033

Iqbal, Z. A., Abid, G., Contreras, F., Hassan, Q., & Zafar, R. (2020). Ethical leadership and innovative work behavior: The mediating role of individual attributes. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(3), Article 68. https://doi.org/10.3390/joitmc6030068

Ishii, R. (2021). Manufacturers' and distributors' capabilities influencing dual channel choice. *Marketing Intelligence and Planning*, *39*(1), 151–166. https://doi.org/10.1108/MIP-06-2019-0336

Kanike, U. K., & Robinson, J. M. (2023). Factors disrupting supply chain management in manufacturing industries. *Journal of Supply Chain Management Science*, *4*(1–2), 1–24. https://doi.org/10.18757/jscms.2023.6986

Karunarathne, W. V. A. D., Weligamage, S. S., & Wanigasekara, W. A. D. K. J. (2023). the mediating effect of knowledge management on intellectual capital and value creation: Evidence from Sri Lanka. *Kelaniya Journal of Management*, *12*(2), 53–73. https://doi.org/10.4038/kjm.v12i2.7721

Ketchen, D. J. (2022). A primer on partial least squares structural equation modeling. *Long Range Planning*, *46*(1–2), 184–185. https://doi.org/10.1016/j.lrp.2013.01.002

Laguna, M., Walachowska, K., Gorgievski-Duijvesteijn, M. J., & Moriano, J. A. (2019). Authentic leadership and employees' innovative behaviour: A multilevel investigation in three countries. *International Journal of Environmental Research and Public Health*, *16*(21), Article 4201. https://doi.org/10.3390/ijerph16214201

Lam, L., Nguyen, P., Le, N., & Tran, K. (2021). The relation among organizational culture, knowledge management, and innovation capability: Its implication for open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(1), Article 66. https://doi.org/10.3390/joitmc7010066

Le, P. B., & Lei, H. (2019). Determinants of innovation capability: The roles of transformational leadership, knowledge sharing and perceived organizational support. *Journal of Knowledge Management*, *23*(3), 527–547. https://doi.org/10.1108/JKM-09-2018-0568

Lei, H., Leaungkhamma, L., & Le, P. B. (2020). How transformational leadership facilitates innovation capability: The mediating role of employees' psychological capital. *Leadership and Organization Development Journal*, *41*(4), 481–499. https://doi.org/10.1108/LODJ-06-2019-0245

Li, C., Makhdoom, H. U. R., & Asim, S. (2020). Impact of entrepreneurial leadership on innovative work behavior: Examining mediation and moderation mechanisms. *Psychology Research and Behavior Management*, *13*, 105–118. https://doi.org/10.2147/PRBM.S236876

Li, T., Liang, W., Yu, Z., & Dang, X. (2020). Analysis of the influence of entrepreneur's psychological capital on employee's innovation behavior under leader-member exchange relationship. *Frontiers in Psychology*, *11*, 1–12. https://doi.org/10.3389/fpsyg.2020.01853

Li, Y., Song, Y., Wang, J., & Li, C. (2019). Intellectual capital, knowledge sharing, and innovation performance: Evidence from the Chinese construction industry. *Sustainability*, *11*(9), Article 2713. https://doi.org/10.3390/su11092713

Liu, Y., Chen, J., & Han, X. (2023). Research on the influence of employee psychological capital and knowledge sharing on breakthrough innovation performance. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.1084090

Mendoza-Silva, A. (2020). Innovation capability: A systematic literature review. *European Journal of Innovation Management*, *24*(3), 707–734. https://doi.org/10.1108/EJIM-09-2019-0263

Migdadi, M. M. (2021). Knowledge management, customer relationship management and innovation capabilities. *Journal of Business and Industrial Marketing*, *36*(1), 111–124. https://doi.org/10.1108/JBIM-12-2019-0504

Migdadi, M. M. (2022). Knowledge management processes, innovation capability and organizational performance. *International Journal of Productivity and Performance Management*, *71*(1), 182–210. https://doi.org/10.1108/IJPPM-04-2020-0154

Mohsen, B. M. (2023). Impact of artificial intelligence on supply chain management performance. *Journal of Service Science and Management*, *16*(01), 44–58. https://doi.org/10.4236/jssm.2023.161004

Muda, S., Rahman, M. R. C. A., Hamzah, N., & Saleh, N. M. (2020). Intellectual capital and SMEs' business performance from an organisational lifecycle perspective. *The South East Asian Journal of Management*, *14*(1), 3–8. https://doi.org/10.21002/seam.v14i1.11939

Munizu, M., Alam, S., Pono, M., & Riyadi, S. (2024). Do digital marketing, integrated supply chain, and innovation capability affect competitiveness, and creative industry performance? *International Journal of Data and Network Science*, *8*(2), 1025–1034. https://doi.org/10.5267/j.ijdns.2023.12.005

Novitasari, D., Cahya Kumoro, D. F., Yuwono, T., & Asbari, M. (2020). Authentic leadership and innovation: What is the role of psychological capital? *International Journal of Science and Management Studies* (*IJSMS*), *3*(5), 27–42. https://doi.org/10.51386/25815946/ijsms-v3i5p103

Paoloni, M., Coluccia, D., Fontana, S., & Solimene, S. (2020). Knowledge management, intellectual capital and entrepreneurship: A structured literature review. *Journal of Knowledge Management*, *24*(8), 1797–1818. https://doi.org/10.1108/JKM-01-2020-0052

Park, J. H., Kim, M. K., & Paik, J. H. (2018). Factors influencing innovation capability of small and medium-sized enterprises in Korean manufacturing sector: Facilitators, barriers and moderators. *International Journal of Technology Management*, *76*(3/4), 214–235. https://doi.org/10.1504/IJTM.2018.10012461

Peng, J.-C., & Chen, S.-W. (2023). Learning climate and innovative creative performance: Exploring the multi-level mediating mechanism of team psychological capital and work engagement. *Current Psychology*, *42*, 13114–13132. https://doi.org/10.1007/s12144-021-02617-3

Purwanto, A., Asbari, M., Nuraeni Setiana, Y., & Fahmi, K. (2021). Effect of psychological capital and authentic leadership on innovation work behavior. *International Journal of Social and Management Studies*, *2*(1).

Purwianti, L. (2023). The role of innovation and absorptive capacity mediation in improving hotel performance during the Covid-19 pandemic. *EKUITAS* (*Jurnal Ekonomi Dan Keuangan*), *7*(2), 171–192. https://doi.org/10.24034/j25485024.y2023.v7.i2.5251

Putra, N. P., Loppies, S. H. D., & Sayukti, T. N. (2021). Utilization of RFID technology in the employee mobility system of the inspectorate office of Merauke Regency. *E3S Web of Conferences*, *328*. https://doi.org/10.1051/e3sconf/202132804020

Raad, M. W., Deriche, M., & Sheltami, T. (2021). An IoT-based school bus and vehicle tracking system using RFID technology and mobile data networks. *Arabian Journal for Science and Engineering*, *46*(4), 3087–3097. https://doi.org/10.1007/s13369-020-05111-3

Sari, A. E., Salamah, S., & Albetris, A. (2019). The impact of intellectual capital dimensions on knowledge management of village facilitators in Kerinci Regency. *J-MAS* (*Jurnal Manajemen Dan Sains*), *4*(2), Article 220. https://doi.org/10.33087/jmas.v4i2.102

Setyandari, A., Wibowo, M. E., Purwanto, E., & Sunawan. (2020). Adaptation of academic psychological capital questionnaire in Bahasa Indonesia. *Proceedings of the International Conference on Science and Education and Technology* (*ISET 2019*), *443*, 261–264. https://doi.org/10.2991/assehr.k.200620.051

Shamim, S., Cang, S., & Yu, H. (2019). Impact of knowledge oriented leadership on knowledge management behaviour through employee work attitudes. *International Journal of Human Resource Management*, *30*(16), 2387–2417. https://doi.org/10.1080/09585192.2017.1323772

Somwethee, P., Aujirapongpan, S., & Ru-Zhue, J. (2023). The influence of entrepreneurial capability and innovation capability on sustainable organization performance: Evidence of community enterprise in Thailand. *Journal of Open Innovation*: *Technology*, *Market*, *and Complexity*, *9*(2), Article 100082. https://doi.org/10.1016/j.joitmc.2023.100082

Suparwadi, Musadieq, M. A., Riza, M. F., & Hutahayan, B. (2024). Leveraging intellectual capital and knowledge management to drive innovation and organizational performance. *International Journal of Engineering Business Management*, *16*, 1–18. https://doi.org/10.1177/18479790241304563

Syahchari, D. H., & Sahban, M. A. (2019). The impact of intellectual capital and knowledge management on competitive advantage. *International Journal of Innovation*, *Creativity and Change*, *10*(8), 261–272. https://doi.org/10.2991/aebmr.k.210616.075

Tan, W. C., & Sidhu, M. S. (2022). Review of RFID and IoT integration in supply chain management. *Operations Research Perspectives*, *9*(February), Article 100229. https://doi.org/10.1016/j.orp.2022.100229

Theglobaleconomy.com (2025). *Innovation index – country rankings*. https://www.theglobaleconomy.com/rankings/GII_Index/South-East-Asia/

Torre, C., Tommasetti, A., & Maione, G. (2020). Technology usage, intellectual capital, firm performance and employee satisfaction: The accountants' idea. *TQM Journal*, *33*(3), 545–567. https://doi.org/10.1108/TQM-04-2020-0070

Udin, U., Dananjoyo, R., & Isalman, I. (2022). Transactional leadership and innovative work behavior: Testing the mediation role of knowledge sharing in distribution market. *Journal of Distribution Science*, *20*(1), 41–53.

Vu, H. M. (2020). A review of dynamic capabilities, innovation capabilities, entrepreneurial capabilities and their consequences. *Journal of Asian Finance*, *Economics and Business*, *7*(8), 485–494. https://doi.org/10.13106/jafeb.2020.vol7.no8.485

Wirawan, H., Jufri, M., & Saman, A. (2020). The effect of authentic leadership and psychological capital on work engagement: The mediating role of job satisfaction. *Leadership and Organization Development Journal*, *41*(8), 1139–1154. https://doi.org/10.1108/LODJ-10-2019-0433

Yudhistira, A. (2021). *Indonesia's innovation index ranking has stagnant since 2018*. https://databoks.katadata.co.id/teknologi-telekomunikasi/statistik/671cd9bc5a98ffc/peringkat-indeks-inovasi-indonesia-stagnan-sejak-2018

Yuwono, W. (2021). Empirical analysis of intellectual capital, potential absorptive capacity, realized absorptive capacity and cultural intelligence on innovation. *Management Science Letters*, *11*, 1399–1406. https://doi.org/10.5267/j.msl.2020.10.034

Zeb, A., Abdullah, N. H., Hussain, A., & Safi, A. (2020). Authentic leadership, knowledge sharing, and employees' creativity. *Management Research Review*, *43*(6), 669–690. https://doi.org/10.1108/MRR-04-2019-0164

Zhen, Y., & Mansor, Z. D. (2020). A review on the relationship between psychological capital and job attitudes with the mediating effect of work engagement in hotel industry. *Journal of Critical Reviews*, *7*(2), 591–600. https://doi.org/10.31838/jcr.07.02.109