

## Human Centered Technology Management for Innovation and Sustainable Competitive Advantage

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### ABSTRACT

The accelerating technological transformation requires organizations to manage technology not only from the technical aspect, but also by considering the human needs, participation, and adaptability of the organization. This research aims to explore how human-centered technology management supports organizational innovation and contributes to sustainable competitive advantage. The research used a qualitative approach with an exploratory design on 20 informants consisting of technology managers, innovation managers, and organizational leaders in technology-based companies. Data were collected through semi-structured in-depth interviews and analyzed using thematic analysis. The results show that employee participation, human-oriented technology design, digital capability development, and adaptive leadership strengthen the innovation process as well as organizational responsiveness. The findings affirm the importance of integrating the human aspect in technology management to build innovation and sustainable competitive advantage

## INTRODUCTION

Digital transformation has changed the way organizations design business processes, develop innovations, and build competitive advantages. The development of artificial intelligence, automation, data analytics, and digital systems makes technology no longer just function as an operational tool, but becomes an essential part of organizational strategy. However, the success of technological transformation is not solely determined by the sophistication of the technology used. The Industry 5.0 paradigm instead places people, sustainability, and resilience as the main elements in creating organizational value. In this perspective, technology needs to be designed and managed to strengthen human capabilities, not just replace human work or improve process efficiency (Alves et al., 2023; van Erp et al., 2024).

This approach is increasingly important because the implementation of technology that is too technically oriented can face employee resistance, digital skills gaps, low technology acceptance, and mismatches between technology and job needs. Ullrich et al. (2023) show that the success of digital transformation is strongly influenced by the quality of employee engagement, the availability of information, and opportunities for employees to contribute to the change process. A similar thing was found by Haipeter et al. (2024), who affirmed that employee participation in the implementation of artificial intelligence allows organizations to build more human-oriented and sustainable technology management. Thus, human-centered technology management can be understood as a managerial approach that integrates technology with human needs, competencies, participation, and experience.

In the context of innovation, an organization's ability to manage technology and develop digital capabilities also determines the ability to respond to changes in the business environment. Benitez et al. (2022) found that digital leadership capabilities can improve innovation performance through the organization's ability to digitize platforms. Meanwhile, Karneli et al. (2021) found that digital capabilities have an important role in building sustainable competitive advantages for businesses in Indonesia. The findings show that the strategic value of technology does not come from technology ownership alone, but from how organizations effectively integrate technology, leadership, human skills, and innovation processes.

Nevertheless, there is still a gap in the literature. Some previous research has explained digital transformation through the quantitative relationship between technological capabilities, innovation, and organizational performance. Karneli et al. (2021), for example, focus on the influence of digital capabilities on competitive advantage, while Benitez et al. (2022) emphasize digital leadership capabilities and innovation performance. On the other hand, the study by Ullrich et al. (2023) and Haipeter et al. (2024) more specifically discusses employee involvement in the process of digitization and implementation of AI. A recent study by Bieńkowska et al. (2025) shows that human-centered organizational practices can drive sustainable innovation through the dynamic capabilities of employees. However, there is still limited research that integrates the dimensions of employee participation, human-oriented technology design, digital capability

development, and adaptive leadership to explain the process of forming innovation as well as sustainable competitive advantage.

Based on these gaps, this study aims to explore how the application of human-centered technology management supports organizational innovation processes and contributes to the formation of sustainable competitive advantage. In particular, the research is directed to understand how employee participation, design and implementation of technologies that take into account human needs, the development of digital capabilities, and adaptive leadership interact in the technology management process. This approach is relevant to the development of Industry 5.0 which places synergy between people and technology as the foundation for innovative, sustainable, and resilient value creation (Li et al., 2023; van Erp et al., 2024).

Theoretically, this research is expected to expand the study of technology management by connecting the perspectives of human-centered management, digital capabilities, innovation, and sustainable competitive advantage in a single conceptual framework. This research also provides a deeper understanding of the organizational mechanisms that make humans the main actors in the creation of value from technology. In practical terms, the results of the research are expected to be the basis for technology managers, innovation managers, and organizational leaders in designing technology transformation strategies that are not only efficiency-oriented, but also strengthen employee engagement, competency development, adaptability, and sustainable innovation. With this approach, technology investments can be directed to become a more sustainable source of competitive advantage.

## **LITERATURE REVIEW**

### ***Human-Centered Technology Management***

Human-centered technology management develops from the view that the technological success of an organization is not only determined by the sophistication of the system, but also by its suitability with human needs, values, capabilities, and experiences. Townsend and Romme (2024) explain that human-centered organizations are built through human values, positive work experiences, collaborative structures, and participatory approaches in decision-making. In the context of technology, the approach shifts the orientation of management from technology-centered to the integration between technological capabilities and human capacity. Fenwick et al. (2024) emphasized that digital transformation, especially the implementation of AI, requires an approach that pays attention to employee acceptance, competency development, human values, and workforce welfare. Thus, human-centered technology management can be understood as technology management that places humans as active actors in the design, implementation, evaluation, and development of organizational technology.

### ***Employee Participation and Human-Centered Technology Design***

Employee participation is an important component in ensuring that technology is in accordance with the conditions and needs of users. Orso et al. (2022) found that employee engagement from the early stages of technology

design allows organizations to gain a more accurate understanding of work activities and produce design recommendations that are more tailored to user needs. From an Industry 5.0 perspective, such engagement is not only related to the acceptance of technology, but also provides space for employee knowledge, creativity, and experience to become a source of innovation. However, Pacheco and Iwaszczenko (2024) show that the implementation of human-centered systems can also present tensions related to changes in human roles, skill development, human-machine interactions, and organizational settings. Therefore, human-centered technology management requires a participatory mechanism that allows employees to participate in shaping how technology is used in organizational activities.

### ***Digital Capability and Human-Technology Complementarity***

The development of digital capabilities is an important mechanism that connects humans with the productive use of technology. The Industry 5.0 perspective emphasizes that technology should function as a complement to human capabilities, not solely as a substitute for labor. Horvat et al. (2025), based on an analysis of 1,334 manufacturing companies, showed that the combination of human competence with new technologies plays a role in the formation of innovation capabilities, including digital and ecological product innovation. The findings indicate that organizations gain greater value when technology investment is accompanied by the development of human skills and competencies. Thus, digital capabilities in this study do not only refer to the ability to use technology, but include the ability of individuals and organizations to understand, adapt, integrate, and exploit technology in value creation and innovation.

### ***Adaptive and Digital Leadership for Innovation***

Human-centered technology management also depends on the ability of leaders to direct the organization to face technological changes. Tigre et al. (2025) identify that leadership in a digital environment includes strategic dimensions, execution orientation, personal attributes, and interpersonal abilities. This means that technology leadership is not enough just to have digital knowledge, but it also requires adaptability, building collaboration, and directing people in complex situations. Furthermore, Fatima and Masood (2024) show that digital leadership can support open innovation through increasing knowledge sharing and innovation capability. This relationship shows that the role of leaders is important in creating an environment where technology, knowledge, and employee creativity can interact to generate innovation. Within the framework of this research, adaptive leadership is therefore positioned as an organizational factor that supports the implementation of technology humanely while being responsive to change.

### ***Human-Centered Technology Management and Organizational Innovation***

Innovation in a human-centered perspective is not only the result of the adoption of new technologies, but arises from the interaction between technology, human knowledge, job design, and organizational learning processes. Orso et al. (2022) show that an employee-centric design approach can result in technological improvements based on real user experience, while Horvat et al. (2025) show that the combination of human and technological

competencies increases the company's innovation capabilities. This shows that humans play a role as a source of contextual knowledge and creativity, while technology provides computational capabilities, connectivity, automation, and information processing. The synergy between the two allows organizations to create an innovation process that is more adaptive and responsive to internal needs and changes in the external environment.

### ***Innovation and Sustainable Competitive Advantage***

From a strategic perspective, a sustainable competitive advantage is increasingly difficult to build through technology ownership alone because technology can be accessed and replicated by competitors. More sustainable differentiation arises from the ability of organizations to combine technology with human competencies, organizational structures, leadership, learning, and innovation processes. Narkhede et al. (2023) show that Industry 5.0 integrates technology with human-centricity, resilience, and sustainability so that technology orientation develops from increased productivity to long-term value creation. This perspective shows that innovations that come from a combination of human resources and technology have the potential to be more difficult to imitate because they are formed through experience, knowledge, social relationships, and organization-specific routines. Thus, innovation becomes a strategic mechanism that transforms the management of human-based technology into an organization's ability to maintain relevance, adaptability, and competitive advantage in the long run.

### ***Conceptual Synthesis***

Based on the literature, human-centered technology management can be seen as a management system that integrates employee participation, human-oriented technology design, digital capability development, and adaptive leadership. These four aspects do not stand separately, but form organizational conditions that allow technology to strengthen human capacity to generate knowledge and innovation. Furthermore, innovations that arise from the human-technology relationship can be the basis for the formation of sustainable competitive advantage. However, previous research still tends to study aspects of leadership, technology design, human competence, and innovation separately. Therefore, this study uses a qualitative perspective to explore how these four aspects interact in organizational practices and explain the mechanisms through which human-centered technology management drives innovation and builds a sustainable competitive advantage.

## **METHODOLOGY**

### ***Types of Research***

This research uses a qualitative approach with an exploratory design to gain an in-depth understanding of how human-centered technology management is applied in organizations and how the practice supports innovation and sustainable competitive advantage. The qualitative approach was chosen because the research is oriented towards the exploration of experience, managerial practices, technology management processes, and interactions between humans and technology in the context of the organization. Exploratory

design allows research to identify patterns, experiences, and mechanisms that explain how employee participation, human-oriented technology design, digital capabilities, and adaptive leadership interact in supporting organizational innovation and responsiveness.

### ***Population and Sample***

The target group of the research is individuals who have direct involvement in technology management, innovation, and decision-making in technology-based companies. The research involved 20 informants consisting of technology managers, innovation managers, and organizational leaders. The selection of informants uses non-probability purposive sampling, because informants are selected based on the relevance of their knowledge and experience to the phenomenon being studied. The number of 20 informants was maintained according to the research design and was considered adequate to produce depth of information in the interview-based research. Hennink and Kaiser (2022) show that information saturation in qualitative interview studies can be achieved with a relatively limited number of participants, although its adequacy remains dependent on the characteristics of the sample and the complexity of the research objectives.

### ***Research Instruments***

The main instrument of the study is a semi-structured in-depth interview guide. The interviews were directed at the informant's experiences and practices regarding human-centered technology management, in particular employee participation, human-oriented technology design, digital capability development, adaptive leadership, innovation processes, and the formation of sustainable competitive advantage. The instrument did not use quantitative scale items from previous research because the research was oriented towards the exploration of organizational experiences and processes. The semi-structured format allows questions to remain focused on the research objectives while providing flexibility to explore important themes that emerge during the interview, as recommended by Adeoye-Olatunde and Olenik (2021). Because the research is qualitative, statistical validity and reliability testing is not applied; Data quality is maintained through consistency of interview guidance, traceability of the coding process, and consistency of data interpretation between cases.

### ***Data Collection Procedure***

Data collection is carried out in stages. The initial stage includes determining the focus of research based on the concept of human-centered technology management, innovation, and sustainable competitive advantage, followed by the identification of informants who meet the characteristics of the research. Furthermore, data was obtained through semi-structured in-depth interviews with 20 informants. The interview questions were directed to explore the informants' experiences regarding technology management, employee engagement, digital capability development, leadership roles, and the contribution of these practices to organizational innovation and responsiveness. The interview data is then transcribed and prepared for coding, categorization, theme development, and cross-case interpretation. Semi-structured interviews were chosen because they were able to maintain the consistency of the research

focus while allowing for further exploration of contextual information that emerged during the data collection process (Adeoye-Olatunde & Olenik, 2021).

#### ***Data Analysis Techniques***

Data were analyzed using thematic analysis to identify, organize, and interpret the patterns of meaning contained in the interview. Analysis is carried out through the process of reading and familiarizing the data, initial code formation, grouping the code into categories, developing and reviewing themes, and interpreting inter-theme relationships. The process is directed at four main focuses, namely employee participation, human-oriented technology design, digital capability development, and adaptive leadership, as well as how these four strengthen organizational innovation and responsiveness in building sustainable competitive advantage. This stage is consistent with the principles of thematic analysis that emphasizes the process of systematic encoding, formation, review, and interpretation of themes (Braun & Clarke, 2021; Cernasev & Axon, 2023). Furthermore, thematic results are compared between cases (cross-case interpretation) to find convergent patterns and variations in organizational experiences. The qualitative analysis software was not established in this study to remain consistent with the design listed in the abstract; As such, the software can only serve as a data organizing tool and not as a substitute for the researcher's interpretation process.

### **RESEARCH RESULT**

Thematic analysis of semi-structured in-depth interviews yielded four main themes, namely: (1) employee participation in technology management; (2) human-oriented technology design; (3) digital capability development; and (4) adaptive leadership. Further analysis shows that the interaction of the four themes resulted in three consequential findings, namely strengthening innovation processes, increasing organizational responsiveness, and contributing to the formation of sustainable competitive advantage. Thus, innovation, organizational responsiveness, and sustainable competitive advantage are not positioned as stand-alone main themes, but as organizational outcomes of the implementation of human-centered technology management.

#### ***Characteristics of Research Informants***

This study involved 20 informants who were purposively selected based on their direct involvement in technology management, innovation development, and decision-making in technology-based companies. The informants consisted of 7 technology managers, 7 innovation managers, and 6 organizational leaders. The composition allows research to obtain diverse perspectives, ranging from the technical aspects of technology implementation, innovation development, to the organization's strategic decision-making process.

Based on the tenure of the service, most informants have more than five years of professional experience, so they have adequate knowledge of technological changes and organizational transformation processes. A total of 12 informants have a service period of 6-10 years, five informants have more than 10 years of experience, while three informants have a service period of 3-5 years. This characteristic shows that most of the informants have direct experience in

the process of implementation, evaluation, and development of organizational technology.

Table 1. Characteristics of Research Informants

| Features        | Category                                 | Quantity | Percentage |
|-----------------|------------------------------------------|----------|------------|
| Position/Title  | Technology Manager                       | 7        | 35%        |
|                 | Innovation Manager                       | 7        | 35%        |
|                 | Organizational Leaders                   | 6        | 30%        |
| Tenure          | 3–5 years                                | 3        | 15%        |
|                 | 6–10 years                               | 12       | 60%        |
|                 | >10 years                                | 5        | 25%        |
| Key Involvement | Technology management and implementation | 7        | 35%        |
|                 | Innovation development                   | 7        | 35%        |
|                 | Strategic decision-making                | 6        | 30%        |
| Total Informan  |                                          | 20       | 100%       |

The diversity of informant positions and experiences provides data coverage from the three main levels of organizational technology management. Technology managers provide information regarding the process of selection, implementation, and evaluation of technology; Innovation managers provide perspectives on the use of technology to produce new products, services, and processes; Meanwhile, organizational leaders provide information on strategies, policies, and decisions related to technological transformation. Therefore, the data obtained allows cross-case analysis of how human and technological aspects interact in supporting innovation and sustainable competitive advantage.

Thematic analysis of semi-structured in-depth interviews with all informants further resulted in four main themes, namely: (1) employee participation in technology management; (2) technology design that is oriented to human needs; (3) digital capability development; and (4) adaptive leadership. Cross-case analysis shows that the four themes interact with each other in strengthening organizational innovation and responsiveness, which then contributes to the formation of sustainable competitive advantage.

#### ***Employee Participation in Technology Management and Development***

The first theme shows that employee engagement is an important pattern in the process of selection, implementation, evaluation, and technology refinement. In the various cases analyzed, technology is not completely determined top-down by management or technology units. Employees as direct users also convey operational needs, barriers to use, and proposed improvements based on daily work experience.

Participation is especially seen at the stage of needs identification and evaluation after implementation. The informant describes that user feedback helps organizations find problems that are not always visible at the technical planning stage. Employees are also a source of ideas regarding simplifying workflows and developing more relevant features.

*"If the system is made only from the perspective of the IT team, sometimes it is technically good, but when used by operational friends, it is complicated. So now from the beginning we invite users to chat, what they really need and which parts make their job easier."*(MT-03, interview, February 14, 2026)

Similar findings emerged in the process of developing innovations. Some informants place employees not just as recipients of technology, but as sources of innovation ideas because they have first-hand knowledge of customer problems and internal processes.

*"The simplest ideas often come from people who use the system every day. They said, 'Why do you have to do this three times? Can it be just one time?' From such input, we finally changed the process."*(MI-05, interview, February 27, 2026)

Cross-case results show a pattern that early user engagement makes the implementation process more responsive to job needs. In contrast, when engagement is done after the technology has been implemented, organizations tend to need additional adjustments to align the system with actual work processes.

### ***Human-Oriented Technology Design***

The second theme has to do with changing organizational orientation from simply pursuing sophistication and automation to the suitability of technology with the capabilities and user experience. The informant described that effective technology is not always the technology with the most complex features, but technology that is easy to understand, relevant to work, and able to reduce administrative activities that do not provide added value.

In the implementation process, attention to humans can be seen through simplifying the interface, reducing work stages, adjusting features to user characteristics, and implementing the implementation in stages. This approach shows that usability and employee experience aspects are considerations in technology decision-making.

*"We once had a system whose features were actually very complete, but people were lazy to use it because there were too many clicks. From there we learned that good technology is not the most complicated, but one that does help people work more comfortably."*(MT-06, interview, March 6, 2026)

The findings also show that automation is not always geared towards replacing human work. In some cases, technology is being used to take over routine work so that employees can allocate more time to activities that require analysis, creativity, decision-making, and interaction with customers.

*"We don't see automation as a way to reduce people. What we are looking for is which repetitive work the system can take, so that the team has time for work that does require human judgment."*(PO-02, interview, March 18, 2026)

Thus, the data shows a tendency towards a pattern of human-technology complementarity. Technology serves as a support for human capabilities, while employees still have a role in decision-making, evaluation, and innovation development.

### ***Development of Digital Capabilities as a Support for Adaptation***

The third theme shows that the success of technology implementation is highly dependent on the readiness of employees' digital capabilities. The

informant revealed that the procurement of new systems without improving user capabilities often results in suboptimal use. Therefore, competency development takes place through training, mentoring, learning between employees, experiments, and the direct learning process when using technology.

Digital capabilities are not only found in the form of technical ability to operate devices or applications, but also the ability to understand how technology can be used to solve problems and improve work processes.

*"If you just teach the buttons where it is, it's actually easy. More importantly, they understand that this technology can be used to solve problems. After understanding, they usually start to have ideas themselves."* (MT-07, interview, April 8, 2026)

Informants from the field of innovation also showed that increasing digital competencies affects the speed of organizations in trying alternative solutions. Employees who are more familiar with technology tend to be able to experiment without always waiting for formal instructions.

*"After the team is more familiar with digital tools, they can try small changes themselves. Not everything has to be a big project. From those small experiments, sometimes solutions emerge that we end up using more widely."* (MI-02, interview, April 17, 2026)

The results of the analysis show that digital capabilities develop as adaptive capabilities, not just as individual technical skills. These capabilities help organizations adapt processes, adopt new technologies, and accelerate solution development when needs change.

#### ***Adaptive Leadership in Technology Transformation***

The fourth theme shows the importance of the role of leadership in shaping an environment that supports the flexible and humane use of technology. Informants describe adaptive leadership through openness to input, courage to experiment, support for learning, and the ability to adjust policies when technology implementation does not produce results as planned.

In some cases, leaders give the team room to try out new technologies or ways of working in a limited scope before they are widely implemented. Errors in the experimental stage are not directly seen as failures, but are used as evaluation material.

*"If every experiment has to succeed immediately, people end up afraid to try. We usually start small, see the results, listen to the team, and then decide whether to continue, improve, or stop."* (PO-04, interview, May 4, 2026)

Leadership also appears in the form of communication regarding the reasons for technological change. Informants show that employee acceptance is easier to form when leaders explain the purpose of the change and its impact on work.

*"People usually don't reject the technology, they worry about what changes for them. So we explain why this system is used and what it benefits for their work. After that, the discussion is much more open."* (PO-06, interview, May 21, 2026)

The data shows that leaders' ability to respond to employee concerns, adjust implementations, and provide learning spaces is part of the mechanism that allows technology to be more quickly accepted and utilized.

### ***Strengthening the Innovation Process through Human and Technology Integration***

Cross-thematic analysis shows that innovation does not emerge as an automatic consequence of technology adoption. Innovation is formed when employee participation, human-oriented technology design, digital capabilities, and adaptive leadership run simultaneously.

Employee engagement provides information about actual problems, while technology provides the means to develop solutions. Digital capabilities allow employees to test and leverage the solution, while leadership support provides room for experimentation and refinement.

*"The technology can actually be bought by anyone. What makes the results different is how the team uses the technology. When people are free to give input and try new ways, the same technology can make a difference."* (MI-07, interview, June 11, 2026)

The findings show that the resulting innovations are not limited to new products. Emerging forms of innovation include simplifying processes, increasing service speed, changing decision-making, improving user experience, and developing internal solutions.

#### ***Organizational Responsiveness to Change***

The results of the analysis also identified organizational responsiveness as a consistent outcome arising from human-oriented technology management. Informants describe that organizations become faster to identify changing needs and adjust processes when employees have the space to provide input and have the ability to use technology.

Responsiveness is not only seen when facing external changes, but also in internal problem solving. Information from users can be translated into changes in processes or technology without going through too long a decision-making cycle.

*"Now if there is a problem from users, we don't have to wait until the end of the year for the evaluation of the system. It can be discussed immediately, tested, and if it is better, the changes are implemented."* (MT-05, interview, June 25, 2026)

This pattern shows that technological flexibility becomes more effective when it is accompanied by human and organizational flexibility. Thus, the responsiveness identified in the study comes from a combination of technological capabilities, user competencies, and organizational decision mechanisms.

#### ***Contribution to Sustainable Competitive Advantage***

The final theme shows that informants do not place technology itself as the primary source of long-term competitive advantage. Technology is seen as relatively easy to acquire or replicate by competitors. A more difficult to replicate difference lies in the way organizations integrate technology with employee knowledge, work processes, leadership, and innovation capabilities.

*"When it comes to software, competitors can buy the same software. What they can't just copy is the way our team works, the experience of the people, and how we use data and technology to make decisions."* (PO-05, interview, July 9, 2026)

Informants also link the sustainability of organizational excellence to the ability to continuously learn and improve the technology used.

"It's not a matter of once digital and then finished. The system will change, customer needs will also change. So what keeps us going is the team's ability to keep learning and adjusting." (MI-06, interview, July 23, 2026)

These results show that *sustainable competitive advantage* is gradually formed through accumulated experience, organizational learning, digital competencies, and repeated innovations. Thus, technology serves as a supporting resource, while the ability of humans and organizations to utilize and develop technology is a differentiating factor that appears consistently in the data.

Table 1. Summary of Thematic Analysis Findings

| Category              | Theme/Findings                   | Key Findings                                                                                                                                       | Organizational Outcomes                               |
|-----------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Major Theme           | Employee Participation           | Employee involvement from the early stages of implementation enhances the alignment of technology with work-related needs and practices.           | Greater technology acceptance and process improvement |
| Major Theme           | Human-Centered Technology Design | The effectiveness of technology depends on how well it aligns with users' needs, experiences, and work contexts.                                   | Improved efficiency and user experience               |
| Major Theme           | Digital Capabilities             | Strong digital capabilities enhance technology utilization, experimentation, and problem-solving within the organization.                          | Greater organizational adaptability                   |
| Major Theme           | Adaptive Leadership              | Leadership characterized by openness, effective communication, and support for experimentation helps reduce barriers to technology implementation. | Greater acceptance and organizational flexibility     |
| Consequential Finding | Organizational Innovation        | Effective human-technology interaction contributes to the development of new processes, services, and solutions.                                   | Enhanced value creation                               |
| Consequential Finding | Organizational Responsiveness    | Organizations with effective human-technology integration are able to respond more rapidly to emerging needs                                       | Greater organizational agility                        |

|                       |                                   |                                                                                                                                 |                                                                |
|-----------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
|                       |                                   | and environmental changes.                                                                                                      |                                                                |
| Consequential Finding | Sustainable Competitive Advantage | Organizational excellence emerges from the effective integration of technology, knowledge, experience, and continuous learning. | Differentiation that is difficult for competitors to replicate |

Overall, the results show that the application of *human-centered technology management* is reflected through employee participation, human-oriented technology design, digital capability development, and adaptive leadership. The four themes appear consistently in various cases and are related to strengthening the innovation process and organizational responsiveness. The findings also show that sustainable competitive advantage does not rest solely on technology ownership, but on the organization's ability to integrate technology with human knowledge, competence, experience, and learning processes.

## DISCUSSION

The results show that human-centered technology management is not only related to the selection or use of technology, but is an organizational process that integrates humans into technological decision-making. Employee participation from the identification of needs to the evaluation of the system makes the technology more suitable for working conditions and allows for the emergence of innovative ideas from the user experience. These findings reinforce Haipeter et al. (2024), who show that worker participation is an important element in the implementation of human-oriented technology and artificial intelligence. The findings are also in line with Friedrich et al. (2024), who place user engagement and multidisciplinary approaches as an important part of human-centered technology development. Thus, the value of technology is not formed only through technical capabilities, but through social processes when user knowledge is translated into improvements to systems, processes, and services.

Findings regarding human-oriented technology design show that complex technologies do not always result in greater organizational benefits. Ease of use, compatibility with workflows, reduction of repetitive work, and the position of technology as a support for human decision-making are actually more dominant characteristics. These findings expand the perspective of Industry 5.0, which places human-centricity, sustainability, and resilience as strategic principles in value creation (van Erp et al., 2024). The results of this study show that human-centricity can be realized concretely through the simplification of technology and the principle of human-technology complementarity, where technology takes over routine activities while humans retain their role in creativity, assessment, problem-solving, and decision-making. Therefore, effective digital transformation should not be directed at human substitution, but at improving human capabilities through technology.

Digital capabilities emerged as an important factor that explains why the same technology investment can produce different organizational consequences. The results of the study show that digital competence is not limited to the ability to run applications, but includes the ability to understand the benefits of technology, conduct experiments, solve problems, and adapt technology to new needs. These results are consistent with Wang et al. (2023), who found that the capabilities of digital platforms can strengthen sustainability-oriented innovation through open innovation mechanisms. Similarly, research on digitalization capabilities in emerging markets shows that technology delivers sustainable results when combined with innovation mechanisms and the organization's ability to leverage knowledge. Thus, digital capabilities in this study can be interpreted as a form of dynamic capabilities that allow organizations to continue to integrate and reconfigure resources when the business environment changes.

Adaptive leadership then becomes the organizational condition that allows these three elements to function effectively. The findings show that openness to input, communication of change, tolerance for experimentation, and the ability to correct technological decisions strengthen organizational acceptance and responsiveness. This is in line with Tigre et al. (2025), who identified strategic, interpersonal, personal, and executive abilities as important elements of digital leadership. Ahmed and Naqshbandi (2024) also found that digital leadership is related to innovative work behaviors through learning orientation and innovation capabilities, while Fatima and Masood (2024) show that knowledge sharing and innovation capability bridge the relationship between digital leadership and open innovation. This means that leaders do not only act as decision-makers regarding technology, but as a shaping learning environment that makes employees dare to use, evaluate, and develop technology.

The most important finding of this study lies in the integrative relationship between the four elements. Innovation is not found as an automatic consequence after a company adopts technology, but rather emerges through a combination of employee participation, design that suits human needs, digital capabilities, and leadership that provides room for experimentation. The innovation is also not limited to the creation of new products, but includes simplifying processes, improving services, improving user experience, changing decision-making, and developing internal solutions. The findings are in line with Wang et al. (2023), who show that digital capabilities increase sustainability-oriented innovation through openness of innovation processes. With this perspective, innovation is the result of a process of reconfiguring knowledge and resources, not a direct product of technology investment.

In relation to sustainable competitive advantage, the results of the study show that the technology itself is relatively easy to obtain or imitate. More sustainable excellence comes from a combination of technology with tacit employee knowledge, organizational experience, leadership practices, learning abilities, and a cumulatively evolving innovation process. These findings are supported by Liao et al. (2024), who show that digital platform capabilities can increase competitive advantage through quality innovation, and by Sharma and

Gupta (2024), who place the integration of technology and sustainability strategies as an important foundation for the creation of competitive advantages in the Industry 5.0 era. The significance of the findings is that organizations do not gain long-term advantages simply because they have newer technology than competitors; Excellence is formed when technology is attached to routines, knowledge, adaptability, and learning processes that are more difficult to replicate.

Compared to previous research, the contribution of this research mainly lies in efforts to answer the research gap regarding the separation of previous studies. Previous research has tended to examine digital capabilities and competitive advantage, leadership and innovation, or employee participation and technology implementation as separate relationships. This study shows qualitatively that employee participation, human-oriented technology design, digital capabilities, and adaptive leadership actually work as complementary configurations. Thus, the theoretical contribution of the research is to expand the concept of human-centered technology management from just the principle of design or acceptance of technology to an organizational capability that connects people, technology, leadership, learning, and innovation. These results also provide a mechanistic explanation that cannot be fully obtained from previous quantitative research: technology contributes to competitive advantage through the ability of people and organizations to adapt and develop its use continuously.

Not all findings should be understood as automatic relationships. The results show that technologies designed without user involvement require more customization, while technologies that are not accompanied by the development of digital capabilities tend to be less optimal. This explains why previous research has sometimes found the strength of the different relationships between digitalization, innovation, and performance. Liao et al. (2024), for example, found that environmental uncertainty can weaken some of the mechanisms linking digital capabilities and innovation. Thus, organizational context, human readiness, leadership style, and environmental uncertainty can determine whether technology investment develops into innovation or just an additional infrastructure. Because this study is qualitative, the findings are not a test of statistical hypotheses, but rather an empirical pattern that explains the conditions and mechanisms that emerge from the informant's experience.

This research has several limitations. First, the use of 20 informants with purposive sampling techniques provides depth of information but limits statistical generalization to the entire organization or industry. Second, the data is mainly sourced from semi-structured interviews so it relies heavily on the informants' experiences, perceptions, and reflective abilities; Therefore, the possibility of self-report bias cannot be completely eliminated. Third, a focus on technology-based companies can cause the experience of organizations with low levels of digital maturity to not be adequately represented. Fourth, although the multiple case study design allows for cross-case interpretation, this study has not used longitudinal testing to find out whether human-centered technology management practices actually produce competitive advantages that last over long periods. Further research is suggested to combine interviews with

organizational observations and documentation, involving more diverse industries and digital maturity levels, and using longitudinal or mixed methods design. Further quantitative research can also empirically test whether innovation and organizational responsiveness function as a mediation mechanism between human-centered technology management and sustainable competitive advantage.

Overall, this discussion emphasized that the strategic advantage in digital transformation does not lie in the dominance of technology over humans, but in the ability of organizations to build human-technology configurations that are difficult to replicate. Employee participation generates contextual knowledge, human-centered design ensures technology is relevant to job needs, digital capabilities enable exploration and learning, while adaptive leadership creates space for change and experimentation. Its four interactions drive innovation and repetitive responsiveness and ultimately form the foundation for sustainable competitive advantage. Thus, human-centered technology management can be placed as a strategic approach that bridges the digital transformation agenda with innovation, organizational adaptability, and long-term value creation.

## **CONCLUSIONS AND RECOMMENDATIONS**

This study concludes that human-centered technology management is a strategic approach that integrates the human and technology dimensions in the process of organizational transformation. The four main themes identified, namely employee participation, human-oriented technology design, digital capability development, and adaptive leadership, complement each other in forming conditions that support organizational innovation and responsiveness. The findings show that innovation and responsiveness are further an important part of the formation of a sustainable competitive advantage. Thus, organizational excellence does not solely come from the ownership of technology, but from the ability to integrate technology with human knowledge, experience, competence, creativity, and learning processes.

Based on these findings, organizations are advised to strengthen employee engagement from the planning stage to technology evaluation, ensure that the systems implemented are in line with user needs, develop digital capabilities on an ongoing basis, and build leadership that is adaptive and open to experimentation. Evaluation of technology transformation also needs to consider its impact on innovation, responsiveness, organizational learning, and long-term value creation, not just operational efficiency or technological sophistication.

## **ADVANCED RESEARCH**

Further research is suggested to expand the research context in organizations with different levels of digital maturity and industry sectors and use longitudinal design to observe the sustainability impact of human-centered technology management. The mixed methods approach can also be used to quantitatively test the relationship between employee participation, human-oriented technology design, digital capabilities, adaptive leadership, innovation, organizational responsiveness, and sustainable competitive advantage.

Advanced research can also examine the role of innovation and organizational responsiveness as a mediation mechanism and incorporate contextual factors such as organizational culture, environmental uncertainty, and digital maturity levels.

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