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Sustainable Knowledge is the Basis of Sustainable Corporate Operation

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ABSTRACT

Research background: The relationship between sustainability and knowledge management has been examined from several perspectives. However, research has not yet addressed the sustainability of knowledge itself, which underpins knowledge management systems.

Purpose of the article: This study aims to define the concept of sustainable knowledge and the conditions under which it can be achieved in functioning business organizations, based on a theoretical model. It also seeks to identify differences in attitudes, mindsets, and professional values between members of the international research community and corporate experts involved in the study.

Methods: An international study was conducted to empirically validate the model, involving experts from all seven continents. Using the Delphi method, multi-level expert inputs were collected through open-ended responses and analyzed via qualitative content analysis (Atlas.ti). Consensus was subsequently assessed through quantitative analysis using SPSS 25.

Findings & Value added: The study's main contribution is a definition of sustainable knowledge and a set of conditions for its implementation, adding novel insights to the knowledge management literature. Differences among participating experts emerged across continents and between expert panels. Notable variation was observed in evaluations of a culture grounded in trust, cooperation, and continuous training: corporate experts rated these conditions as the most critical. Respondents from the Americas emphasized culture and leadership, whereas Asian experts rated trust as more important than did other participants. These findings provide stakeholders with knowledge needed to support shifts in sustainability-related attitudes and the associated changes in behavioral patterns.

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INTRODUCTION

Nowadays, knowledge management is increasingly used to enhance competitiveness in the business sphere – at both corporate and national levels – through the deliberate and systematic management of knowledge. Although it has been recognized as an independent scientific field for only a few decades, theoretical and applied research on the critical phases of knowledge management processes continues to attract attention (Lukacs, 2023). In Western societies, knowledge management is an integral part of business management, whereas in many Eastern countries it is often acknowledged at the strategic level but does not translate into implementation (Mahdi et al., 2019). As researchers have sought to map the developmental stages of knowledge management, the importance of prerequisites that enable system building has become increasingly apparent. These prerequisites include adequate IT infrastructure, organizational culture, and leadership. Although these factors have been examined repeatedly, prior studies have not explored the relationships among them in sufficient depth (Paliwal et al., 2024).

The problem of knowledge loss has been evident for centuries, even millennia, yet no definitive scientific solution has been identified (Massingham, 2018). This raises

a central question: why is knowledge sharing at the corporate level so often constrained? In response, organizations increasingly seek to establish foundations for sustainable knowledge in practice by cultivating organizational trust (International Atomic Energy Agency, 2017; Levallet & Chan, 2019; Galan, 2023; Jain, 2024). The present research aims to address this gap in the literature. However, because existing evidence suggests that the most critical phase of the knowledge management process is knowledge sharing (Addae et al., 2023) – and that failures in sharing are frequently linked to the absence of a trust-based organizational culture (Nugroho, 2018; Al-Faouri, 2023) – the study does not revisit these explanations in detail.

Mechanisms for storing shared information and knowledge include, on the one hand, advanced IT solutions and, on the other, organizational memory (Hakimi et al., 2017). Yet maintaining these repositories – through continuous updating, development, and the removal of obsolete content – ultimately depends on human behavior (Versiani et al., 2024). The challenge becomes more complex when organizations must consider not only immediate operational needs but also longer time horizons associated with strategy development and vision setting. This issue intersects with a dominant theme across contemporary research: sustainability (Weina & Yanling, 2022). While most corporate-level studies on sustainability focus on operational solutions (e.g., processes, environmental conditions, technologies), comparatively few return to foundational questions (Khan et al., 2024). These foundations concern the behavioral conditions that enable the preservation and transfer of essential knowledge (Bencsik, 2022; Arduini et al., 2024).

At the core of these challenges lies the relationship between sustainable leadership and sustainable knowledge and their combined impact on organizational performance. The literature has engaged extensively with organizational trust, the causes of knowledge loss, organizational memory, and organizational sustainability. Nevertheless, a substantial gap remains regarding the sustainability of organizational knowledge and the feasibility of achieving it in practice. If the prerequisites outlined above are not met, sustainability-related decisions and measures risk losing their substance and effectiveness (Contreras-Medina et al., 2022). Accordingly, this study is guided by three research questions: (1) How can sustainable knowledge be defined? (2) Do expert opinions differ across countries? (3) What additional conditions are required for sustainable knowledge to support sustainable business operations over the long term?

To address these questions, a multi-year research project was initiated to test all elements of the proposed research model and their interrelationships. Owing to space limitations, the present article reports only a subset of the overall findings. Specifically, it focuses on validating the definition of sustainable knowledge through international expert panels. Building on this validation, the study examines the conditions required to ensure sustainable knowledge and assesses the theoretical model.

The remainder of the paper briefly outlines the hypothesized theoretical model and the relationships underpinning the international study, followed by the empirical design and key results. The discussion and conclusion then synthesize the study's main contributions and implications.

THEORETICAL BACKGROUND

Organizational culture (trust)

The factors introduced above – assumed to be the core elements shaping sustainable knowledge – are connected through a logical chain of relationships. Together, these interdependencies enable the practical realization of sustainable knowledge via sustainable organizational functioning. The starting point of this relational system is the development of organizational trust, which in turn shapes the key dimensions of organizational culture (Ochoa et al., 2020).

Sustainable knowledge is inherently intertwined with knowledge management. From the perspective of organizational embeddedness and operationalization, knowledge management relies on meeting the requirements of a learning organization culture (LOC). Senge (2006) summarized the fundamental principles of learning organizations in five disciplines, which he grouped into three core capabilities.

Research also indicates that the intensification of human needs is closely associated with the accelerating demand for digitalization, IT, and artificial intelligence, all of which increasingly shape work across domains. This influence is commonly conceptualized as technostress (Bondanini et al., 2020). Its components can undermine work – life balance and job security, and can also negatively affect knowledge sharing as well as the development of interpersonal and impersonal trust (Bahamondes-Rosado et al., 2023). Contreras-Medina et al. (2023) likewise emphasize the strategic importance of human resources in achieving sustainability in the digital age.

System approach

Competitiveness is shaped by a wide range of criteria, including human resource factors, technical and technological conditions, and economic and strategic decisions (Vo et al., 2022; Wanjiru, 2022). A knowledge management system can support the organization as a whole because its three core components – people, technology, and processes – enable alignment with high-level performance expectations. Such systems are grounded in cooperation between people and technology and in the system-level management of processes, both as theoretical principles and practical requirements. They can coordinate the path from identifying knowledge needs in strategy, through knowledge acquisition, to knowledge application. Achieving this requires a systematic approach to knowledge management (Raymond-Yakoubian et al., 2017; Eberherr, 2018).

Klingenberg and Rothberg (2021) argue that insufficient systemic knowledge is one reason for the slow progress of sustainability initiatives. Current knowledge management practices often fail to match the complexity of sustainability-related knowledge, which is reflected in limited support for sustainability transitions. Using a systems perspective, Broccardo et al. (2025) identified six overarching groups that can serve as a framework for embedding sustainability requirements through the operation of knowledge management systems.

Organizational sustainability

Sustainability is one of the most widely used terms today, both at the social and economic levels and within corporates. Its definition has been formulated from several perspectives, depending on the specific social, economic, or industrial field or business activity in question (Sakalasooriya, 2021; Taticchi & Demartini, 2021). As a generally accepted definition, thinking in general terms at the social level, the 1987 UN report Our Common Future states: "Sustainability is meeting the needs of the present without compromising the ability of future generations to meet their own needs." Points 8 and 9 of the 17 Sustainable Development Goals (SDGs) formulated at the 2015 World Summit summarize the expectations for organizations engaged in economic activity. Braßler & Sprenger (2021) studied the level of sustainability knowledge, attitudes, and behavior among university students. Their results confirmed the positive impact of the necessary level of knowledge. Hussien et al. (2024) examined the relationship between innovation, technological capabilities, and knowledge management systems that ensure the sustainability of organizations and their impact on business success. They showed that innovation has a positive effect on technological capabilities and knowledge management, and that the combined effect of the two significantly increases business success. This result supports the need to enforce the sustainability requirements described above. Numerous other studies support the links between organizational sustainability and knowledge management, the influence of knowledge risk, and their impact on business success (López-Torras et al., 2019; Abdullah et al, 2023; Zieba et al, 2022; Turan et al, 2024; Mohaghegh et al, 2024). Since our research focuses on organizations, our findings should be interpreted at this level. At the organizational level, we did not find a uniformly accepted definition of sustainability, just as there is no definition of sustainable knowledge. Understanding the need for sustainable knowledge is the key to sustainable business efficiency.

Sustainability management

The new conditions imposed on economic development and the accompanying social phenomena present new challenges for leaders. A new way of thinking, an integrative approach, and a holistic perspective are needed to integrate economic benefits, social responsibility, and environmental protection (Bradley et al., 2020; Amaechi et al, 2025). In the long term, the prerequisite for the successful operation of a corporate is a leader and/or management who is aware of the concept of sustainable development and is able to interpret it in a complex manner when making decisions (Al Muhairi et al., 2019; Amara & Chen, 2020; Shrivastav et al, 2025).

Sustainability has become a critical management task for business success. Leaders who work in the spirit of sustainability see the role of their organization in a larger context, beyond immediate, short-term benefits. They take a holistic approach at the system level. They define strategies and ensure the achievement of results that meet the triple requirements of social, environmental, and financial performance (Avery & Bergsteiner, 2011a; 2011b). This triple requirement covers the expectations of environmentally conscious management (ECM), expected behavior and values (EBV), and conscious thinking (CT).

Sustainable knowledge

The concept of "sustainable knowledge" refers to knowledge that remains valuable, applicable, and transferable in the long term-that is, it does not become obsolete quickly, or if it does, it can be updated and adapted. It can be applied on three levels:

- Personal (individuals build knowledge in a way that encourages development and learning).
- Organizational (knowledge systems that adapt to a changing environment).
- Social (the transfer of knowledge across generations, e.g., through education and culture).

The knowledge management process is effective when it produces and manages sustainable knowledge. The process ensures that knowledge is not only useful in the short term, but also lives on in a sustainable way within the organization. Sustainability is a kind of quality criterion in the functioning of knowledge management. If a corporate only manages knowledge on an ad hoc basis, it can quickly become obsolete and be lost. Well-functioning knowledge management supports a learning organization culture, which is key to the long-term viability of knowledge. The benefits of the acquired knowledge, its proper implementation, and conceptual framework were verified by Zhang et al. (2025) through the results of a systematic literature review.

The practice of sustainable knowledge goes beyond the well-known SECI model as the basis of knowledge management, which provides a strong foundation for understanding the flow and creation of knowledge.

- SECI focuses on the flow of knowledge – sustainable knowledge focuses on the system as a whole. The SECI model describes the movement of knowledge between individuals and groups at the micro level. The practice of sustainable knowledge also operates at the macro level. It involves organizational culture, technological infrastructure, the learning ecosystem, and strategic planning.
- SECI is cyclical but not context-sensitive: it does not include elements for dealing with technological,

market, or social changes. The practice of sustainable knowledge, on the other hand, actively addresses knowledge obsolescence, adaptability to a changing environment, and what is worth keeping and what is worth letting go.

- The SECI model is value-neutral: it does not distinguish between useful and useless knowledge. Sustainable knowledge practice, on the other hand, also applies value-based filtering based on which knowledge contributes to strategic goals and which knowledge supports social responsibility and environmental sustainability.
- SECI is primarily an interaction model. Sustainable knowledge is a complex knowledge ecology that includes knowledge systems (e.g., document repositories, wikis), organizational culture (e.g., encouraging sharing, learning from mistakes), education and training (reskilling, mentoring), and strategic management. (What knowledge is really needed?)

Overall, sustainable knowledge combines knowledge management and value orientation. It encompasses infrastructure, culture, and strategy. The SECI model may be the "engine," but sustainable knowledge practice is also the "vehicle, the road, and the destination."

In order to define sustainable knowledge and justify its raison d'être, we have presented in the above short chapters the prerequisites necessary for sustainable knowledge to serve the long-term functioning of organizations (Hallinger & Suriyankietkaew, 2018; dos Santos et al., 2020).

In the literature, the relationship between sustainability and knowledge is examined through the role of knowledge management in supporting sustainability. This pushes into the background questions that would answer the conditions for the long-term sustainability of knowledge itself (Klingenberg & Rothberg, 2020). This research does not consider the application of traditional indicator systems. The aim is to develop a model that uses logic to reveal the conditions for sustainable knowledge. The research aims to verify the validity of the hypothetical model (Fig 1) based on the theory.

RESEARCH OBJECTIVE, METHODOLOGY AND DATA

To test the theoretical considerations presented above, we launched an international research project in 2023, consisting of several phases. The empirical research aims to answer the research questions formulated in the introduction and to verify the validity of the theoretical model.

The definition of sustainable knowledge answers the first research question. Hypotheses were formulated to answer the next two questions.

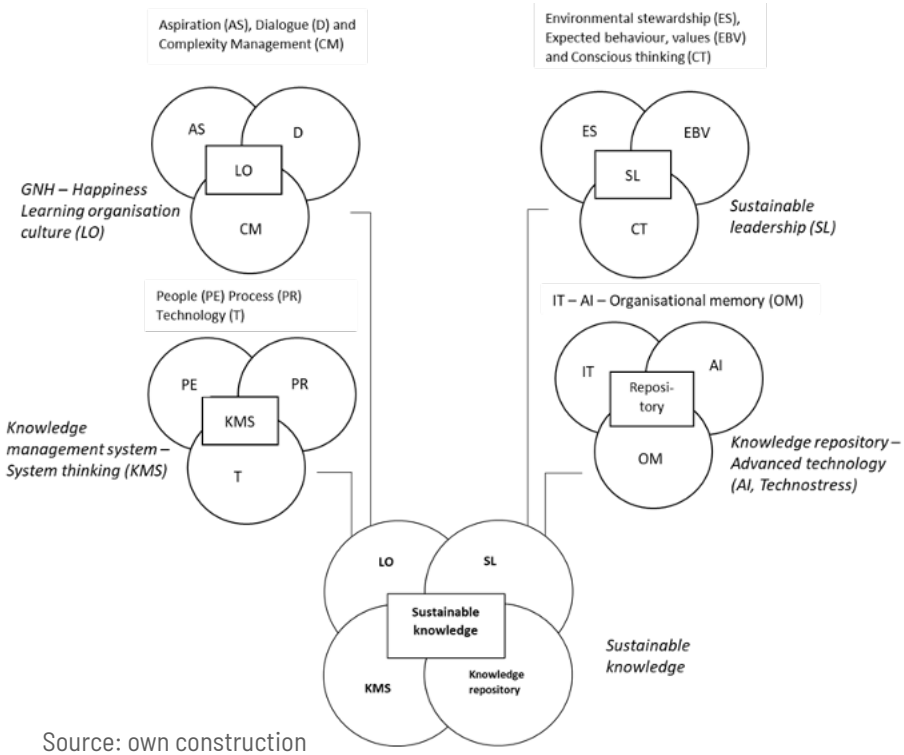
The results of the examination of the first three hypotheses provide answers to the question of what conditions are necessary for sustainable knowledge.

H1: The basic condition for knowledge sustainability is an organizational culture based on trust.

H2: To ensure the long-term sustainability of knowledge, it is essential to align knowledge management with organizational objectives.

H3: The IT background of the organization plays an important role in making knowledge sustainable within the organization.

Figure 1: Theoretical model of sustainable knowledge



Source: own construction

The examination of further hypotheses aimed to confirm the differences in opinion among the respondents of the panel groups participating in the research.

H4 There are significant differences between the opinions of respondents in the first panel group (knowledge management experts, academic experts, corporate professionals) regarding the statements related to the four categories.

H5 There are significant differences between the opinions of respondents in the second panel group (experts from different continents) regarding the statements related to the four categories.

The methodology required to test the validity of the model and verify the hypotheses, as well as the research results, are presented in the following chapters.

Methods

The multi-step methodology consisted of free expression of opinion, the Delphi method, and in-depth interviews. We used text analysis software (Atlas.ti) and SPSS software for the analysis.

The Delphi method formed the backbone of the research. The Delphi method is a tool often used in futurology to gather expert opinions (Nyström & Kaartemo, 2022). It is a forecasting method based on the cooperation of independent experts who independently fill out questionnaires to predict the course of a problem and then, in several rounds, mutually shape their opinions and approximate their assumptions (Borgulya, 2017).

We performed content analysis using Atlas.ti software. Through careful preparation, coding, and interpretation of the data, the results of qualitative content analysis can support the development of new theories and models, validate existing theories, and provide detailed descriptions of certain phenomena (Zhang & Wildemuth, 2005).

Quantitative data analysis and hypothesis testing were performed using SPSS software (multivariate linear regression analysis, ANOVA tests, and Tukey HSD tests within the post-hoc analysis group) (Sajtos & Mitev, 2007).

Sample

One of the most important parts of the Delphi method is selecting the right experts to ensure the quality of the results. (Paré et al., 2013). Respondents involved in the research were selected by directly contacting participants of knowledge management conferences, members of editorial boards of scientific journals, researchers publishing in journals, university lecturers, consultants, and employees of professional organizations. Potential respondents were recruited from all seven continents. In the first round of the method used, approximately 1,000 questionnaires were sent out. The return rate was thus slightly more than 10% (n=126). This ratio is accepted in similar types of research.

Panel groups were also created, which enabled multifaceted and comprehensive expert feedback, reliability, and diversity. The experts in this research are divided into two panel groups (7 panels).

The first panel group was formed based on the main source of opinion of the respondent expert. Three panels were formed: (1) knowledge management consultants, (2) academic knowledge management experts, and (3) corporate professionals involved in knowledge management. This panel group is crucial because the aim was to explore differences in perspectives, viewpoints, and thought patterns, based on which panel-specific conclusions can be drawn.

The four panels in the second panel group were formed based on the respondents' origin. We distinguished between responses from (1) Europe, (2) America, and (3) Asia. The remaining continents were classified into a fourth, (4) 'Other' panel due to the lower proportion of responses. This panel group is also relevant to the research, as people living on different continents live in different cultural, social, and economic environments. These differences can influence opinions, attitudes, and preferences.

Methods of data analysis

In the first round of the research, 1,000 experts were sent a question based on free expression of opinion (126 responses were received). During the survey, we asked the experts to express their views on the question "What does sustainable knowledge mean for a successful, sustainable future?". The aggregated data were analyzed using ATLAS.ti text analysis software. In each case, we looked for the characteristics and conditions of sustainable knowledge based on the responses received. We used an automatic coding process during the analysis. In addition to coding, we created memos that allowed us to record comments and additional information. From the documents received, we extracted the words, expressions, and phrases that occurred most frequently in the responses received in the first round. In this way, we created a list of the most frequently occurring expressions. Conceptual analysis was at the forefront of the data analysis. We created different document categories, which we used to identify and mark relevant ideas and expressions that formed the basis of our second questionnaire. We created categories related to knowledge sustainability for the objectives formulated by the experts, the conditions for knowledge sustainability, ideas related to knowledge management, and positions related to IT solutions. As a result, 22 statements were formulated on knowledge sustainability, which we sent back to the respondents from the first round. We asked the respondents to indicate their level of agreement with the statements. In order to measure consensus, the mean, standard deviation, median, and interquartile range (IQR) values of the responses were examined during data analysis using IMB SPSS Statistics 25 software. Based on these, we were able to formulate a definition of sustainable knowledge and obtain further analysis results. The application of the Delphi method and its results have been publi-

shed, so we will refrain from providing a detailed description here (Bencsik, 2022; 2024).

RESULTS

Following the logic of the research process described above, a definition of "sustainable knowledge" and the supporting model framework, which also includes the prerequisites for sustainable knowledge, were formulated. The definition was formulated based on the analysis of the responses to a 22-question questionnaire.

The next step was to test the validity of the definition using a questionnaire consisting of 22 statements, which experts individually and independently ranked on a six-point Likert scale. The values on the scale were: 1 – strongly disagree; 2 – disagree; 3 – partially disagree; 4 – partially agree; 5 – agree; 6 – strongly agree. The questionnaire was created using Survio questionnaire creation software. After testing, the questionnaire was sent to the experts involved in the first round of Delphi. (All 126 responses received were usable.) The questionnaire consisted of 22 statements covering 4 units. The reliability indicators (Cronbach's alpha (α) are adequate, indicating that the questionnaire is a reliable measure (Sajtos and Mitev, 2007). Units: 1. Knowledge sustainability goals and values (6 statements, α= 0.923); 2. Role of organizational culture (5 statements, α= 0.785); 3. Relationship between knowledge management and knowledge sustainability (5 statements, α=0.834); 4. Relationship between technological background and knowledge sustainability (6 statements, α= 0.870).

The first category focuses on gaining insight into the primary goals of knowledge sustainability and its inherent values.

Due to space limitations, Table 1 summarizes the three highest average values for each category and the corresponding standard deviations based on expert evaluations, without claiming to be exhaustive.

Given that the rating was on a six-point scale, the values are sufficiently high. The relatively low standard deviations (homogeneous) indicate the consensus nature of the opinions. For further verification, we examined the median values of each statement and the interquartile range (IQR) values for the two panel groups. We took the experts' responses into account as a whole, and the decision on consensus was made based on the aggregate interquartile range. In determining consensus, we followed the position of Kittel-Limerick (2005), who stated that an interquartile range of 2.5 or less is a good indicator of consensus. Table 2 shows the results of the two panel groups for the three highest-rated statements in each category.

Table 1: Responses with the highest average values by category

Category	Statements	n	Ave.	Std. dev.
I.	1. In the 21st century, knowledge sustainability is a ***vital factor*** for organizations, regardless of the industry in which they operate.	126	5.22	0.83
	2. The value inherent in knowledge sustainability is used to make ***better decisions***.	126	5.04	1.00
	3. Ensuring knowledge sustainability has become a key source of ***competitive advantage*** for organizations in a rapidly changing world.	126	4.93	1.01
II.	1. Within the organization, knowledge sustainability raises ***ethical issues*** (e.g., inappropriate data management, behavior, knowledge withholding, etc.) that must be addressed.	126	5.00	0.88
	2. Ensuring the cycle of knowledge sustainability depends on the ***cooperation between*** the ***organization's members and management,*** and their shared values.	126	4.94	1.01
	3. An important step in the organizational application of knowledge sustainability is ***knowledge development/knowledge renewal.***	126	4.82	1.09
III.	1. The basic prerequisite for ensuring the long-term sustainability of knowledge within an organization is the ***integration of knowledge management process elements*** into organizational processes.	126	5.06	0.88
	2. Continuous, unconditional ***knowledge sharing*** among organizational members plays an important role in the cycle of knowledge sustainability.	126	5.02	1.05
	3. An important step in the organizational application of knowledge sustainability is ***knowledge development/knowledge renewal.***	126	4.91	1.14
IV.	1. A vital element of successful knowledge retention is the ***trust*** of organizational members in technology.	126	5.02	1.05
	2. The prerequisite for ensuring the long-term sustainability of knowledge is an adequate level of ***technological background***.	126	4.91	1.14
	3. To ensure the long-term sustainability of knowledge within the organization, its members must possess IT knowledge and skills ***(human capital).***	126	4.75	1.18

Source: own construction

Table 2: Consensus scores of the panel groups

Panel group 1 Category	Statement	Expert of knowledge management		Academic expert		Corporate expert	
		Median	IQR	Median	IQR	Median	IQR
I.	1.	5.00	1.5	6.00	1	6.00	1
	2.	6.00	1	5.00	1	6.00	2
	3.	5.00	1	5.00	2	4.00	1.5
II.	1.	5.00	2	6.00	1	6.00	2
	2.	5.00	1	6.00	1	5.00	1
	3.	5.00	1	5.00	2	5.00	1
III.	1.	6.00	0.5	6.00	1	5.00	1
	2.	6.00	1	6.00	1	5.00	1
	3.	5.00	1	5.00	1	5.00	2
IV.	1.	5.00	1	6.00	1	6.00	1
	2.	5.00	2	6.00	1	6.00	1
	3.	6.00	2	5.00	2.5	5.00	2

Panel group 2 Category	Statement	Europe		America		Asia		Other	
		Median	IQR	Median	IQR	Median	IQR	Median	IQR
I.	1.	6.00	1	6.00	1	6.00	1	6.00	1
	2.	6.00	1	5.00	1.5	6.00	1	5.00	1.5
	3.	5.00	2	5.00	2	5.00	2	5.00	2
II.	1.	4.00	2	5.00	1	6.00	1	5.00	2
	2.	5.00	1	5.00	1	5.00	1	5.00	2
	3.	5.00	2	6.00	0.5	6.00	1	5.00	1
III.	1.	5.00	1	6.00	2	6.00	1	5.00	2
	2.	5.00	2	5.00	2	6.00	1	5.00	2
	3.	5.00	1.5	5.00	1	5.00	0.5	5.00	2
IV.	1.	5.00	2	6.00	1	5.00	1	5.00	1
	2.	5.00	2	6.00	1	5.00	2	5.00	2
	3.	5.00	1.5	6.00	1	5.00	1.5	5.00	2

Source: own construction

Based on the mean, standard deviation, and IQR values, it can be said that the respondents reached a consensus on the statements related to the concept of organizational knowledge sustainability. Based on the analysis results, the definition of sustainable knowledge confirmed by the experts is as follows:

Knowledge sustainability is a vital organizational strategy to make better decisions for ethical and sustainable organizational operations by preserving the value and usefulness of knowledge (tacit and explicit) in the organization over the long term. It contributes to gaining and maintaining a competitive advantage by continuously updating existing and new knowledge, embedded in organizational activities. At the heart of knowledge sustainability is human capital, the prerequisites for its provision within an organization:

- An organizational culture based on trust (personal and impersonal), where members and management of the organization work together in a spirit of sustainable leadership.
- Integrating the elements of the knowledge management process into organizational processes, ensuring a continuous, evolving, knowledge-sharing cycle of knowledge.
- Ensuring a high level of availability of the technological background supporting the knowledge management process, maintaining the stress-free operation of technology, and ensuring digital and workplace well-being.

The definition of sustainable knowledge was formulated with the help of the evaluation of the first and second rounds of the Delphi method presented above, the reliability of which is ensured by the homogeneity of the respondents' opinions. The definition answers the first research question. The hypotheses formulated to answer the next two questions were tested as follows.

The results of examining the first three hypotheses provide answers to the question of what conditions are necessary for sustainable knowledge.

The validity of the hypotheses was verified using multiple linear regression analysis in IMB SPSS Statistics 25 software, which has the advantage of determining the relationships between variables much more accurately than the correlation coefficient. For the fit test and to examine the condition of homoscedasticity (constant

variance of the error term), the standardized estimated value and the value of the standardized residuals had to be determined, followed by the "R Square" coefficient of determination and the "Std. Error of the Estimate" value. The results for the first three hypotheses are summarized in Table 3.

Table 3: Basis for verifying the hypotheses

Hypotheses	R	R Square	Adj. R. Sq	Est. Std. Error
H1	.487	.237	.212	1.101
H2	.440	.194	.160	1.136
H3	.514	.265	.228	1.090

Source: own construction

The low value of the Std. Error of the Estimate predicts the effectiveness of further testing. The results of the regression analysis for each hypothesis are illustrated in Table 4.

H1 A trust-based organizational culture is a prerequisite for knowledge sustainability.

All variables are significantly related to knowledge sustainability, which suggests that a close relationship can be identified between knowledge sustainability and organizational culture, meaning that our first hypothesis proved to be valid.

The next hypothesis stated that knowledge sustainability is inconceivable in organizations where there is no adequate knowledge management system or where it is not aligned with the organization's strategy.

H2 To ensure the long-term sustainability of knowledge, it is essential to align knowledge management with organizational objectives.

The statistical analysis was performed as described above. In this case, the variables in Table 5 represent the most important expectations related to the knowledge management system.

The closest relationship is between the indispensability of knowledge development/renewal and ensuring that knowledge management elements are integrated into organizational activities, followed by continuous, unconditional knowledge sharing among organizational members. Based on the results, the second hypothesis also proved to be valid.

The third hypothesis tested the IT technology conditions of the theoretical model. The statistical analysis was similar to the above (see Table 6).

H3 The IT background of the organization plays an important role in making knowledge sustainable within the organization.

Except two variables, the correlations are significant, which means that four of the six variables examined have a statistically significant effect on sustainable knowledge. For the two statements, we obtained a higher p-value than the specified significance level ($p < 0.05$). This means that, in the opinion of the experts, IT solutions are no more important than other conditions, and they disagree with the statement that artificial intelligence is essential for knowledge sustainability. At the same time, it is noteworthy that adequate IT support is the most important expectation. This is closely followed by employees'

Table 4: Significant correlations between the determining factors of organizational culture

Statements (independent variables)	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
Organizational culture based on trust	.405	.116	.405	3.505	.004
Cooperation, shared values	.355	.137	.239	2.600	.001
Enforcement of sustainability management principles	.160	.110	.140	1.459	.015
Continuous training of employees	.124	.124	.102	1.178	.028

Source: own construction

Table 5: Significant relationships between the determining factors of the knowledge management system

Statements (independent variables)	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
Integration of knowledge management elements into organizational processes	.634	.216	.567	4.301	.003
Continuous, unconditional knowledge sharing among organizational members	.452	.189	.404	3.528	.009
Knowledge development/ knowledge renewal	.235	.179	.165	2.867	.002
The role of organizational memory	.209	.172	.146	2.464	.061
Aligning KM goals with organizational goals	.149	.145	.119	1.319	.049

Source: own construction

trust in technology, combined with the right skills. These results represent the correct and real contribution of technology to knowledge sustainability. Based on the results, we also accept hypothesis 3.

The examination of the other two hypotheses aimed to confirm the differences in opinion among the respondents in the panel groups.

H4 There are significant differences between the opinions of the respondents in the first panel group (knowledge management experts, academic experts, corporate professionals) regarding the statements related to the four categories.

When the median responses in multiple sample groups/ panels differ, it is worth performing a one-way ANOVA test ($p < 0.05$). Based on the test run on the twenty-two

Table 6: Significant correlations between key IT factors

Statements (independent variables)	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
The significant role of IT infrastructure	.541	.098	.458	2.607	.0192
Possession of IT knowledge and skills	.485	.092	.386	2.818	.0105
IT priority	.054	.095	.052	.566	.572
The indispensable role of artificial intelligence	.023	.062	.029	.363	.467
Appropriate level of technological background	.327	.084	.274	5.265	.001
Trust in technology	.219	.0063	.178	5.509	.005

Source: own construction

Table 7: Significant results of ANOVA analysis – panel group 1

Statements	Sum of Squares	df	Mean Square	F	Sig.
An organizational culture based on trust, where members and management work together, is key to sustaining knowledge within an organization.	7.288	2	3.644	2.590	.039
Ensuring the cycle of knowledge sustainability depends on the cooperation and shared values of the organization's members and management.	7.307	2	3.654	3.761	.026
A key element of successful knowledge retention is the appropriate and continuous training of employees.	7.016	2	3.219	.756	.048

Source: own construction

Table 8: Results of Tukey HSD analysis (panel group 1)

Statements	Comparison of panels		Mean Difference
An organizational culture based on trust, where members and management work together, is key to sustaining knowledge within an organization.	Panel 1	Panel 2	.255
		Panel 3	-.346
	Panel 2	Panel 1	-.255
		Panel 3	-.601
	Panel 3	Panel 1	**.346**
		Panel 2	**.601**
Ensuring the cycle of knowledge sustainability depends on the cooperation and shared values of the organization's members and management.	Panel 1	Panel 2	.187
		Panel 3	-.576
	Panel 2	Panel 1	-.187
		Panel 3	-.296
	Panel 3	Panel 1	**.576**
		Panel 2	**.296**
A key element of successful knowledge retention is the appropriate and continuous training of employees.	Panel 1	Panel 2	-.211
		Panel 3	-.694
	Panel 2	Panel 1	.211
		Panel 3	-.731
	Panel 3	Panel 1	**.694**
		Panel 2	**.731**

Source: own construction

Table 9: Significant results of ANOVA analysis (2nd panel group)

Statements	Sum of Squares	df	Mean Square	F	Sig.
An organizational culture based on trust, where members and management work together, is key to sustaining knowledge within an organization.	6.275	2	3.138	2.816	.012
In order to make knowledge sustainable in the long term, it is necessary to apply the principles of sustainability management.	5.397	2	1.122	.779	.028
A vital element of successful knowledge retention is the trust that organizational members place in technology.	3.742	2	1.371	.890	.047

Source: own construction

Table 10: Results of Tukey HSD analysis (2nd panel group)

Statements	Comparison of panel groups		Mean Difference
An organizational culture based on trust, where members and management work together, is key to sustaining knowledge within an organization.	Panel 1	Panel 2	-.852
		Panel 3	-.318
		Panel 4	.145
	Panel 2	Panel 1	**.852**
		Panel 3	**.765**
		Panel 4	**.419**
	Panel 3	Panel 1	.318
		Panel 2	-.765
		Panel 4	.210
	Panel 4	Panel 1	-.145
		Panel 2	-.419
		Panel 3	-.201
In order to make knowledge sustainable in the long term, it is necessary to apply the principles of sustainability management.	Panel 1	Panel 2	-.612
		Panel 3	.331
		Panel 4	-.460
	Panel 2	Panel 1	**.612**
		Panel 3	**.421**
		Panel 4	**.592**
	Panel 3	Panel 1	-.331
		Panel 2	-.421
		Panel 4	.165
	Panel 4	Panel 1	.460
		Panel 2	-.592
		Panel 3	-.165
A vital element for successful knowledge sustainability is the trust that organizational members have in technology.	Panel 1	Panel 2	.122
		Panel 3	-.349
		Panel 4	.332
	Panel 2	Panel 1	-.122
		Panel 3	-.567
		Panel 4	-.257
	Panel 3	Panel 1	**.349**
		Panel 2	**.567**
		Panel 4	**.407**
	Panel 4	Panel 1	-.332
		Panel 2	.257
		Panel 3	-407

Source: own construction

statements of the second round of the Delphi method, Table 7 shows only the significant results.

The high values in the "Sum of Squares" (SS) column suggest that the differences between the panels are large, i.e., the variance is significant. The table also shows the degrees of freedom (df) and the "Mean Square" values. High values in the "Mean Square" column appear where the "Sum of Squares" also shows high values. This supports the assumption that the difference between the panels is high. The combined interpretation of

the F and Sig. values helps to determine whether there is a significant relationship between the variables. For the other statements, the results of the study did not show a significant relationship between the mindsets of the members of the first panel group (1. knowledge management experts, 2. academic experts, 3. corporate experts). We examined how the differences in opinion developed in the case of statements showing a significant relationship. This was done using Tukey HSD (Honestly Significant Difference) analysis within the post-hoc analysis. The results of the analysis are summarized in Table 8.

Positive values indicate that the average rating of the first group of the two panels examined is higher, meaning that they considered the statement to be more important. In all three cases, the rating of the corporate experts differs from the opinion of the other two panels (they consider the statements to be significantly more important). In the case of the first two statements, the opinion of the knowledge management consultants is also more pronounced, but only supersedes that of the representatives of the academic sphere. In one case, the opinion of the academic sphere dominates that of the consultants.

We accept the hypothesis with the remark that in some cases there are significant differences in thinking between the participating panels, and the background to the differences in opinion has not been examined in detail. The differences do not affect the validity of the theoretical model or the accuracy of the definition.

The analysis of the last hypothesis examines the differences in opinion between the members of the other panel groups (1. Europe, 2. America, 3. Asia, 4. Others).

H5 There are significant differences between the opinions of respondents in the second panel group (experts from different continents) regarding the statements related to the four categories.

The analysis follows a similar logic to that of the previous hypothesis. The statements showing significant correlations are shown in Table 9.

<T9>

The Tukey HSD (Honestly Significant Difference) analysis was again used to identify differences of opinion among the panel group members. The results are summarized in Table 10.

<T10>

The differences in opinion were interesting. In all three statements, there was a significant difference between the opinions of the respondents, with the given panel overriding the opinions of all other panels. These relate to culture, trust, and sustainable leadership. On the issues of culture and leadership, the American panel's opinion differs significantly from the others (they consider it significantly more important), while the Asian panel's opinion places greater emphasis on trust. The differences are probably due to differences in experience and culture. Some panels also express stronger opinions, but these only override the opinions of one or more other panels, not all of them. Further research would be needed to determine the order of importance among them. It appears that the results of this study reinforce previous views and analyses and support the validity of the theoretical model and the definition formulated. Based on this, we accept the final hypothesis.

DISCUSSION

Based on the analysis of the results and the experiences gained during the research process, the theoretical model of sustainable knowledge and its constituent elements can be considered empirically supported. The findings align with our underlying assumption that the point of departure for sustainable knowledge is the continuous development of knowledge, which must be embedded in organizational processes and continuously shared. Sustainable corporate operation is achievable only when the conditions for sustainable knowledge are deliberately created. This argument is consistent with the work of Levallet and Chan (2019) and Dzenopoliak et al. (2024), who emphasize the necessity of knowledge sharing and the consequences of knowledge loss.

These requirements presuppose skilled employees who are open to continuous learning, experience psychological comfort in the workplace, and are able to achieve a work – life balance that enables creativity and innovation. This perspective is supported by Ochoa et al. (2020) as well as by the work on WHR (De Neve & Sachs, 2020). As the foundation of sustainable corporate functioning – and, by extension, a sustainable economy – sustainable knowledge also depends on prerequisites long discussed in relation to knowledge management systems. Chief among these are a trust-based organizational culture (Contreras-Medina et al., 2023; Versiani et al., 2024) and high-level IT solutions for storing and preserving knowledge. The importance of these conditions has been demonstrated in prior studies (Nugroho, 2018; Arduini et al., 2024).

In addition, the international expert community highlighted another salient cultural component: the enforcement of ethical principles, ethical employee and managerial conduct, and ethical organizational functioning more broadly. Although ethical leadership and ethical business functioning have been addressed in earlier work (Belas et al., 2020; Zheng et al., 2022; Malik et al., 2023; Belas et al., 2024), we did not identify research that links these issues explicitly to sustainable knowledge in the manner suggested by our findings. Overall, cultural requirements emerged as among the most strongly preferred expectations. This also implies that, alongside IT systems, organizational memory plays a pivotal role; however, its effective operation presupposes both trust and ethics (Zheng et al., 2022).

The study further confirms that sustainable knowledge cannot be meaningfully discussed in the absence of a functioning knowledge management system. For the model elements to operate in a coordinated way – sup-

porting organizational and macroeconomic interests while remaining aligned with sustainability goals – sustainable leadership mindsets, behaviors, and decisions are required.

The relationships among organizational sustainability, knowledge management, knowledge risk, and business success have been examined widely, underlining the importance of this broader field (López-Torres et al., 2019; Zieba et al., 2022; Abdullah et al., 2023; Turan et al., 2024; Mohaghegh et al., 2024). Nevertheless, sustainable knowledge – as the knowledge foundation of sustainable organizational functioning – remains under-researched, and a clear definition is largely absent from the literature. Consequently, its organizational applicability and contribution to performance have not been demonstrated convincingly to date. The present study sought to address this gap. Research on the knowledge management – sustainability nexus identifies requirements that informed our approach, particularly the need to manage relevant conditions at the system level and to extend them with additional requirements emerging from expert judgment (Levallet & Chan, 2019; Galan, 2023; Jain, 2024). These relationships are reflected in the relational logic of the proposed theoretical model.

From a systems perspective, existing research only partially acknowledges the need to consider interdependencies explicitly and to incorporate them into managerial decision-making. Klingenberg and Rothberg (2021) identify the absence of systems thinking as a barrier to the diffusion of sustainability-oriented developments and mindsets. Our theoretical model and the empirical verification of the hypotheses support this argument. Some studies likewise stress that technical conditions, knowledge management, and human resources should be treated as equally critical dimensions of competitiveness (Vo et al., 2022; Wanjiru, 2022). These requirements are embedded in the definition of sustainable knowledge formulated by the international expert panels. Moreover, surveys of university students' sustainability knowledge repeatedly highlight the importance of achieving an adequate knowledge base and its effects on attitudes and behaviors (Braßler & Sprenger, 2021). Overall, while earlier findings are broadly corroborated, they have tended to present only fragments of the interrelationships required to enable the organizational implementation of sustainable knowledge. The present study addresses these gaps by proposing a new theoretical model and by articulating both a relational framework and a definition of sustainable knowledge.

CONCLUSION

The key contribution of this research is the development of a novel conceptual model of sustainable knowledge. Its validity was confirmed using the Delphi method – an approach that is less commonly used today, yet well suited to the study's aims. Testing the three hypotheses supported the model's relational structure, linking a trust-based organizational culture to a learning organization orientation, sustainability management, knowledge reservoirs (including organizational memory), and the knowledge management system. The strongest relationship emerged for a trust-based culture grounded in cooperation and shared values, which also encompasses requirements associated with sustainable leadership.

The results confirm the necessity of a knowledge management system and the integration of its principles, as well as the central role of continuous knowledge development and knowledge sharing. Experts – particularly from the corporate sphere – rated these requirements as especially important. The role of information technology was also confirmed, though the findings do not support a view of technology as sufficient on its own.

The study also indicates that sustainable knowledge requires sustainable leadership thinking, behavior, and decision-making for the theoretical model elements to function coherently and to serve both organizational and broader economic interests in line with sustainability objectives. Across expert value judgments, cultural requirements emerged as particularly salient. Respondents from the Americas assigned significantly greater importance to organizational culture expectations, including those related to colleagues and managers. In addition to IT, organizational memory was again emphasized as a key component.

Relative to prior work, a notable new insight is the international expert consensus that ethical principles – expressed through ethical employee and managerial conduct and ethical organizational functioning – represent a dominant element of organizational culture in the context of sustainable knowledge. Overall, people were still perceived as more important than technology. Notably, the presumed centrality of artificial intelligence in shaping future knowledge practices did not emerge strongly in expert responses. Finally, while a broad consensus was achieved on major issues, cross-national cultural differences were apparent in several response patterns.

LIMITATIONS OF THE RESEARCH AND FUTURE DIRECTIONS

A key limitation of the study is the generally low response rate. During personal inquiries and interviews, we frequently encountered reactions such as "we have not considered this yet," "we cannot answer that," or "it is not part of our research agenda." This aligns with the literature, which suggests that the topic is not yet among the most intensively researched areas. In addition, the study did not examine the mechanisms underlying differences between panel opinions; therefore, the precise drivers of more emphatic judgments remain unclear.

A further limitation is that no new experts were included in the second Delphi round; the same experts participated in both rounds. Including additional respondents might have generated novel insights, introduced further perspectives, or pointed to additional research directions. Participation also varied substantially across continents; for instance, Africa and Australia were represented by

particularly small numbers. Consequently, results for these regions can be interpreted only for those countries where participation was sufficient to support statistical analysis.

Future research could profitably involve a larger and more culturally diverse expert sample to enable more robust comparisons of culturally grounded differences in judgments. It may also be valuable to apply a "Delphi Public" approach more widely, capturing the views of non-expert respondents who may experience the consequences of insufficient sustainable knowledge in everyday life across different societal levels. Another promising direction would be to investigate the role of artificial intelligence more explicitly and through more targeted questions, as its potential benefits and risks were not foregrounded in expert responses in the present study. Given that sustainable knowledge is essential across sustainability-related domains, it is reasonable to expect that both the volume and diversity of research on this topic will expand substantially in the future.

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AUTHOR CONTRIBUTIONS STATEMENT

Conceptualization, A. B.; methodology, A. B.; validation, A. B.; formal analysis, A. B. & students; investigation, A. B. & students; resources, A. B.; data curation, A. B. & students; writing-original draft preparation, A. B.; writing-review and editing, A. B.; visualization, A. B.; supervision, A. B.

DATA AVAILABILITY STATEMENT

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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