

PAPER

Bridging Tacit Knowledge and Explicit Knowledge: An Ontological Model for Effective Knowledge Conversion

Ouissale Zaoui
Seghroucheni¹(✉),
Mohamed Lazaar¹,
Mohammed Al Achhab²

¹ENSIAS, Mohammed
V University in Rabat,
Rabat, Morocco

²ENSA, Abdelmalek Essaadi
University, Tetouan, Morocco

ouissale_zaouiseghroucheni@um5.ac.ma

ABSTRACT

Knowledge management (KM) involves a structured approach to creating, sharing, utilizing, and organizing knowledge and information within an organization, aiming to enhance its efficiency, productivity, and competitive advantage. A core element of KM is the distinction between tacit and explicit knowledge (EK). Tacit knowledge (TK) refers to personal insights and skills that are difficult to articulate or transfer, as they are deeply embedded in individual experiences. In contrast, EK consists of information that can be easily documented, communicated, and shared. The process of converting TK into EK is essential for fostering innovation and organizational growth, particularly in today's fast-paced business environment. By translating TK into a more formal, shareable format, it becomes easier for others to access and apply valuable insights. However, capturing TK presents challenges because it is subjective and linked to personal experience. The practice of externalization involves developing creative methods to articulate and share this kind of knowledge, making it accessible and actionable for others. This paper introduces a model for representing TK and outlines strategies for transforming it into explicit forms. It also discusses techniques for effectively capturing this valuable expertise, which is crucial for making informed decisions. Converting TK into EK ensures that organizations can preserve and utilize critical insights across different roles and functions.

KEYWORDS

knowledge management (KM), tacit knowledge (TK), explicit knowledge (EK), knowledge conversion, ontology

1 INTRODUCTION

In today's knowledge-driven economy, organizations face the pressing need to manage and leverage their collective knowledge to remain competitive, innovative, and efficient. Knowledge management (KM), defined as the systematic process of creating, sharing, utilizing and preserving information has emerged as a critical strategy for achieving these goals [1] at its core, KM involves a fundamental

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distinction between two types of knowledge: tacit and explicit. Tacit knowledge (TK) encompasses deep-seated insights, intuitions, and experiences that individuals acquire over time, which are often challenging to articulate or codify. In contrast, explicit knowledge (EK) refers to information that can be readily documented, shared, and communicated [2]. This distinction is central to KM processes, as converting TK into EK is essential for facilitating the transfer of valuable insights across an organization [3].

The conversion of tacit to EK enables organizations to retain critical expertise, even amid staff turnover or role changes. Nonaka and Takeuchi's knowledge creation model offers a widely recognized framework that outlines four processes of knowledge conversion: socialization, externalization, combination, and internalization, known as the SECI model. Externalization, in particular, represents the process of articulating TK into explicit forms, such as documents or models, which makes this knowledge accessible and usable for others. This process, however, presents unique challenges, as TK is deeply personal and often rooted in an individual's experiences and subjective insights. Consequently, effective externalization requires creative methods to translate this nuanced knowledge into accessible forms that others can readily understand and utilize [4].

The significance of converting TK into EK extends beyond knowledge retention; it also enhances decision-making and drives innovation. By systematically capturing and codifying TK, organizations can develop a comprehensive repository of expertise that facilitates strategic decision-making and fosters a culture of continuous improvement. For example, a 2019 study of Fortune 500 companies showed that organizations with robust KM practices reported a 25% faster rate of product development compared to those without such practices [5]. Another study found that converting TK into explicit forms improved cross-departmental decision-making by 30%, leading to a significant increase in overall organizational efficiency [6]. This underscores the pivotal role that KM plays in shaping not only the internal dynamics of an organization but also its competitive positioning in the market.

Overall, by investing in processes to convert TK into explicit forms, organizations can transform individual expertise into an enduring organizational asset that supports both immediate operational needs and long-term strategic goals.

2 KNOWLEDGE CONVERSION

2.1 The SECI model of knowledge management

The Nonaka model has become a reference within the field of management to understand how to bring closer the dynamics of TK to that of EK. The approach to the combination of these two types of knowledge is, above all, relevant to the processes of creation, articulation, and exploitation of knowledge. These are fundamental processes in an era marked by the creation of knowledge and innovation as elements that enable the development of organizations and the continuous generation of relevant results for all stakeholders. From the perspective of the model proposed, knowledge is not assimilated as an individual property or a process carried out individually: on the contrary, the starting point is the interaction among individuals and with the organizational context. Thus, in this sense, an approach of a cognitive character is included, the epistemic dimension, the focus. The model is an attempt to synthesize the key aspects of this perspective and articulate the concepts of knowledge, learning, and innovation.

The model in the (see Figure 1) is decisive for four reasons. First, it seeks to systematize a perspective on the relationship between tacit and EK. Second, it integrates the characteristics inherent in the knowledge of organizations: tacit and explicit, and at the individual and collective levels. Third, it underlines the importance of considering the context in the analysis of the management and combination of different types of knowledge. Finally, it articulates the process by which the individual knowledge of people tries to connect with organizational knowledge, explicitly linking learning and innovation. The dynamics of knowledge are based on the processes of recombination and integration of diverse elements within the business context. In turn, these mechanisms reflect the exploration and exploitation processes.

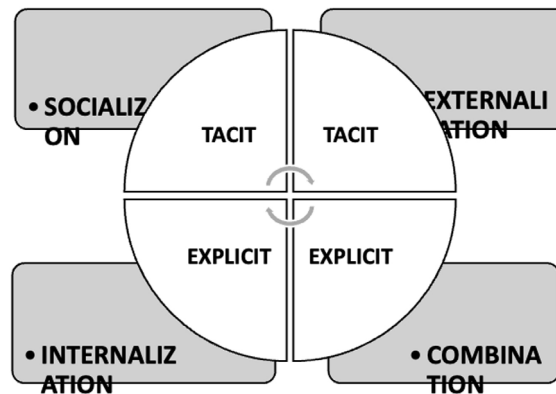


Fig. 1. The SECI model of knowledge management

Socialization. The process of sharing TK through direct interaction, experience, and observation. Socialization involves learning from others by engaging in activities or participating in group interactions.

$$S: \forall x, y (Kt(x) \wedge Experience(x, y) \rightarrow Shared(Kt(x, y))) \tag{1}$$

Where:

- x, y: Individuals
- Kt(x): TK possessed by x
- Shared (Kt (x, y)): TK shared from x to y

Externalization. The process of articulating TK and converting it into explicit forms, such as documents, models, or frameworks. This is often considered the most challenging process because TK is deeply personal and difficult to express.

$$E: Kt(x) \rightarrow Ke(x) \tag{2}$$

Where:

- Ke(x): EK derived from x's tacit knowledge

Combination. The process of combining different sets of EK to create new EK. This often involves synthesizing information from different sources and organizing it into more useful forms.

$$C: \forall Ke(x), Ke(y) (Ke(x) \wedge Ke(y) \rightarrow Ke(x, y)) \quad (3)$$

Where:

- Ke (x, y): A new form of EK created by combining Ke(x) and Ke(y)

Internalization. The process through which EK is absorbed and converted back into TK. Individuals internalize EK through learning, practice, and experience.

$$I: Ke(x) \rightarrow Kt(x) \quad (4)$$

Among the four processes in the SECI model, externalization stands out as a critical process for converting TK into EK, making it accessible and shareable with others across an organization. This conversion is essential because TK rooted in personal experiences, intuition, and context—is often inaccessible to others unless it is translated into a communicable form. Through externalization, insights held by individuals are articulated in tangible formats, such as written reports, manuals, models, or diagrams, which can then be used and understood by a broader audience.

Externalization is not only about capturing information but also about transforming complex insights into formats that encourage widespread understanding and utility. This transformation can be challenging, as it requires the ability to accurately convey nuanced knowledge without losing its context or depth. To address this, organizations often employ structured techniques such as storytelling, analogy, conceptual modeling, and case documentation. For example, an engineer with years of on-the-ground expertise might document their troubleshooting process in a manual, which can then be referenced by new team members who might lack that same level of experience.

2.2 Externalization in knowledge conversion

The process of externalizing TK is key to KM and organizational learning. By externalization, we imply the transformation of informal insights and contextual ‘know-how’ into a format broadly accessible to stakeholders. This transformation from tacit into EK can take several forms, including formal documents, minutes of meetings, and technical papers. At the first stage of conversion, the process of ‘articulating an intuition’ into an explicit concept occurs (‘tacit’ to ‘explicit’), and this is subsequently recorded and stored for potential transfer to others. The significance of this process of externalization is that it encapsulates a series of explanations, which relate personal insights to the experiences of others. Further, it often includes examples or analogies to illustrate understanding [6].

There are some major challenges associated with externalizing TK, including that precognitive or intuitive experiences are often difficult to articulate and explain. A range of techniques can form part of the externalization process, including storytelling, metaphorical thinking, the use of narratives, and the development of knowledge artifacts. Clearly, the context of use, the purpose of the practice, the spatial and temporal constraints, as well as the participants involved, can all contribute to the most effective method. It has also been noted that the externalization of TK is enhanced by an organizational culture that encourages the sharing of expertise, as those who possess TK are more likely to attempt its articulation in a trust-creating environment. This process presents several challenges. First, articulating TK can be difficult since it often resides in unconscious insights and skills that individuals

may not easily express. Studies have highlighted that explicit reflection and time are often required to facilitate this articulation [7].

Another issue is the loss of context. TK is deeply embedded within specific environments and circumstances, and when externalized, much of this contextual richness can be lost. This diminishes the knowledge's relevance and applicability across different organizational settings [8]. Addressing this requires a more nuanced approach to documentation, where context is preserved as much as possible.

Cultural barriers also hinder externalization. In many organizations, employees may feel reluctant to share their knowledge due to fears of losing personal advantage or concerns over intellectual property. Promoting a culture of trust and collaboration can help mitigate these challenges, making employees more willing to externalize their insights [9].

Organizations aiming to overcome these barriers can adopt strategies such as fostering a supportive, open culture and using detailed contextualization in documentation, which can improve knowledge transfer and promote continuous organizational learning [10].

3 MODELING AND CONVERSION OF TACIT KNOWLEDGE

3.1 Tacit knowledge

Tacit knowledge is conceptualized as an emergent property from the interaction between know-how (KH), practical, procedural knowledge and E personal insights gained over time. This interaction aligns with contemporary perspectives on TK, which suggest that it is not solely an individual attribute but is also contextually and relationally shaped, evolving through social interactions and specific situational applications [11] [12].

The model allows us to visualize TK as a flexible construct, where varying the depths and balances of KH and E results in different levels and qualities of tacit knowledge.

When KH is more prominent, TK may be specialized and highly technical but less adaptable. Conversely, when E is richer, TK may offer broader situational awareness and adaptability, critical for dynamic problem-solving [13].

The elements in the (see Figure 2) reflects that TK depth can expand through learning and iterative application, emphasizing that increasing either component—through training or real-world practice—enhances the richness and applicability of tacit knowledge [14].

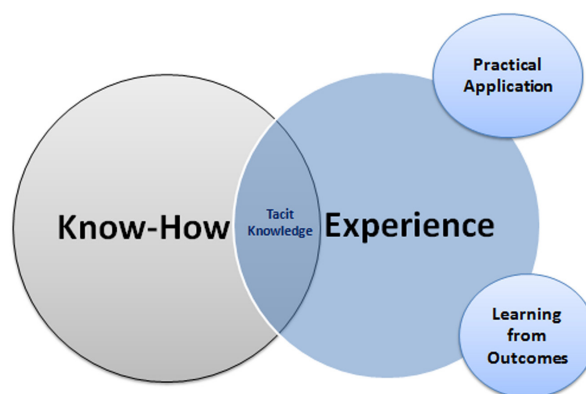


Fig. 2. The tacit knowledge elements

Given that TK is defined as the combination of procedural knowledge (KH) and experiential knowledge, we can define TK as a function of KH and experience:

$$\text{Tacit Knowledge (TK)} = f(\text{Know-how (KH), Experience (E)}) \quad (5)$$

Tacit knowledge results from the multiplicative relationship between KH and E, reflecting that both components enhance each other synergistically:

$$\text{TK} = \text{KH} \cdot \text{E} \quad (6)$$

Tacit knowledge grows proportionally with both KH and E. When either component is missing ($\text{KH} = 0$ or $\text{E} = 0$), TK is significantly diminished. This reflects that TK requires both a depth of E and practical KH to fully develop.

In practice, the relationship between KH, E, and TK is often complex and non-linear. A more nuanced model could introduce exponents to capture how knowledge accumulation accelerates as one gains depth in both areas:

$$\text{TK} = \text{KH}^\alpha \cdot \text{E}^\beta \quad (7)$$

When $\alpha > 1$, KH has a more substantial impact on TK, while if $\beta > 1$, E plays a more significant role. This model allows customization to various types of TK. For example, technical fields may place greater emphasis on KH, whereas fields such as leadership might lean more on accumulated experience.

Given that TK develops through ongoing learning and accumulated experience over time, we can expand the model by incorporating a time factor:

$$\text{TK}(t) = \text{KH}(t)^\alpha \cdot \text{E}(t)^\beta \quad (8)$$

This indicates that both KH and experience grow over time, enhancing the TK base as these elements expand.

3.2 The proposed ontology for TK conversion

To effectively model and formalize the conversion of TK, we propose the use of an ontology that captures the essential concepts and relationships involved in this process. The ontology serves as a structured framework that enables the representation of TK in a way that is both systematic and accessible. It defines key concepts, such as TK, EK, intuition, E, and the conversion process (CP), and establishes the relationships between them, offering a coherent model for understanding how tacit knowledge.

The ontology can be represented visually in a diagram (see Figure 3), where the relationships between tacit and EK, as well as the CP, are mapped out. This figure would depict the flow from TK—characterized by E and intuition—to EK, with various intermediary processes such as articulation, documentation, and sharing. The ontology provides a clear structure for understanding how TK can be externalized and utilized across an organization or learning environment.

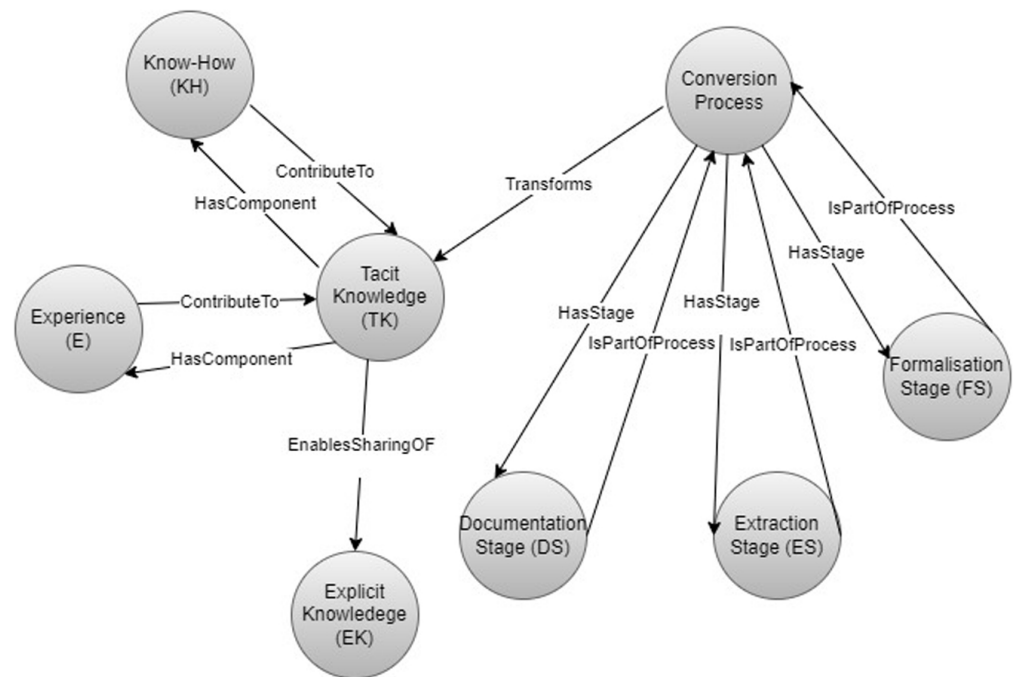


Fig. 3. The proposed ontology for tacit knowledge conversion

The ontology includes various components to capture the nuances of TK conversion:

- **Tacit knowledge:** Core concept encapsulating both KH and experience.
- **Know-how:** Practical skills, techniques, and operational knowledge.
- **Experience:** Insights, lessons learned, and personal reflections derived from practice.
- **Conversion process:** A structured series of steps to transform TK into a shareable form.
- **Extraction stage (ES):** Initial stage where TK elements are identified and gathered.
- **Formalisation stage (FS):** Stage where knowledge is organized into codified representations.
- **Documentation stage (DS):** Final stage where formalized knowledge is documented and prepared for dissemination.
- **Explicit knowledge:** Knowledge that has been codified and is easily accessible and shareable after the conversion process.

In our ontology, we define several relationships to formalize the interaction between these concepts:

- **HasComponent:** Links TK to its components, KH and experience.
- **ContributeTo:** Indicates that KH and E contribute to the formation of tacit knowledge.
- **ConvertedTo:** Represents that TK is converted to EK through the conversion process.
- **HasStage:** Links the CP to its constituent stages (extraction, formalization, documentation).
- **Transforms:** Indicates that the CP transforms TK into explicit knowledge.
- **IsPartOfProcess:** Specifies that each stage (extraction, formalization, documentation) is part of the overall conversion process.

- **EnablesSharingOF:** Shows that EK enables the sharing of insights initially held in tacit knowledge.

By using this ontology, organizations can better manage the process of knowledge transfer, ensuring that TK is captured, formalized, and effectively shared, leading to enhanced organizational learning and decision-making.

4 ELICITATION OF TACIT KNOWLEDGE

Eliciting TK involves uncovering and capturing personal, experiential knowledge that individuals possess but may not easily express. TK is deeply embedded in practical skills, insights, and intuitions developed through E, making it challenging to formalize. Several methods are commonly used to extract this type of knowledge, particularly in KM and organizational learning. Key methods include:

Interviews. Structured interviews: Structured interviews use predefined questions to guide the conversation. Though primarily used to gather EK, these interviews can also elicit TK by encouraging individuals to reflect on their personal experiences and insights [15].

Unstructured or semi-structured interviews: These interviews are more flexible and allow interviewees to share personal stories and experiences, making them particularly effective for uncovering TK [16].

Observations. Job shadowing: By observing an individual in their work environment, one can gain insight into how decisions are made, how skills are applied, and how problems are solved in real time. TK often becomes apparent through behavioral and action-based cues [17].

Cognitive task analysis (CTA): CTA is focused on understanding how experts perform tasks and make decisions. Structured observation helps uncover the mental models and decision-making strategies that are not visible [18].

Storytelling. Storytelling serves as an effective method for sharing personal experiences and lessons, allowing individuals to convey insights that might be challenging to express formally. By fostering storytelling within group environments, organizations can facilitate the transfer of TK. Employees can be encouraged to share their stories, which can then be recorded and made accessible to others, creating a valuable repository that transforms TK into EK. This approach strengthens knowledge-sharing practices and enhances organizational learning. [19].

Reporting and documentaion. Reporting systems allow experts to systematically document their experiences, decision-making processes, and insights, which can be structured into formal documents. These documents can later be processed to extract TK patterns and decision rules [20].

Encouraging organizations can convert TK into EK by using documentation as a method. This entails capturing and organizing knowledge in a structured manner to make it accessible and usable to others. Documentation comes in various forms, including written reports, manuals, procedures, guidelines, or visual aids. The process of documenting TK makes it more tangible, transferable, and shareable, leading to enhanced performance, reduced errors, and improved decision-making. However, documentation alone may not be enough to capture all aspects of TK, and it should be complemented with other methods, such as communities of practice, apprenticeship, or mentoring [21].

Chatbots. The Q&A chatbots are a powerful tool in organizational KM, specifically for enhancing the accessibility of EK. These chatbots can be programmed to answer frequently asked questions, direct employees to resources, and even guide

them through complex procedures. By automating responses to common queries, chatbots save employees time and reduce the burden on human resources or support teams. Moreover, chatbots can be designed to learn from ongoing interactions and provide increasingly refined answers. Over time, they may be able to handle more complex queries, improving both knowledge accessibility and employee performance. This is particularly valuable in large organizations where employees may struggle to find the right resources or answers quickly. Through integration with existing KM systems, chatbots can serve as a central hub for employees to access documents, guidelines, and solutions, fostering a more efficient workflow. In addition to improving individual productivity, chatbots can also promote a culture of continuous learning by offering timely updates on best practices, new tools, or relevant training materials. With AI-driven chatbots, organizations can enhance employee engagement, reduce knowledge silos, and create a more responsive, learning-oriented work environment [21].

After-action reviews. After-action reviews (AARs) are a valuable tool for transforming TK into EK within organizations. During AARs, team members reflect on a completed project or event, sharing their insights and lessons learned. This reflective process often reveals knowledge that was previously implicit or unspoken. By documenting and codifying these insights, the organization makes them accessible to others, ensuring better decision-making, improved problem-solving, and fostering a culture of continuous learning. AARs not only capture knowledge but also strengthen organizational resilience and adaptability by creating a feedback loop for future improvements [22].

Ontological modeling. Ontological modeling serves as a powerful technique for converting TK into EK by creating a formalized representation of concepts and relationships within a specific domain. This structured approach makes previously implicit expertise accessible and shareable.

Conceptual modeling: By developing an ontology, organizations can map out processes, systems, or knowledge domains, effectively capturing the expertise of individuals with specialized knowledge. Through this process, TK is externalized and can be communicated across the organization.

Knowledge representation: Ontologies provide a standardized format for representing knowledge, making it possible to encode the expertise of individuals into a formalized structure. This allows TK to be made explicit and shared across various applications, systems, and contexts, ensuring it can be reused effectively. The approach also ensures that knowledge is not only captured but also preserved in a way that makes it accessible for further use and development by others within the organization [23].

Visual analytics tools. Software applications that enable users to explore complex data sets can reveal patterns and relationships that might be overlooked with traditional analysis techniques. By visualizing TK in a graphical format, these tools make it easier to identify, share, and communicate insights. For example, a skilled craftsman may possess extensive TK of their craft that is challenging to articulate verbally. Using visual analytics tools, they can capture their techniques and movements, analyze the data to uncover patterns, and then present these insights through visualizations that offer a more intuitive understanding of the craft [24].

Modeling and simulation. Modeling and simulation are powerful tools for converting TK into EK. These methods involve creating virtual models and simulations of real-world systems and processes, which help capture, analyze, and transfer TK. By representing the complexities of real-world situations in a controlled, virtual

environment, TK can be externalized, making it easier to communicate, study, and apply across different contexts [25].

There are several ways in which modeling and simulation can facilitate TK conversion:

Visualization of expertise: Experts often have deep, intuitive understanding of complex systems that are difficult to articulate. Modeling and simulation allow these experts to create visual representations of their knowledge, which can then be analyzed, adjusted, and improved. This visualization helps externalize their expertise, making it easier for others to grasp.

Scenario-based learning: By simulating various scenarios, TK embedded in real-world situations can be captured. Experts can create scenarios that demonstrate how certain decisions lead to specific outcomes, helping others understand the decision-making process and its underlying tacit knowledge.

Interactive simulation: Interactive models allow users to experiment and manipulate variables in a simulated environment, offering a deeper understanding of the processes and systems involved. This hands-on experience can uncover hidden knowledge and provide insights into how experts approach complex tasks or challenges.

Capturing intuition through algorithms: In some cases, TK is based on expert intuition, which is difficult to formalize. Through modeling, this intuitive knowledge can be translated into algorithms or mathematical representations that can be shared, tested, and applied more widely.

Training and knowledge transfer: Simulation-based training allows organizations to capture TK from experienced employees and pass it on to less experienced workers. This method helps bridge knowledge gaps, making TK more accessible through practical, simulated experiences.

Knowledge refinement and validation: Through simulation, TK can be refined and validated by testing different models and approaches. By applying the TK in simulated environments, experts can verify its accuracy, improve its robustness, and ensure its applicability in a variety of situations.

Collaborative knowledge sharing: Modeling and simulation tools can be shared across teams, departments, or organizations. This collaborative approach enables multiple experts to contribute their TK to a single model, leading to a more comprehensive and explicit representation of complex systems or processes.

These methods are designed to foster environments that encourage thoughtful reflection, open sharing, and collaborative discussion, essential for extracting and transferring TK. TK is often deeply embedded in personal experiences, insights, and expertise, which makes it challenging to articulate and formalize. By promoting an atmosphere where individuals feel comfortable discussing their insights and reflecting on their processes, these methods enable the uncovering of subtle, nuanced information that might not emerge in structured, formal settings. Furthermore, such environments encourage knowledge exchange across different levels of expertise, allowing experienced individuals to pass on critical skills and insights to newer team members. This dynamic exchange not only enriches the organizational knowledge base but also promotes continuous learning, adaptability, and innovation by integrating diverse perspectives and real-world experience into accessible knowledge assets.

5 CONCLUSION

Converting TK into explicit, shareable forms is a cornerstone of effective KM, yet it remains a complex challenge for many organizations. This paper introduces a model designed to facilitate this conversion, using traditional methods such as interviews, observations, and documentation to capture valuable TK. However, as organizations generate increasingly vast amounts of unstructured data, such as emails, reports, and social media interactions, emerging AI technologies, particularly natural language processing (NLP) and machine learning, present significant advancements to enhance and accelerate this process. Future research will concentrate on leveraging NLP to automate the analysis of unstructured text, extracting valuable insights from otherwise chaotic or ambiguous data. By using sophisticated algorithms, NLP can identify key themes, sentiments, and patterns within large volumes of text, making it easier to convert TK into structured, usable forms. Additionally, machine learning algorithms can be employed to detect hidden patterns within this data, providing deeper context and understanding of the knowledge being shared. This can support organizations in identifying trends, best practices, and insights that are not immediately obvious, thereby helping them make informed decisions. Furthermore, machine learning can facilitate knowledge contextualization across different domains, enabling the integration of knowledge from various sources and applications. This capability can assist in building more comprehensive and dynamic knowledge bases that evolve over time as new insights are continuously added. These advancements will not only improve the efficiency of knowledge conversion but also empower organizations to adapt and innovate more rapidly. By automating aspects of this process, AI can reduce the burden on human experts and facilitate the seamless flow of knowledge, ultimately supporting the growth of organizational intelligence and fostering continuous innovation.

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7 AUTHORS

Ouissale Zaoui Seghroucheni graduated with a master's degree from the National School of Applied Sciences of Tetouan, Morocco. Her primary research interests include knowledge management systems, especially knowledge conversion (E-mail: ouissale_zaouiseghroucehni@um5.ac.ma).

Mohamed Lazaar received his PhD in Computer Science in 2013 from the Faculty of Sciences and Techniques of Fez. He is a Professor of Higher Education at the National School of Computer Science and Systems Analysis in Rabat, Morocco. His research interests lie in optimizing machine learning models, with a particular focus on improving the performance of deep learning systems. Additionally, he works extensively in natural language processing, social network analysis, and recommender systems. His academic contributions aim to push the boundaries of artificial intelligence and data-driven solutions, applying these technologies to solve practical and complex issues across various domains.

Mohammed Al Achhab received his PhD in 2006 from the University of Franche-Comté, France, specializing in the formal verification of reactive systems. He earned a master's degree in software engineering and artificial intelligence in 2003 from the same university. From 2007 to 2012, he served as an assistant professor at the Faculty of Sciences Dhar El Mehraz in Fez. Currently, he is a professor at the National School of Applied Sciences of Tetouan, where he is actively involved in the computer science department and the school's governance. His research focuses on business process validation, natural language processing (especially Arabic), and adaptive e-learning. With over 20 peer-reviewed publications, he is also a member of various scientific associations such as IEEE and has chaired notable IEEE CiSt conferences.