

The Role of Knowledge Management and Organizational Learning in Improving Eco-Innovation Capabilities in Technology Start-up Companies in Indonesia.

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ABSTRACT

Climate change and the environment encourage companies, especially technology start-ups, to develop eco-innovation capabilities. However, limited resources in knowledge management, difficulties in building an organizational learning culture, and communication barriers are the main problems that hinder these capabilities. This research aims to explore the role of knowledge management and organizational learning in improving eco-innovation capabilities in technology start-up companies in Indonesia. The method used is qualitative with a case study approach. Data was collected through participatory observational interviews and documentation with purposive sampling on three technology start-up companies in Indonesia that have tried to implement eco-innovation. This study involved 88 respondents. Data analysis is carried out thematically to identify the patterns and dynamics underlying the knowledge management and organizational learning process. The results show that effective knowledge management and an adaptive learning culture strengthen the capabilities of eco-innovation despite limited resources. Communication and coordination barriers between team members can be overcome with supportive information systems and leadership that encourages collaboration. These findings offer insight into best practices and the challenges faced by tech start-ups in developing eco-friendly innovations. The conclusion of this study emphasizes the importance of strengthening knowledge management and learning culture to support eco-innovation. The practical implications include recommendations for managerial strategies that start-ups can implement to optimize their sustainable innovation capabilities.

I. INTRODUCTION

Technology start-ups in Indonesia are increasingly encouraged to develop environmentally friendly innovations in response to regulations and market expectations regarding sustainability (Mehmood et al., 2025). However, many start-up founders still rely on individual initiatives without a systematic mechanism to store and disseminate knowledge about eco-innovation practices. This leads to the implementation of environmental innovations that remain sporadic and poorly structured at the organizational level (Sultan & Ansari, 2025).

The role of knowledge management in improving eco-innovation capabilities in technology start-up companies in Indonesia is very important because it facilitates the creation, storage, and distribution of knowledge that supports the environmentally friendly innovation process (Yadav et al., 2022). Knowledge management helps overcome resource limitations by ensuring that relevant information and experiences can be accessed and used effectively by all members of the organization (Ball & Kittler, 2019). With good knowledge management, start-ups are able to turn ideas and information into sustainable, innovative practices, driving increased performance and competitiveness. In addition, knowledge management strengthens coordination between teams by providing a knowledge-sharing platform that allows for smoother collaboration and more informed decision-making. This is especially important given the dynamic nature of start-ups, which often face rapid changes in the business environment (Riandita et al., 2025).

Organizational learning serves as the foundation for developing an adaptive and resilient innovation culture in technology start-ups. Organizational learning allows company members to continuously evaluate and improve internal processes through reflection and exchange of experiences, thus supporting the development of more resilient eco-innovation capabilities. By fostering a strong learning culture, communication and coordination barriers in knowledge management can be minimized as collaborative attitudes and openness to change are increasing. In this context, organizational learning not only improves adaptability but also encourages sustainable and environmentally responsible innovation. Therefore, the integration of knowledge management and organizational learning is the main strategy to overcome resource constraints, build a culture of innovation, and facilitate communication and coordination in technology start-ups in Indonesia (Al-Doghan et al., 2025).

Some start-up companies have established dedicated knowledge management units supported by advanced information technology, indicating effective knowledge management implementation. However, there is not much evidence to reveal how the process affects their ability to create green innovations consistently. It is not yet clear how a learning culture can be maintained when organizations face rapid changes in business models. Although some start-ups have implemented internal training programs, their effectiveness in fostering continuous learning practices is still little evaluated.

Formal and informal communication systems within start-ups frequently suffer from fragmentation. In fact, coordination between divisions is very important so that eco-innovation ideas do not stop at the exchange of information only. This aspect is still very rarely described in previous research. No qualitative case studies in Indonesia have yet revealed the internal mechanisms of knowledge management and organizational learning within the context of eco-innovation. Previous research has tended to use a quantitative approach and ignore the dynamics of relationships between stakeholders in start-ups. This study introduces a qualitative approach to case studies that will provide a holistic and contextual understanding of the process. The uniqueness of this method lies in the exploration of three main issues: limited resources in managing knowledge, difficulties in building a learning culture, and barriers to communication and coordination.

The primary objective of this study is to observe the daily practices and cross-functional team interactions in selected start-ups, aiming to identify effective work patterns that support eco-innovation. The data for this research will be collected through purposive sampling, comprising internal documents, interview narratives, and field notes. This research aims to describe how knowledge management and organizational learning can strengthen the capabilities of eco-innovation in technology start-ups in Indonesia. In contrast to Enaldi's (2025) study entitled "The Influence of Knowledge Management and Learning Organization on Competitive Advantage in Startup Ecosystem," which is quantitative and generalist, this study presents qualitative insights based on real cases in Indonesia to close the gap in understanding the internal processes underlying green innovation. It is based on several theories that support the understanding and analysis of the phenomenon studied. One of the theories that is based on it is the Resource-Based View (RBV), which emphasizes that a company's ability to achieve a competitive advantage depends on the management of unique and valuable internal resources, including knowledge resources. In the context of technology start-ups, RBV explains how knowledge management is a strategic asset that affects innovation capabilities, especially in the development of eco-innovation. This theory helps analyze resource limitations in knowledge management that can hinder sustainable innovation capabilities in a dynamic business environment (Yadav et al., 2022).

Then, the theory of the Knowledge-Based View (KBV) strengthens the RBV perspective by focusing on knowledge as the main resource that empowers organizational learning and innovation. KBV states that organizations that are able to create, integrate, and apply knowledge effectively have greater potential to develop adaptive and durable innovation capabilities. In this study, the KBV theory helps explain the difficulties that arise in building and maintaining an organizational learning culture, which is an important prerequisite for the development of eco-innovation capabilities. Organizational learning is not only about information gathering, but also about the transformation and adaptation of knowledge in daily activities that drive environmentally friendly innovation. And strengthened by organizational communication theory is also an important element in understanding the mechanism of coordination and knowledge exchange between members of the organization (Galachieva et al., 2023). This

theory explains how formal and informal communication structures, as well as information channels, affect the effectiveness of knowledge management and organizational learning processes. In the context of start-ups, fragmented communication and resistance to change can hinder the flow of knowledge necessary for innovation. According to organizational communication theory, the development of communication systems that support openness and collaboration is key to strengthening innovation capabilities, especially in companies that face limited resources and rapidly changing dynamics.

Thus, the concept of dynamic capabilities from Teece (1997) is also a useful theoretical framework in this research. Dynamic capabilities describe an organization's ability to integrate, build, and reconfigure internal and external competencies in the face of rapidly changing environments (Kee et al., 2019). In the context of technology start-ups in Indonesia, dynamic capabilities explain how knowledge management and organizational learning can act as adaptive mechanisms that strengthen eco-innovation capabilities. This theory provides a more dynamic perspective on start-ups' efforts to overcome limited resources, manage learning cultures, and optimize communication and coordination to support sustainable and competitive ecological innovation (Harris & Wonglimpiyarat, 2019).

II. METHODOLOGY

This research uses a qualitative research method with a case study research design that aims to examine the role of knowledge management and organizational learning in improving eco-innovation capabilities in technology start-up companies in Indonesia. The research population comprises all technology start-up companies operating in Indonesia, with a sample of 88 respondents selected purposively based on their direct involvement in the knowledge management process and organizational learning in their respective companies. The research subjects include managers, employees, and start-up owners who play an active role in the management of knowledge and organizational learning culture. The research instruments used include semi-structured interviews, participatory observations, and documentation designed to unearth information about internal processes that occur in the organization. The research instrument involved developing an interview guide based on knowledge management concepts by Fernandez and Sabherwal (2010) and organizational learning theory by Peter Senge (2006), which was piloted to ensure clarity and relevance. The data obtained was analyzed using thematic analysis techniques and data reduction in stages to identify patterns, themes, and relationships between variables that emerged during the research process, so as to be able to contextually describe the knowledge management and learning organization processes in support of eco-innovation. To maintain the validity of the data, different data sources and data collection techniques were triangulated.

The research procedure begins with the preparation stage, namely the identification of the location and research participants, followed by data collection through interviews and direct observation of organizational activities, as well as the collection of supporting documents. Furthermore, the collected data is analyzed simultaneously with the data collection process to find key

themes related to resource limitations, learning culture, and communication in knowledge management and organizational learning. Finally, conclusions were drawn and research reports were prepared that reflected empirical findings as well as provided practical recommendations for the development of eco-innovation in technology start-ups in Indonesia. This case study method allows for a rich and holistic understanding of complex phenomena in the real context of organizations. This study uses a qualitative method with a case study research design to examine the role of knowledge management and organizational learning in improving eco-innovation capabilities in technology start-up companies in Indonesia. The research population was all technology start-up companies in Indonesia, while the sample used was 88 respondents who were taken purposively based on their involvement in the knowledge management process and organizational learning. The research subjects consist of managers, employees, and start-up owners who are active in knowledge management and organizational learning culture. Research instruments include semi-structured interviews, participatory observations, and documentation directed at exploring internal processes within the organization.

III. RESULTS AND DISCUSSION.

Based on the results of a study using a case study design on three technology start-up companies in Indonesia that focus on developing eco-innovation capabilities, important findings were found regarding the role of knowledge management and organizational learning in improving these capabilities. The results show that effective knowledge management, which includes the creation, storage, distribution, and utilization of knowledge, significantly strengthens the capabilities of eco-innovation despite the resource limitations inherent in start-ups. An effective knowledge management process enables each team member to quickly and accurately access relevant information and experiences, thereby fostering sustainable eco-innovation practices that are adaptive to the changing dynamic business environment (Bikse et al., 2018).

In addition, an adaptive organizational learning culture has also proven to be a critical foundation in fostering eco-innovation capabilities. Organizations that successfully internalize the value of continuous learning can create mechanisms for reflection and evaluation of work processes on a regular basis, allowing team members to share experiences, improve processes, and adopt new practices that support green innovation (Wicki & Hansen, 2019). This culture also reduces communication barriers and improves coordination between divisions, which research findings often fragment in many start-ups. It is imperative that organizational learning does not stop at information gathering, but evolves into a knowledge transformation process that encourages environmentally responsible innovation. The research also said that communication and coordination barriers are significant challenges that hinder the strengthening of eco-innovation capabilities. Fragmented communication, both formal and informal, leads to a failure in knowledge transfer and effective collaboration between cross-functional team members. However, these barriers can be reduced by implementing a supportive information system and an active leadership role in encouraging a culture of collaboration and information disclosure (Reitano et

al., 2014). Leaders at successful start-ups demonstrate that they consistently facilitate dialogue between teams and provide a digital platform to ensure knowledge flows smoothly, which then contributes to increased green innovation.

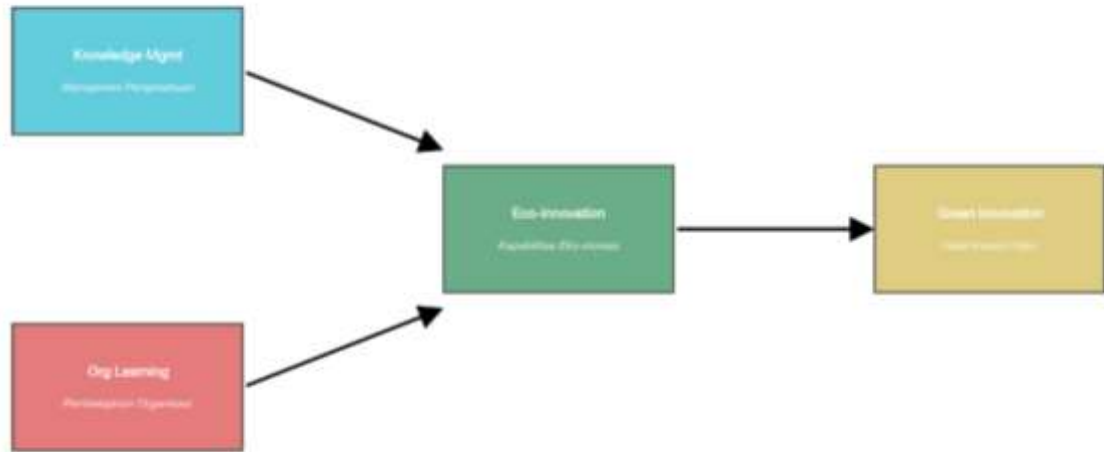


Figure 1. Conceptual Model Innovation Variables

Based on a conceptual model that describes the flow of causal relationships between knowledge management and organizational learning to increase eco-innovation capabilities, which then leads to the achievement of green innovation outcomes. In the early stages, knowledge management provides a framework and mechanism for technology start-up organizations to capture, store, and disseminate relevant knowledge, both technical and related to environmentally friendly practices. This factor is knowledge management and organizational learning that interact and synergistically strengthen the birth of eco-innovation capabilities in the organization. This capability reflects the company's ability to integrate knowledge across fields, adapt internal processes to environmental demands, and collaborate with various stakeholders to adopt or create green innovation solutions (Srisathan et al., 2025). As a result, eco-innovation capabilities become a mediating variable that connects the input of organizational resources to real outputs in the form of green innovation outcomes, for example, in the successful adoption of environmentally friendly technology, the creation of environmentally friendly innovative products, and the implementation of sustainable business models.

Table 1. Knowledge Management and Organizational Learning

Variable	Indicator	Description
Knowledge Management	Knowledge Creation	The process of generating new knowledge internally
Knowledge Management	Knowledge Sharing	Distribution/sharing of knowledge between members of the organization

Knowledge Management	Knowledge Utilization	Leveraging knowledge to support the innovation process
Organizational Learning	Team Learning	Collective learning through teamwork
Organizational Learning	Organizational Reflection	Joint reflection process for evaluation and improvement
Organizational Learning	Continuous Improvement	Culture of continuous improvement based on experience
Eco-Innovation Capability	Integration of Green Knowledge	Integration of environmental knowledge in business/innovation processes
Eco-Innovation Capability	Collaboration for Innovation	Cross-sectoral and external collaboration for green innovation
Eco-Innovation Capability	Adaptation to Change	Ability to adapt processes/businesses to environmental demands
Green Innovation Outcomes	Green Product Development	Eco-friendly product development
Green Innovation Outcomes	Sustainable Process Implementation	Implementation of sustainable business processes
Green Innovation Outcomes	Environmental Performance Improvement	Improving environmental performance through green innovation

In the aspect of knowledge management, the indicators of knowledge creation, knowledge sharing, and knowledge utilization represent the entire process of the knowledge cycle in the organization, starting from the creation of new knowledge, the dissemination of knowledge between team members, to the use of knowledge to support innovation. Then, organizational learning is measured through team learning indicators that emphasize team collaboration, organizational reflection through continuous evaluation, and continuous improvement that encourages a culture of continuous learning. The translation of these two key variables results in eco-innovation capabilities that are identified through the integration of environmental knowledge, cross-sector collaboration for green innovation, and adaptation to changes in the business environment. Thus, the outcome of the entire series of processes is green innovation outcomes that are reflected in the development of environmentally friendly products, the implementation of sustainable business processes, and real improvements in the organization's environmental performance (Kuzmina et al., 2025).

Concrete results from several technology start-ups in Indonesia have initiated a special knowledge management unit supported by cutting-edge information technology to make the knowledge management process effective. However, not many companies can maintain a consistent learning culture, especially in the face of rapid and dynamic changes in business models. Internal training programs have indeed begun to be implemented, but their effectiveness in fostering

continuous learning practices still needs to be evaluated more deeply. Awareness of the importance of organizational learning needs to be continuously improved as part of the science management strategy.

Theoretically, this study shows a strong relevance between the Resource-Based View (RBV) and Knowledge-Based View (KBV) frameworks in the context of eco-innovation development in technology start-ups. RBV emphasizes the management of knowledge resources as a strategic asset that supports sustainable innovation, while KBV reinforces that an organization's ability to create and apply knowledge will trigger more adaptive and long-lasting innovation capabilities. The concept of dynamic capabilities from Teece (1997) is also relevant, describing how start-up companies are able to integrate, build, and reconfigure internal competencies adaptively to rapidly changing business environments. The integration of knowledge management and organizational learning is an important mechanism in building these dynamic capabilities.

Thus, this study provides insight that strengthening knowledge management and organizational learning greatly determines the success of technology start-ups in developing resilient and sustainable eco-innovation capabilities. Best practices found include the use of digital platforms for knowledge dissemination, strengthening the role of leaders in fostering a culture of collaboration, and developing training programs that are relevant to business and environmental needs. Key barriers such as resource constraints and fragmented communication can be overcome with the right managerial strategies, including investments in information technology and efforts to develop an organizational culture that is open to change and innovation. The practical implication of this study is the recommendation that technology start-ups in Indonesia strengthen knowledge management mechanisms and organizational learning as an integral part of the environmentally friendly innovation strategy in order to be able to compete sustainably in the global market (Buttol et al., 2012).

Based on the results of the research that has been presented, several important aspects need to be examined to understand the complexity of the interaction between knowledge management and organizational learning in improving the eco-innovation capabilities of technology start-ups in Indonesia. This analysis will integrate theoretical perspectives with empirical realities found in the context of Indonesia's unique start-up ecosystem.

1. Implementation of Knowledge Management in the Context of Resource Shortage

Findings indicate that technology start-ups in Indonesia face a fundamental challenge in implementing effective knowledge management due to inherent resource limitations. In this context, Nonaka and Takeuchi's SECI (Socialization, Externalization, Combination, Internalization) model becomes particularly relevant to understand how tacit knowledge can be converted into explicit knowledge even with resource constraints. The socialization process in Indonesian technology start-ups shows a different pattern than established companies, where knowledge sharing occurs more informally through daily interactions between relatively small team members.

This is in line with the findings of Guruge and Vilko, who emphasized that digital platforms can facilitate tacit knowledge sharing in innovation networks. Technology start-ups in Indonesia have leveraged various digital tools such as collaboration platforms, knowledge repositories, and real-time communication systems to overcome physical and financial limitations in knowledge management. However, the main challenge lies in the externalization stage, where tacit knowledge needs to be codified into explicit knowledge that can be accessed by the entire organization, which requires an investment of time and resources that is often limited to start-ups.

2. Organizational Learning as a Dynamic Capability

The concept of dynamic capabilities from Teece provides a powerful framework for understanding how organizational learning functions as an adaptive mechanism in technology start-ups. In start-ups, organizational learning extends beyond single-loop learning, which emphasizes efficiency, to double-loop learning that challenges fundamental assumptions and fosters radical innovation. This is especially important considering that technology start-ups in Indonesia operate in a highly dynamic and uncertain environment, where the ability to sense, seize, and reconfigure is critical for survival and growth.

Research shows that the learning culture in Indonesian tech start-ups is often hampered by the pressure to achieve short-term results and limitations in structured learning programs. Unlike large companies that have dedicated training departments, start-ups must rely on learning by doing and peer-to-peer knowledge transfer. Senge's five disciplines - personal mastery, mental models, shared vision, team learning, and systems thinking - need to be adapted according to the context of start-ups that are flatter and agile in their organizational structure.

3. Communication and Coordination Barriers in the Digital Era

Although digital technology is supposed to facilitate better communication, the reality on the ground shows that many Indonesian technology start-ups are experiencing communication fragmentation that can hinder knowledge flow and collaborative innovation (Agyemang et al., 2025). This is contrary to the expectation that digital natives in tech start-ups should be more proficient in digital collaboration. The findings show that communication challenges are not only about technology, but also about establishing communication protocols, managing information overload, and creating psychological safety for knowledge sharing. Abdurrahman's research on barriers in digital transformation in Indonesia reveals that the fragmentation of communication systems and the lack of interoperability between platforms are systemic barriers that affect the effectiveness of knowledge management. In the context of start-ups, this is exacerbated by rapid scaling, which is often not followed by proper communication infrastructure development. As a result, knowledge silos can form even in relatively small organizations, hindering the cross-functional collaboration that is essential for eco-innovation.

4. Eco-Innovation Capability as a Competitive Advantage

Eco-innovation capability in Indonesian technology start-ups shows unique characteristics compared to traditional innovation. Research shows that eco-innovation requires the integration of environmental considerations into the entire innovation process, from ideation to commercialization. This requires more complex knowledge integration, combining technical knowledge, environmental science, regulatory knowledge, and market insights.

The Resource-Based View (RBV) and Knowledge-Based View (KBV) provide complementary perspectives in understanding how knowledge assets can be developed into sustainable competitive advantages in eco-innovation. Indonesian technology start-ups that have successfully developed eco-innovation capabilities have demonstrated the ability to integrate diverse knowledge sources, including collaboration with research institutions, environmental NGOs, and government agencies(Ullah et al., 2025). However, this knowledge integration process requires sophisticated knowledge management systems that can be challenging to implement with resource limitations.

5. The Context of Indonesia's Start-up Ecosystem

The technology start-up ecosystem in Indonesia has special characteristics that affect the implementation of knowledge management and organizational learning. Research shows that Indonesia has more than 2,000 active start-ups with an increasingly mature ecosystem, but still faces challenges in talent development and knowledge ecosystem development.

The Indonesian government's policy in supporting the start-up ecosystem, through various programs such as 1000 Digital Startups and various incubator programs, has created an infrastructure that supports knowledge sharing between start-ups. However, the effectiveness of these programs in fostering organizational learning capabilities still needs to be evaluated more deeply. The findings show that collaboration between start-ups in knowledge sharing is still limited, even though ecosystem-level learning can accelerate the development of eco-innovation capabilities(Vijayakumar & Davidova, 2025).

6. Integration of Theory and Practice

The integration between knowledge management and organizational learning in improving eco-innovation capabilities shows the complexity that requires a holistic approach. Knowledge management functions as an enabler for organizational learning, while organizational learning provides context and culture that support effective knowledge utilization. In the context of eco-innovation, these two components must work synergistically to integrate environmental considerations into innovation processes. The dynamic capabilities framework provides an understanding of how start-ups can develop meta-capabilities to continuously adapt and evolve their knowledge management and organizational learning practices, in accordance with changing environmental demands and business contexts(Fathoni et al., 2025). This is particularly relevant for eco-innovation that requires continuous learning about

evolving environmental standards, emerging technologies, and changing market preferences.

IV. CONCLUSION AND RECOMMENDATIONS

This study concludes that knowledge management and organizational learning play complementary roles in enhancing eco-innovation capabilities among technology start-up companies in Indonesia. Effective knowledge management helps organizations create, disseminate, and utilize knowledge in a structured way that supports environmentally friendly innovation. On the other hand, continuous organizational learning builds a culture of collaboration and evaluation that allows for continuous renewal of innovation processes and outcomes. The eco-innovation capabilities developed through these processes are crucial for producing green innovation outcomes that enhance organizational performance and contribute positively to environmental sustainability.

Implicitly, this study encourages technology start-up companies to optimize knowledge management mechanisms and strengthen organizational learning culture as the main strategy in developing green innovation. Investment in digital-based knowledge management systems and training focused on developing environmental innovation competencies is one of the recommended practical ways. In addition, organizational leaders need to take an active role in shaping a work environment that supports information disclosure and collaboration between functions to overcome communication barriers that often occur in start-ups. Further implications emphasize the necessity of collaboration with various external stakeholders, including research institutions, regulators, and environmental organizations, to accelerate the development of eco-innovation capabilities and ensure the widespread success of green innovation across the board.

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