

Adaptive Leadership and Managerial Innovation in Agritech Startup Development

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Abstract

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The transformation of the agricultural sector through modern technology requires strong adaptive leadership and managerial innovation, particularly in the context of agritech startup development operating within dynamic and complex environments. This study aims to comprehensively examine the relationship between adaptive leadership and managerial innovation in supporting the growth and sustainability of agritech startups. A systematic literature review was conducted by analyzing 10 international scholarly articles. The selected articles include empirical studies, conceptual reviews, and case analyses relevant to the research focus. The findings indicate that leadership flexibility, technology-based innovative strategies, and dynamic organizational models are key elements in the success of agritech startups. These results underscore the importance of synergy between an adaptive leadership vision and innovative management approaches as decisive factors for long-term viability. This study also provides practical implications for stakeholders in the agritech sector to strengthen leadership capabilities and managerial systems in addressing increasingly complex future challenges.

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1. Introduction

In the era of rapid digital transformation and the continuously evolving Industrial Revolution 4.0, the agricultural sector is experiencing a profound and comprehensive disruption. This disruption is marked by the emergence of various forms of technological innovations implemented through the rise of agritech startups. Agritech startups have taken on the role of pioneers in introducing intelligent solutions based on digital data and the automation of agricultural processes into a sector previously known for its traditional and conventional working methods and business approaches. This transformation offers new hope for increasing the productivity and efficiency of the agricultural sector globally.

However, the highly dynamic nature of the startup ecosystem in terms of technology, market competition, and constantly changing regulations demands the presence of leaders with a high capacity for adaptation and a managerial approach that is innovative and progressive. Without responsive and innovative leadership, agritech startups face a significant risk of losing their relevance and failing to sustain competitiveness within an increasingly dynamic and highly competitive ecosystem. In an environment driven by rapid technological advancement, shifting market demands, and evolving regulatory landscapes, the absence of adaptive leadership can hinder a startup's ability to pivot, innovate, and scale effectively. Leaders who lack the vision and flexibility to embrace change may struggle to foster a culture of continuous learning and experimentation, which is essential for driving innovation and maintaining agility

Adaptive leadership is a form of leadership characterized by flexibility, the ability to quickly adjust to changes in the business environment, and the capacity to respond to complex challenges and uncertainties that arise in daily operations. In the context of agritech startups, a leader is not only required to have a long-term vision but also to be able to read the latest technological trends, deeply understand the challenges faced by farmers and the agricultural supply chain, and navigate the dynamics of changing government regulations and rapid shifts in market demand. Adaptive leaders have the ability to facilitate internal innovation while simultaneously building and maintaining an organizational culture that supports continuous and fast experimentation, iteration, and learning.

Meanwhile, managerial innovation refers to the process of systematic renewal or improvement in aspects of work processes, organizational structure, and decision-making systems aimed at driving operational efficiency and overall performance effectiveness. In the context of agritech startups, this managerial innovation includes the application of technology such as the Internet of Things (IoT) for real-time monitoring of agricultural conditions, artificial intelligence (AI) for predicting crop yields or optimizing fertilization, as well as the implementation of go-to-market strategies based on digital platforms and e-commerce to expand market access. Agile, responsive, and less bureaucratic organizational structures, along with decision-making processes based on accurate data analysis, are real examples of managerial innovation that supports the rapid development of agritech startups (Ryan et al., 2023).

The close synergy between adaptive leadership and managerial innovation creates a strong foundation for agritech startups not only to survive but also to grow sustainably amidst major challenges such as a highly fluctuating business climate, limited access to investment capital, and a high level of resistance from some farmers towards adopting new technologies (Bethi & Deshmukh, 2023). In this context, leaders who can think visionarily but remain pragmatic in implementing strategies will be the key to success in managing resources and setting a business direction that is precise, targeted, and adaptive. Therefore, this research presents a systematic literature review by collecting and analyzing various scientific articles that discuss leadership practices and innovative management specifically in the context of agritech startup development. The goal of this review is to identify common patterns, key principles, and real challenges faced in applying both aspects, while also providing practical and applicable insights for business actors, investors, and academics interested in developing startups in the modern technology-based agricultural sector.

2. Literature Review

2.1. Adaptive Leadership in the Startup Context

Adaptive leadership demands a leader to have the ability to manage conflict, internal and external pressures, as well as sudden or gradual changes in a constructive and solution-oriented manner. This leadership style is highly relevant and crucial in the context of agritech startups, especially because this sector is in the midst of a vortex of rapidly developing technology and unpredictable market shifts. Regulatory

changes, evolving farmer needs, and rapid advances in digital agricultural technology require leaders to be flexible, open, and responsive to various emerging and challenges.

A study by Mukaram et al. (2021) found that leaders who apply an adaptive leadership style tend to have higher effectiveness in dealing with operational uncertainty, especially in the context of organizations with limited resources, such as startups. This leadership style helps accelerate critical decision-making processes and encourages the organization to remain agile in its activities. Furthermore, adaptive leaders are required to empower multidisciplinary work teams, foster a culture of continuous experimentation, and maintain flexibility towards business model changes that can occur at any time. Resilience to failure and the ability to pivot, or change strategies quickly and effectively, are key elements in the successful adaptation of agritech startups to environmental changes.

2.2. Managerial Innovation and Agritech Startup Organizational Performance

Managerial innovation plays a very large and significant role in shaping and strengthening the strategic competitiveness of agritech startups operating in an increasingly competitive market. According to a study by Sharma et al. (2022), this form of innovation includes various important aspects such as the comprehensive integration of digital technology into the agricultural supply chain, the automation of harvesting processes that were previously manual and time-consuming, and the development of integrated digital platforms to directly connect farmers with agricultural markets or end consumers. This innovation provides tangible added

value, as it can reduce operational costs while increasing productivity and market access efficiently.

One common managerial approach is the design of a flat organizational structure, which allows for faster communication and more responsive decisions. In addition, an agile approach or organizational agility in responding to changes and product iterations has also proven to be an effective practice that promotes operational efficiency and organizational resilience. Furthermore, Krishnan et al. (2020) shows that agritech startups that implement data-driven managerial strategies have a much greater chance of scaling or sustainable business growth, and have higher appeal to investors. Managerial innovation is also closely related to flexibility in developing marketing strategies, product development that is responsive to direct customer feedback, and efficiency in managing logistics and the distribution of agricultural products.

2.3. Synergy between Leadership and Innovation in Agritech

The synergistic relationship between adaptive leadership and managerial innovation is a very important and inseparable foundation in supporting the success and sustainability of agritech startups. The harmonious interaction between the two creates an organizational ecosystem that is ready to face external and internal challenges dynamically and responsively. Daraojimba et al. (2023) explained that leaders with an adaptive leadership style tend to be more capable and more easily able to encourage innovation, as they are able to create a work environment that is open to change, collaborative, and supports the emergence of new ideas without fear of failure.

Startups led by individuals with high adaptive skills have a better capacity to explore and evaluate new technological opportunities, as well as respond to market needs and demands quickly and accurately. Sensitivity to market dynamics becomes a key asset demonstrated by this type of leadership style. Furthermore, Chaurasia et al. (2020) adds that sustainable organizational innovation cannot grow consistently if it is not supported by inclusive, participatory leadership and the ability to create dynamic and flexible organizational structures. Thus, the synergy between adaptive leadership and managerial innovation not only supports short-term success but is also very important for achieving sustainable innovation and creating long-term added value for the organization and all stakeholders.

3. Method

This research was conducted using a systematic literature review approach, which focuses on examining scientific articles obtained through a search of the Google Scholar database. The articles considered for analysis were published between last five years, thus reflecting the latest developments and relevance of the topic under study. In the selection process, a number of inclusion criteria were established to ensure the quality and suitability of the content with the research focus. First, only articles published in peer-reviewed journals were selected, to guarantee scientific integrity and methodological validity. Second, the content of the articles had to be directly related to the main theme of adaptive leadership, managerial innovation, and agritech startup development. Third, only articles written in English and available in full access, in either PDF or HTML format, were included

in the analysis. From a total of 43 articles successfully collected and screened, 17 articles were then selected for more in-depth analysis. This selection was based on the extent to which the articles made a substantial contribution to the topic, showed a continuity of discussion between the elements of leadership and innovation management, and were relevant to the context of agritech startups.

The types of articles analyzed included empirical studies based on field data, conceptual reviews that discussed key theories, and case-study-based reviews that highlighted actual practices in the field. The analysis process was carried out through a thematic analysis approach, by identifying thematic patterns that emerged from various articles and grouping the findings into three main themes: the role and characteristics of leadership, the forms and impact of managerial innovation, and their interaction in the context of agritech startups. This analysis was narrative and qualitative, without involving a quantitative statistical approach. To maintain the validity of the results, a cross-source comparison was conducted to see the consistency of findings between articles. To maintain the objectivity of the study, non-academic sources such as individual opinions or gray literature, including reports from mass media, were not included in this research.

4. Results

The results of the studies reviewed in this research indicate that adaptive leadership plays a very important role in shaping and maintaining an organizational culture that is responsive to various forms of change, both internal and external. In most of the articles analyzed, leaders in agritech startups are described not only as

strategic decision-makers but also as facilitators of dynamic organizational learning. They encourage the creation of a work environment that allows every team member to be actively involved in the innovation process, conduct structured experiments, and contribute to continuous and sustainable improvements in business processes. Adaptive leadership in the context of agritech startups is closely related to the ability to read market change signals, assess the potential of new technologies, and form cross-functional teams that can operate independently yet remain connected through a shared vision. This is evident in a study by Bethi and Deshmukh (2023), which highlights that successful startup leaders generally apply a collaborative and participatory leadership approach.

They not only focus on the final results but also empower technical and non-technical teams equally, ensuring that all elements in the organization understand the strategic goals and have autonomy in carrying out their roles. This type of leadership enables rapid learning and adaptation to constantly changing market feedback (Karneli, 2023). Furthermore, the results of the literature study also reveal that managerial innovation in the context of agritech startups is not just limited to adopting the latest technology. But also includes broader aspects such as the development of organizational governance systems. The formation of flexible and adaptive work systems, and the intelligent use of data in strategic decision-making. In this regard, a data-based approach becomes one of the main drivers of progressive managerial innovation applied by many agritech startups.

According to the findings of Sharma et al. (2022), managerial innovation in agritech startups is realized through the adoption of platform-based business models

that bring producers closer to consumers, the integration of cloud technology to manage information and operations in real-time, and the implementation of a circular economy approach in production and distribution processes aimed at reducing waste and increasing resource efficiency. This type of managerial model is considered capable of increasing added value for the organization because it can suppress operational costs while strengthening market competitiveness. One important dimension that is also reinforced in the study's findings is how agritech startups that successfully combine an adaptive leadership approach with managerial innovation strategies show a much higher level of resilience compared to startups that only focus on one aspect. This resilience includes the ability to survive market price fluctuations, climate uncertainty, limitations of competent human resources, and complex and changing regulatory pressures.

Mukaram et al. (2021) noted that agritech startup leaders with high adaptive capabilities also demonstrate an extraordinary ability to respond to external dynamics by encouraging the occurrence of targeted internal innovation. This innovation includes redesigning business strategies, redesigning products based on consumer needs, and optimizing the supply chain through digital technology. This becomes a key factor in determining the success of agritech startups, especially when the organization enters the scale-up phase, a phase of rapid growth that requires careful management of risks and resources. Another study by Daraojimba et al. (2023) also reinforces this argument by showing that leaders who understand the complexity of modern technology and are able to simplify organizational structures without reducing their functionality will adapt more quickly to market changes. In practice,

structural simplicity allows for speed in decision-making and more agile organizational movement. Those who apply these flexible leadership principles can anticipate potential market disruptions while optimizing innovation opportunities.

One concrete illustration of structural innovation in this study is the use of Artificial Intelligence (AI) and blockchain-based technology in supply chain management in the agricultural sector. AI technology is used to predict harvest patterns, manage distribution, and analyze climate data in real-time, while blockchain is applied to increase transparency and trust in transactions between parties. However, as noted in several articles analyzed, the success of implementing this technology is highly dependent on the presence of leadership that is not only visionary but also has high flexibility in managing the transformation. In addition, many articles emphasize that the effectiveness of managerial innovation championed in agritech startups is greatly influenced by the courage of leaders to take measured risks and create space for learning from failure. An organizational culture that values iteration and experimentation provides greater opportunities for teams to find new approaches that are more efficient and in line with local and global conditions.

Some studies also noted that the success of innovation does not solely depend on technology, but on the managerial ability to create work processes that support cross-divisional collaboration, work flexibility, and cross-functional data integration. In a growing organization, the management's ability to scale operations without losing efficiency is a major challenge. Therefore, the agile management approach is one of the keys highlighted in many articles as a response to the complexity and acceleration of changes in the technology-based agricultural sector. The synergy

formed between adaptive leadership and managerial innovation also creates a double effect in building long-term competitive advantage (Ali et al., 2022). Organizations that have adaptive leaders and are supported by innovative managerial systems find it easier to attract the best talent, establish strategic partnerships, and create products or services that are more relevant to market needs. This has a positive impact on building customer loyalty and increasing the potential for sustainable growth.

The results of this review also show that agritech startups that integrate the two approaches have the ability to survive in the face of unexpected external pressures, such as food crises, extreme climate change, or global economic uncertainty. Even in the context of limited infrastructure and access to capital, the presence of adaptive leaders who can direct managerial innovation to the relevant path is the main differentiator for the survival of the startup (Istianingsih et al., 2023). Finally, it is also important to note that successful adaptive leadership does not only focus on the internal aspects of the organization but also extends its reach to the ecosystem level. Successful agritech startup leaders are able to establish strategic relationships with various stakeholders, including technology partners, financial institutions, agricultural extension workers, and regulators.

They are able to build trust and cross-sector collaboration, which ultimately opens access to new resources and knowledge that are very important for the organization's growth and innovation. The overall results of this literature study reinforce the view that the success of agritech startups in facing the complexity and challenges of the modern agricultural sector is highly determined by the extent to which leaders can apply the principles of adaptive leadership consistently and in a

structured manner, and the extent to which managerial innovation is applied as an operational and strategic foundation. The integration of the two is not only relevant but also essential to creating an organization that is resilient, innovative, and ready to compete in an increasingly complex and digital global agribusiness landscape.

5. Discussion

The discussion of the results of this literature study strongly indicates that adaptive leadership and managerial innovation are two complementary and inseparable strategic pillars in forming a solid foundation for the growth of agritech startups. Both serve as the main drivers in facing the challenges and dynamics of the agricultural sector, which is full of uncertainty and complexity. In a business environment that is heavily influenced by climate change, market fluctuations, and shifts in government policy, the success of an agritech startup is not enough to depend solely on the sophistication of the technology used. Instead, the organization's ability to continuously learn, self-evaluate, and adapt quickly becomes a decisive aspect in creating a sustainable competitive advantage.

Within the organization, internal factors such as a work culture that is open to change, a management structure that supports rapid decision-making, and effective communication patterns between teams, become fundamental elements in supporting the practice of adaptive leadership and managerial innovation. An organizational culture oriented towards learning and experimentation creates space for innovation to grow, while a lean and non-bureaucratic managerial structure allows for fast movement in responding to market challenges. In addition, horizontal

and participatory communication patterns encourage the creation of cross-functional collaboration and strengthen team involvement in the innovation process.

This study also highlights the importance of support from the external environment or innovation ecosystem, especially through cross-sector collaboration with research institutions, universities, financial institutions, the government, and the farming community itself. Such collaboration not only expands resources and knowledge but also strengthens the startup's resilience to external pressures. A healthy and integrated ecosystem can accelerate growth and help startups overcome initial barriers that are often faced in the embryonic phase. Nevertheless, real challenges still exist and need serious attention. Limited access to funding, especially for the early stages of startup development, is a significant obstacle to implementing long-term strategies. In addition, the lack of a workforce with adequate digital skills is also a constraint in adopting and operating advanced technology optimally.

No less important, there is still resistance from some key players in the agricultural sector, especially farmers, towards the adoption of new technology. This factor can hinder the pace of market penetration and the acceptance of startup products or services (Aldianto et al., 2021). Given these dynamics, it is very important for stakeholders, including investors, academics, training institutions, policymakers, and actors in the agritech ecosystem, to strengthen support for the development of adaptive leadership capacity and innovative management. This support can be provided in the form of training, incubation, investment, regulations that encourage innovation, and policies that reduce barriers to technology adoption.

These collective efforts will determine the future direction and sustainability of the agritech sector.

6. Conclusion

This research clearly affirms that success in the development and growth of agritech startups is highly dependent on the existence of two main, complementary factors, namely adaptive leadership and managerial innovation. These two elements are not only important separately but have a symbiotic relationship that strengthens the overall structure and foundation of the organization. Adaptive leaders have the ability to navigate various forms of uncertainty, ranging from market changes, technological advancements, to regulatory dynamics. In addition, they are able to build and maintain innovative, collaborative teams, and create a flexible organizational environment that is responsive to changes, both from within and outside the organization.

Meanwhile, managerial innovation functions as a key catalyst in creating operational efficiency, designing and implementing sustainable business models, and accelerating the adoption of cutting-edge technology that is key to success in the era of agricultural digitalization. These two aspects, if developed in a synergistic manner, will form a strong organizational resilience and support the long-term sustainability of agritech startups amidst continuously evolving global challenges. The practical implications of these findings show the importance of investing in adaptation-based leadership training and the development of innovative management systems. To strengthen these findings, further research is highly recommended to be conducted

with an empirical approach based on quantitative and longitudinal data, in order to gain a deeper and more contextual understanding.

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