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Agricultural Technology Adoption as a Journey: Proposing the Technology Adoption Journey Map

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Abstract. Agricultural technology plays a critical role in increasing productivity and modernizing the industry. Recognizing the importance of agriculture, governments devote significant public funds to research and development and creating an ecosystem for developing agricultural technology. While investing in new agricultural technology is important, it is also necessary to pay attention to technology adoption. For the technology to be sustainable, mass adoption is needed. This study proposes the technology adoption journey map (TAJM) to plan and study the farmers' technology adoption based on the Diffusion of Innovation (DOI) theory and the Customer Journey Map (CJM). The TAJM should reflect the five stages of the technology process, with further elaboration on the key touchpoints of the CJM adoption experience. The adopter's expectations and actions, as well as the actions of key stakeholders, are documented at each touchpoint. Because each adoption journey is different, the expected failures and recovery actions are recorded for each touchpoint. To facilitate the mass adoption of technology, this study suggests documenting the experiences of innovators and early adopters of the technology as a guide in building the technology adoption journey map of the early majority.

Keywords: Agricultural technology; Customer journey map; Diffusion of innovation, Mass adoption; Technology adoption journey map

1. Introduction

Agriculture is a vital economic, health, and social well-being driver. According to Fuglie et al. (2020), the agriculture sector could contribute to more than 25 % of a country's gross domestic product (GDP) in a developing country and support the livelihood of 65 percent of low-income working adults. Nevertheless, agriculture contributes significantly to the pollution problem and faces the challenges of food wastage or loss. In addition, agriculture must compete for land usage (Abella et al., 2021). Realizing the importance of the agriculture sector and agricultural innovation, governments are willing to commit substantial public funds to support Research and Development (R&D) and the agricultural ecosystem. The funding also

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increases over time, especially in developing countries (Fuglie et al., 2020). As a result of R&D, productivity in the agriculture sector benefits the economy at the macro-level (Fuglie et al., 2020) and micro-level (Mendola, 2007; Nordin et al., 2014; Nor et al., 2018; Munarso et al., 2020; Heryani et al., 2022). From the micro-level of individual business perspective, technology adoption helps grow agriculture business profits, which is the key to the modernization of agriculture businesses (Mannan et al., 2017; Munarso et al., 2020).

It is critical to conduct research and development on new agricultural technology. The impact of technology, however, can only be discovered when it is adopted and used, which would lower the cost of the technology and generate funds for reinvestment in its advancement. Thus, this article focuses on facilitating mass technology adoption among agricultural businesses. The study aims to propose the Technology Adoption Journey Map (TAJM) to facilitate agricultural technology adoption among agriculture businesses by reviewing the Diffusion of Innovation (DOI) theory and the Customer Journey Map (CJM). A similar approach is used in the study of Moretti et al. (2021). However, their focus was not to develop a template to document the journey of technology adoption. Therefore, the contribution of this study is to address the problem by developing a workable template of TAJM that can be widely used across diverse agriculture technology adoption. The practical implications of TAJM are to equip government agencies and agriculture technology producers with a better understanding of the customer experience. The DOI Theory and the CJM will be discussed next.

2. Problem Description

This section reviews the Diffusion of Innovation (DOI) theory and the Customer Journey Map (CJM) that form the backbone of the Technology Adoption Journey Map (TAJM).

2.1. Diffusion of Innovation (DOI) Theory

The DOI Theory by Rogers (1995) lays the fundamentals for technology diffusion regarding the mass adoption of technology or innovation. The two primary points from the DOI theory are the uneven rate of adoption and the stages in the innovation-decision. According to Rogers (2003), there are five types of technology adopters based on their stage of adoption: innovators, early adopters, early majority, late majority, and laggards. The first two categories of adopters in the adoption process are innovators and early adopters (Rogers, 2003). They tend to take more risks and have a higher tolerance for technology's limitations. Besides that, they function as opinion leaders in influencing late adopters in the technology adoption process. Despite their importance, innovators and early adopters may not be available in sufficient numbers to reach the critical mass. Mahler and Rogers (1999) define critical mass as "the minimal number of adopters of an interactive innovation for the further rate of adoption to be self-sustaining". Therefore, the third group of adopters, the early majority, plays a crucial role in getting the technology to the point of critical mass. Nonetheless, unlike innovators and early adopters, the early majority may require additional motivation in the adoption process. Hence, other interventions are needed to facilitate and smooth their technology adoption process.

It is critical to understand the stages of the technology adoption process before designing the intervention process to facilitate technology adoption among the early majority. According to the DOI theory, the innovation diffusion process consists of five main stages: knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1995). These five stages represent the progression of the adopters from gaining information about the new technology to forming an attitude toward it, deciding to adopt, determining the

degree of usage, and continuing to use it. Although the previous empirical research has concentrated on the persuasion and adoption stages (Tung & Chang, 2008; Völlink et al., 2002; Jahanmir & Cavadas, 2018; Min et al., 2019; Kapoor & Dwivedi, 2020), the importance of other stages in the technology adoption process cannot be undermined. Instead of focusing on specific stages, technology adoption should be viewed as a process, as a failure at any stage will affect the technology's adoption or usage.

2.2. The Customer Journey Map (CJM)

While the technology adoption process suggested in DOI theory is useful for providing a broad concept, a more detailed analysis of the adoption process is required. In the context of marketing, the CJM is used to understand customers' total experience in the service delivery process. The CJM is increasingly gaining popularity as a strategic tool for understanding the customer's experience with an organization (Rosenbaum et al., 2017). CJM maps the sequence of experiences of customers' encounters with service consumption from the first point of contact to the full description of the service based on service design principles (Micheaux & Bosio, 2019). A customer journey is a series of customers' direct and indirect contact or interaction with a product or service (Meyer & Schwager, 2007), which may be positive, negative, or neutral experiences (Berry et al., 2002). The customer experience at each touch point affects the perceived quality of the relationship and, as a result, customer commitment. (Palmatier et al., 2006).

Similar to the process of technology adoption in the DOI Theory, the CJM records the customers' experiences from the pre-service, service, and after-service period, with one or more touch points within each phase (Micheaux & Bosio, 2019). The pre-service phase is the customer experience before the actual service begins, such as seeing the product advertised. The second phase (service period) consists of touchpoints that customers experience during the actual service, such as interaction with the product. Post-service or after-service is the final phase of the customer experience, which happens after the actual service. Touchpoints in this phase may include posting pictures of the product on social media or returning the product to the seller (Rosenbaum et al., 2017).

3. The Development of the Technology Adoption Journey Map (TAJM)

This study aims to develop a tool to document and map the agricultural technology adoption among the technology adopters. The DOI theory is analyzed to provide the fundamentals of technology adoption processes from knowledge, persuasion, decision, implementation, and the final stage of confirmation. The following step will identify and document the best practices in the adoption process. Based on the DOI, this documentation process is critical to ensuring that the innovators' and early adopters' technology adoption experiences can be used as a reference for the early and late majority.

Following that, this study examines and adapts the CJM from the marketing field. The context of CJM is changed from studying the customer purchasing journey experience to the farmers' agricultural technology adoption experience. Although the processes are not identical, similarities can be observed regarding the existence of key touch points where the technology adopters and technology providers interact directly or indirectly. These interactions are crucial for the success of the technology adoption, particularly in the agricultural industry, where the early and late majority of technology adopters are primarily small farmers. Their tendency to base decisions on personal experience is high.

Once the template of TAJM is developed, the "journey" of the farmers in adopting the technology will be recorded following the concepts from the service design. Broad-based data is generally collected and refined to distill into key points. The process includes

interviews, thematic analysis and identifying emerging patterns from the data, refining themes, and finally, identifying the key touch points. Interviews with agricultural technology innovators and early adopters will be accomplished in this process. Based on the DOI theory and CJM, the TAJM is proposed and discussed next.

4. The Technology Adoption Journey Map (TAJM)

The uneven rate of technology adoption is pivotal to learning the adoption experience of the innovators and early adopters, which serves as a guide to smoothen the adoption process of the early and late majority. Thus, this study suggests that the TAJM be used to document the adoption experience of the innovators and earlier adopters, which will be the basis for developing the adoption journey map for the early majority. Moreover, the CJM is fundamental for the development of the TAJM.

Based on the CJM, the TAJM is developed as illustrated in Figure 1. The top row of the TAJM indicates the touchpoints in the journey of technology adoption. The TAJM touchpoint definition should be slightly broader than the CJM touchpoint definition. The touchpoint should include all the important interaction or communication points in the technology adoption process. The touchpoint could be the agriculture business learning about new technology at a seminar, a personal consultation session with the technology owner, a field visit by the technology owner, a discussion with fund providers, installation of the technology system, knowledge transfer on technology usage, fine-tuning the approach to optimize the efficiency and effectiveness of the operation, and so on. According to Rogers (1995), the technology diffusion process stages are an excellent guide for designing the touchpoint before any adoption process, namely, knowledge, persuasion, decision, implementation, and confirmation. However, it is important to note that the TAJM will differ depending on the adopters and agricultural technologies used.

Table 1 The Proposed Technology Adoption Journey Map

DOI processes	Knowledge	Persuasion	Decision	Implementation	Confirmation
Key touchpoints					
Adopter's expectations					
Adopter's actions					
Stakeholder's actions					
Expected failure					
Recovery actions					

The adopter's expectations and actions, stakeholder activities, expected failure, and recovery actions must be pre-planned in the TAJM for each touchpoint. Unlike the CJM, the TAJM does not include emotion because business-to-business interaction is expected to result in more rational decision-making. The experience desired by the adopter must be included in the adopter's expectations. For example, at the stage of knowledge transfer on system usage after the system installation, the adopter would expect the technology owner to be on-site to demonstrate the use of the system, ensure the system works smoothly, and have reference documents available to guide them. Based on the adopter's expectation, the stakeholders involved (technology owner), must ensure that a competent team is sent to the technology adopter's site for knowledge transfer and that an operating manual is prepared for the adopter's need. On the other hand, the technology adopter must take appropriate actions at the touchpoints. In this case, the technology adopter must ensure that they have a competent and well-prepared team on site to receive the knowledge and that the site is properly set up for knowledge transfer.

In addition, expected failure and recovery actions are added to the TAJM to manage risk at each touchpoint in the technology adoption process. Looking back on the knowledge transfer process, the potential failure could be a lack of technical knowledge on the part of the adopter team. If this was an expected failure point, the technology owner could have intervened before, during, or even after the knowledge transfer touchpoint. Training the adopter's technical team is one example of early intervention. During the knowledge transfer touchpoint, the intervention is for technology owners to continue providing technical support to the adopters. The possible recovery action after the knowledge transfer touchpoint could include a change of business model to make the technology more front-end usage or the technology more user-friendly to the technology adopter. In contrast, the technology owner maintains the back-end operation of the technology. On the other hand, expected failure and recovery actions are important elements because each TAJM of different agriculture-based businesses is unique. It is necessary to prepare for failure to account for other businesses' uniqueness. The anticipated loss should not be restricted to the most likely failure scenario.

5. Discussion

The TAJM is developed to comprehensively document the technology adoption journey experience. In this context, the TAJM aims to document the agricultural technology adoption experience of the farmers. The TAJM can complement the study of Moretti et al. (2021) by suggesting a template for documenting the farmers' technology adoption journey. This template guides users to the important touchpoints and information needed to capture the technology adoption journey of the farmers. Rather than being overly restricted by the template, users can adapt it to meet their needs.

Moving forward, the study will use the template developed in this article to validate the template through use cases. The use cases can be presented to technology owners, adapters, and key stakeholders. According to these use cases, the template of TAJM will be used to document the adoption journey map of innovators and early adopters to learn the best practices and their pain points in the technology adoption journey. Based on these findings, the research team will incorporate the pain points from the different contexts of early majority agricultural technology adopters to co-develop the ideal TAJM for the early majority.

6. Conclusions

The TAJM serves as a generic and robust tool for documenting the experience of the technology adopter and the key stakeholders in the technology adoption process. The underlying premise is that the experiences of innovators and early adopters should be documented to smooth the journey of the early majority. The early majority plays a key role in achieving the critical mass in technology adoption. After documenting the innovator's and early adopter's adoption journeys, the pain points of their adoption experience must be eliminated or minimized in the planning for the early majority's adoption experience. However, the highlighted gain points must be maintained or improved. Furthermore, the specific circumstances of the various adopters must be considered when translating the journey map of innovators and early adopters to the early majority. In addition, TAJM users must be adaptable and ready to the journey map to different adopters. This is because the situations of every individual adopter and business tend to be different. Certain degrees of customization is expected. The TAJM can be applied to any agricultural technology to improve the adoption process and to facilitate the experiences of adopters and key

stakeholders. The technology with a more complex adoption process and knowledge transfer would require more touchpoints in the journey map than simpler technology. TAJM's key strength is its ability to break down complex technology adoption journeys into different touchpoints to simplify the management of technology adoption. In terms of implication, a well-developed TAJM can be translated into an effective agriculture technology adoption process. By understanding and eliminating pain points from early adopters, the government can better develop procedures and regulations, and technology providers can better establish policies and regulations to encourage the mass adoption of technology in agriculture. The current version of the TAJM is developed mainly based on the customer journey map widely used in the marketing field. The DOI theory is used to guide the technology adoption journey or processes broadly. This enables the template of the TAJM to be created. Following that, the template must be validated by consulting with subject matter experts in technology adoption and tabulating the agriculture business's actual adoption experience. A longitudinal study can only be conducted once the template has been validated.

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