Strategies for Successful Technology Adoption

Insights from Real-World Implementation Projects

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Abstract—This paper investigates strategies for promoting successful user adoption of new technologies by combining theoretical insights with practical experiences from European research projects. It emphasizes three key enablers: co-creation, content marketing, and trust. Co-creation is highlighted to ensure that systems are aligned with user needs and to foster psychological ownership through early and continuous involvement. Marketing is presented as essential for raising awareness, communicating value, and supporting adoption across different user segments. The paper also examines trust as a prerequisite for adoption, particularly in contexts involving the sharing of data or relinquishing control. A range of established models and theories, including the Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT2), Theory of Planned Behavior (TPB), and Diffusion Of Innovations (DOI), are reviewed to provide a foundation for understanding adoption dynamics. The findings suggest that combining theoretical frameworks with user-centered design and effective communication strategies can significantly enhance the adoption of emerging technologies. These insights provide a practical foundation for designing more user-centered, trustworthy, and widely adopted technologies.

Keywords-technology adoption; co-creation; marketing; trust.

I. INTRODUCTION

Technology adoption refers to the process through which individuals, organizations, or entire societies begin to use and integrate new technologies into their daily lives, work, or operations. It is not just about acquiring new technology but about incorporating it into everyday practice in a meaningful way.

Technology adoption is a multifaceted process influenced by psychological, contextual, social, and communicative factors. This paper presents a theoretical and practical exploration of technology adoption mechanisms, drawing on insights from three diverse projects: Smart-MLA, PVADIP-C, and OptFor-EU.

Smart-MLA [1] was a European project that focused on aggregating and trading energy flexibility in the electricity market. The authors were responsible for identifying potential obstacles to users adopting the Smart-MLA solution and found a lack of trust to be a significant obstacle [2]. The Marius Rohde Johannessen School of Business University of South-Eastern Norway Horten, Norway e-mail: marius.johannessen@usn.no

project had partners from Denmark, Norway, Romania, Sweden, and Turkey.

PVADIP-C [3], another European project involving partners from Norway, Romania, and Turkey, has developed a data collection unit and a cloud-based platform that analyzes and diagnoses data from residential or small commercial PhotoVoltaic (PV) installations. The goal was to help prosumers optimize their energy production, improve system efficiency, and maximize financial returns. Here, the focus was on the product itself. What is needed for users to adopt the unit and the platform? In this project, our task was to provide input to the development team on traditional adoption and innovation theories.

The final, and still ongoing, project, OptFor-EU [4], is developing a Decision Support System (DSS) for sustainable forest management. The project involves sixteen partners and eight case studies from different countries. This system is cocreated with forest managers and stakeholders to provide tailored, science-based options for climate adaptation and mitigation, focusing on improving Forest Ecosystem Services (FES), including decarbonization and resilience. In this project, we draw on experiences from former co-creation initiatives, complemented by insights into traditional adoption and innovation theories.

In all three projects, a fundamental prerequisite for adoption is user awareness, enabled through effective marketing. Before considering adoption, the user needs to be informed about the product or service.

By synthesizing findings and theoretical frameworks, the paper aims to guide the increase in user adoption of emerging systems.

The rest of this paper is organized as follows. Section II emphasizes co-creation. Section III describes models and theories addressing technology adoption. Section IV addresses marketing and technology adoption. Section V discusses trust and its impact on adoption. Finally, Section VI concludes the paper and provides ideas for future work.

II. CO-CREATION

A key insight from these projects is the value of involving users throughout the design and implementation process. Cocreation [5][6], where users collaborate with developers and designers to define, shape, and test technology, ensures that solutions align with actual user needs and expectations. It also helps identify usability issues and barriers to adoption early on. Through co-creation, users will not only support development but will also have more substantial ownership of the product.

Tudose et al. [7] have developed a co-creation framework consisting of three iterative stages: co-design, co-production, and co-dissemination, thereby engaging users throughout the lifecycle of the service or product. This framework is embedded in all project activities in OptFor-EU.

Heidenreich, Jordanow, Kraemer, and Obschonka [8] provide theoretical and empirical evidence that:

- User co-creation increases initial adoption: The willingness to co-create significantly shapes usage intention during the pre-adoption stage.
- User co-creation drives continuous engagement: The level of co-creation becomes a significant factor in sustaining long-term usage after the adoption stage.
- Matching user needs is essential: The paper highlights the importance of a "co-creation sweet spot"—the balance between what users are willing to contribute and the degree of co-creation expected. Too high expectations about user involvement may have an adverse effect on willingness to co-create.
- Co-creation fosters psychological ownership: By involving users early, they become more invested in the solution, which enhances satisfaction and commitment, directly supporting your assertion that co-creation leads to a stronger sense of ownership.

In OptFor-EU, for instance, co-design activities in stakeholder workshops helped shape the visual interface and functionality of a forest management decision support system. This participatory approach promotes trust and acceptance. Co-creation aligns closely with service-dominant logic [9] and design thinking methodologies [10], emphasizing iterative development based on continuous feedback. Furthermore, the project employed the co-creation framework to identify and categorize stakeholders, determine how different stakeholders would be engaged, and identify the most suitable engagement methods. It also identified user needs and evaluated the usability of the OptFor-EU forest management DSS. Co-creation activities throughout the project help with technology adoption once the system is ready for implementation [7][11].

III. TECHNOLOGY ADOPTION

Understanding what drives or hinders the adoption of technology requires a strong theoretical foundation. We present several models and theories that highlight key factors developers should consider when building new systems. An overview of models and theories, along with their relationships, is presented in Figure 1.

Based on the models and theories presented in the OptFor-EU deliverable D5.1 [11], this paper reviews these frameworks. The adoption theories presented in subsections A-C build upon each other to form the UTAUT model, which is then discussed in subsection D. UTAUT serves as the basis for evaluating the systems developed in all three projects. Furthermore, innovation and resistance theories were applied to supplement the co-creation framework in OptFor-EU, addressing specific challenges related to the adoption of technological innovation. Affordance theory also informed stakeholder workshops related to the development of the DSS in the OptFor-EU project.

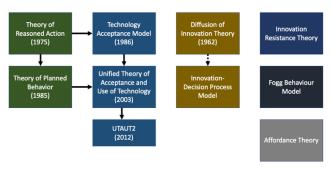


Figure 1. Theories and Models.

A. Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA), developed by Fishbein and Ajzen [12], is a psychological model that explains how intentions and social influences shape human behavior. According to TRA, a person's intention to perform a behavior is the best predictor of whether they will actually do it (see Figure 2). This intention depends on two main factors: the person's attitude toward the behavior and the subjective norms surrounding it.

Attitude refers to how positively or negatively someone evaluates the behavior. This evaluation is based on what they believe will happen if they perform the behavior and how much they value those outcomes.

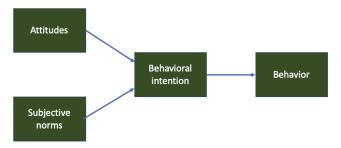


Figure 2. Theory of Reasoned Action (TRA).

Subjective norms relate to perceived social pressure. They reflect what a person thinks is important that others, like friends, family, or coworkers, expect them to do, and how motivated they are to meet those expectations [13].

TRA has been widely applied in areas like health, marketing, and technology adoption. While it does not consider all factors, such as experience or perceived control, it offers valuable insights into how attitudes and social influence shape decisions. This makes it helpful in designing communication strategies and interventions that encourage desired behaviors in specific groups.

B. Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB), developed by Ajzen [14], builds on the TRA to better explain behavior in situations where people may not have complete control over their actions.

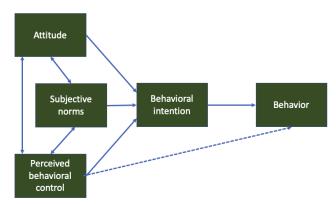


Figure 3. Theory of Planned Behavior.

TPB adds a third key factor to the original model, as shown in Figure 3, perceived behavioral control, which refers to the extent to which people feel they have control over their behavior.

According to TPB, a person's intention to perform a behavior is influenced by three components:

- Attitudes how positively or negatively they view the behavior, based on what they believe will happen and how much they value those outcomes.
- Subjective norms the social pressure they feel, shaped by what they think important others expect of them, and their willingness to meet those expectations.
- Perceived behavioral control how easy or difficult they think it will be to carry out the behavior. This includes both internal factors (such as skills and confidence) and external ones (such as time, resources, or support).

TPB has been applied in various areas, including health, environmental actions, and technology adoption [15]. By considering the extent to which people feel they have control, TPB offers a more realistic view of behavior. It helps researchers and practitioners design strategies that better align with individuals' abilities and the challenges they encounter in various settings.

C. Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), created by Davis [16], is one of the most widely used models for understanding why people accept or reject new technologies. It was developed as an extension of the TRA, with a specific focus on the use of technology.

TAM proposes that a person's intention to use a technology is mainly influenced by two factors: perceived usefulness and perceived ease of use (see Figure 4).

 Perceived usefulness refers to the extent to which a person believes the technology will enhance their performance or aid them in achieving their goals. • Perceived ease of use refers to how effortless users think it will be to use the technology.

These perceptions shape the person's attitude toward using the technology, which then affects their intention to use it. This intention is considered a strong predictor of whether they will actually use the technology.

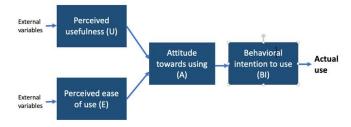
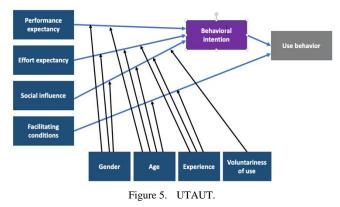


Figure 4. Technology Acceptance Model (TAM).

Over time, TAM has been expanded to include other relevant factors, such as social influence (subjective norms), perceived risk, and trust. Despite being a relatively simple model, the Technology Acceptance Model (TAM) has proven to be a robust and reliable framework across various technologies and user groups. It remains a valuable resource for both researchers and practitioners aiming to promote effective technology adoption.

D. Unified Theory of Acceptance and Use of Technology (UTAUT and UTAUT2)

The Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh and colleagues [17], brings together elements from eight different technology adoption models, including TRA, TAM, and TPB, and is the result of more than three decades of research on user adoption. Its goal is to offer a broader and more complete view of what influences people to adopt new technologies.



As shown in Figure 5, UTAUT identifies four main factors that drive technology acceptance and use:

- Performance expectancy: the belief that using the technology will lead to better performance or help achieve meaningful goals.
- Effort expectancy: the belief that the technology will be easy to use.

- Social influence: the perception that people around you think you should use the technology.
- Facilitating conditions refer to the availability of support, training, or resources that enable the use of technology.

The model also considers that individual differences, such as gender, age, experience, and whether technology use is voluntary, can affect how these factors influence behavior.

Since its introduction, UTAUT has been widely applied and extensively tested in various areas. It has proven to be a strong framework for understanding and encouraging technology adoption. In 2012, the model was extended (UTAUT2) with three additional factors: hedonic motivation (enjoyment or fun), price value, and habit [18].

E. Diffusion of Innovations Theory (DOI)

The Diffusion of Innovations Theory (DOI), developed by Everett Rogers in 1962 [19], explains how new ideas and technologies spread within a society. It examines why some innovations are rapidly adopted, while others take longer to adopt or fail altogether. Drawing on fields such as sociology, psychology, and communication, the theory identifies key factors that influence adoption.

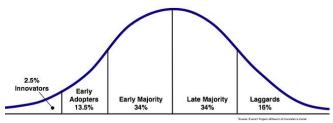


Figure 6. Diffusion of Innovations Theory [19].

According to the DOI, innovations spread gradually through a population as people make decisions to adopt based on five main characteristics:

- Relative advantage how much better the innovation is compared to what it replaces.
- Compatibility how well it fits with existing values, needs, or experiences.
- Complexity how easy or difficult it is to understand and use.
- Trialability whether it can be tested or tried on a limited basis.
- Observability how visible the results are to others.

These factors shape how quickly and widely an innovation is adopted. The model also describes the typical user distribution over time, which includes innovators, early adopters, early majority, late majority, and laggards (Figure 6).

F. Innovation-Decision Process Model (IDPM)

The Innovation-Decision Process Model (IDPM), introduced by Everett Rogers as part of the Diffusion of Innovations Theory, outlines five key stages that individuals typically undergo when deciding whether to adopt a new idea or technology [19].

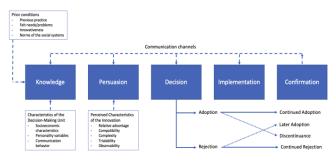


Figure 7. Innovation-Decision Process Model.

These stages, shown in Figure 7, are: knowledge, persuasion, decision, implementation, and confirmation.

- In the knowledge stage, individuals first learn about the innovation and begin to gather information.
- During persuasion, they form an opinion, whether positive or negative, based on how helpful or appealing the innovation appears to be, as well as their past experiences.
- The decision stage is where they choose to adopt or reject the innovation.
- If they adopt it, the implementation stage follows, where the innovation is put into use in real-life situations.
- Finally, in the confirmation stage, individuals look for support or feedback that confirms their decision. If their experience is positive, they continue using it; if not, they may stop.

Understanding these stages enables researchers and practitioners to design more effective strategies and support mechanisms that guide users through the adoption process.

G. Innovation Resistance Theory

Innovation Resistance Theory (IRT) helps explain why people may hesitate or refuse to adopt new ideas, products, or technologies—even when those innovations offer clear benefits [20]. While most adoption theories focus on what encourages people to adopt innovations, IRT examines the obstacles that slow down or block adoption.

Resistance can stem from personal factors, such as habits, preferences, or a fear of change, as well as social and cultural influences, including norms or values that conflict with the innovation.

A key part of IRT is the distinction between two types of resistance:

- Active resistance is a conscious decision to reject an innovation, often because it feels incompatible with one's values, beliefs, or lifestyle.
- Passive resistance is more subtle and may result from a lack of awareness, uncertainty, or difficulty understanding the innovation. In these cases, people tend to stick with what they already know.

For successful innovation adoption, it is important to recognize and address these forms of resistance. This may involve providing better information, offering demonstrations or training, clarifying misconceptions, or gaining support

from trusted influencers. By considering both what encourages and what blocks adoption, IRT provides a more comprehensive picture of how innovations spread [21].

H. Fogg Behavior Model

The Fogg Behavior Model (FBM) [22], created by B.J. Fogg, explains how behavior happens by combining three key elements: motivation, ability, and triggers.

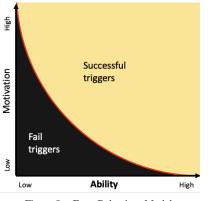


Figure 8. Fogg Behaviour Model.

According to the model shown in Figure 8, a person will only perform a behavior if all three elements come together simultaneously.

- Motivation refers to the degree of desire or enthusiasm someone has for doing something. It can be influenced by factors like pleasure or pain, hope or fear, or the desire for social acceptance.
- Ability refers to how easy or hard it is to do the behavior. If something is too complicated, time-consuming, or expensive, people are less likely to do it, even if they are motivated.
- Triggers (also known as prompts or cues) are signals that prompt the person to take action. This could be a notification, a reminder, or a change in the environment.

If motivation is high and the task is easy, only a small trigger is needed. But if either motivation or ability is low, the behavior is unlikely to happen, even with a strong trigger.

The FBM is especially useful for designing technology, apps, or campaigns that aim to change behavior. By adjusting motivation, enhancing ease of use, or selecting the optimal moments to prompt action, designers can increase the likelihood that users will adopt new behaviors.

I. Affordance Theory

Affordance Theory, first introduced by psychologist James J. Gibson [23], focuses on how people perceive and interact with their environment. An affordance is a feature of an object or system that suggests how it can be used. For example, a button "affords" pushing, and a handle "affords" pulling.

In the context of technology and design, affordances help users understand what actions are possible. If a website or app clearly shows what you can click, swipe, or type into, it is easier and more intuitive to use. These clues can be visible, such as a clickable icon, or hidden, like a keyboard shortcut (see Figure 9), allowing designers to create more user-friendly technologies that feel natural and require less explanation.

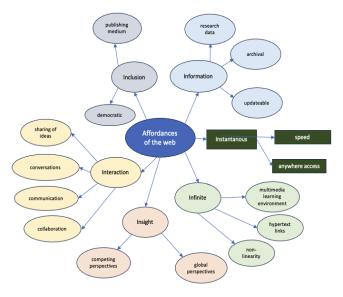


Figure 9. Affordance Theory Example.

The theories presented in this section, summarized in Figure 1, were applied across the three projects. The adoption and diffusion theories enabled us to examine the willingness to adopt smart grid and smart home solutions in Smart-MLA and PVADIC-C. They will be used to analyze the business model and implementation strategy for the OptFor-EU DSS. In contrast, affordance and adoption theories informed the user involvement plan presented in [11] and were applied in stakeholder workshops to elicit user requirements.

IV. MARKETING AND TECHNOLOGY ADOPTION

A recurring theme across practical implementations is that technology does not sell itself. Proactive and strategic product or service marketing is essential for bridging the gap between innovation and user readiness. Heiman, Ferguson, and Silberman [24] used agriculture as a field to investigate the relationship between user adoption and marketing. They concluded that this relationship is important for innovations.

We have already emphasized the importance of connecting with users through co-creation; marketing builds on this by ensuring that users understand what is being offered, why it matters, and how it fits their needs. Beyond raising awareness, marketing helps build trust and communicate the value that drives adoption. Effective marketing strategies for technology adoption include:

- Explainer videos and infographics that clarify complex features.
- User testimonials and pilot project stories that build credibility and relatability.
- Scenario-based demonstrations that show how the technology solves real-world problems.

• Targeted messaging that reflects user motivations, such as financial savings, convenience, or sustainability.

Personalized communication and segmentation are essential for reaching diverse user groups, from early adopters who seek technical depth to later adopters who prefer usecase-driven materials.

Marketing should also evolve across the adoption journey, from initial exposure to onboarding and ongoing engagement.

Another key strategy is to maintain a continuous dialogue with users through newsletters, FAQs, and forums. This fosters trust, provides feedback for improvement, and reinforces user commitment. Ultimately, effective marketing is not just about promotion—it is about building understanding, reducing uncertainty, and supporting the journey from awareness to regular use.

Strategic marketing should be viewed as a core part of the adoption process, not an afterthought.

V. TRUST AND TECHNOLOGY ADOPTION

Trust is a fundamental prerequisite for the adoption of technology, especially in systems that require users to share data or relinquish control. In previous work [25], we identified three main categories of trust-building measures: regulatory, technical, and organizational.

- Regulatory measures provide stability and predictability through clear rules, certifications, and legal frameworks that reduce uncertainty and define user rights and responsibilities.
- Technical measures focus on system transparency, data security, reliability, and ensuring users have control over their personal information.
- Organizational measures address fairness, accountability, and openness—for example, through user-centered governance and clear, consistent communication.

While not a separate category, the use of plain language across all three domains is vital to ensure users understand how systems work, reinforcing transparency and reducing uncertainty.

Evidence from Smart-MLA showed that users were hesitant to relinquish control over their home energy use to aggregators, even when financial incentives were offered unless they trusted the system and its operators [2]. This highlights the importance of both technical safeguards and effective communication.

In public sector contexts, partnering with trusted institutions can further increase confidence. Users are more likely to adopt a technology when they believe it operates fairly and in their best interest.

In today's environment, shaped by misinformation and the growing presence of generative AI, building and maintaining trust is more challenging than ever. To do so, three actions are essential:

• Transparency – Clearly explain how the system works, what data is collected, and how it is used.

- Reliability Ensure the technology performs consistently and is backed by responsive support.
- Social proof Use testimonials, endorsements, and visible success stories to show that others trust and benefit from the solution.

Together, these elements form the foundation for user trust, an essential driver of successful and sustained technology adoption.

VI. CONCLUSION AND FUTURE WORK

Successful technology adoption is not solely driven by technical merit; it relies on a combination of human-centered strategies and foundational theoretical understanding. This paper has highlighted three essential enablers of adoption: cocreation, marketing, and trust. Co-creation ensures that technologies are aligned with user needs, promoting longterm engagement by fostering ownership and relevance. Marketing bridges the gap between innovation and awareness, providing tailored communication that resonates with user motivations and informs decision-making. Trust, as demonstrated through regulatory clarity, technical reliability, and transparent organizational practices, is a prerequisite for acceptance, particularly in systems that involve data sharing or automated control.

By combining these practical strategies with wellestablished models such as TAM, UTAUT2, TPB, and DOI, we gain a robust foundation for designing, promoting, and implementing user-centered technologies. We have briefly mentioned how our three projects have applied these strategies and theories in this paper; however, due to space constraints, we refer readers to the project websites for more detailed information. Future technology initiatives—whether in public or private sectors—will benefit from viewing adoption not as a final step, but as a continuous process rooted in mutual understanding, clear communication, and sustained trust.

In this paper, we demonstrate how to combine practical and theoretical frameworks to increase the chances of successful technology adoption. By following a co-creation approach throughout the project, we ensure that stakeholders and users are involved in everything, from gathering requirements and defining functionality to front-end design and the usability of the system. By utilizing adoption theories (subsections III.A-D), we have both a framework for evaluation and theoretically sound input to what should be emphasized in the co-creation process, especially if affordances (section III.I) are part of the co-creation process regarding requirements and functionality. Innovation theories inform us on how to transition from a research project to implementation. They should, therefore, be integrated into business models to realize the value of software-based research projects, along with the marketing components outlined in Section IV.

Finally, we emphasize the role of trust in Section V. This is not something that a project group can fully control, as it requires regulatory measures and a general level of trust in society. Still, project organizations can implement policies that facilitate trust among project members, while also aiming

for transparency, reliability, and social proof of the software solution.

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