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The Speed of Professional Innovation Adoption

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Abstract: What factors influence the speed of user-driven innovation adoption? This study examines the factors that affect the adoption rate of user-driven innovation. Previous research often attributes the lack of adoption to insufficient adoption efforts by developers, while some argue that user communities accelerate adoption. However, these findings may not apply to all situations. In this paper, we elucidated the relationship between the User Requirements Gap and the speed of adoption through a qualitative study focusing on "AsisTIVA," a software system that supports TIVA by controlling syringe pumps (TIVA) developed by Japanese anesthesiologists. Specifically, while AsisTIVA enables even inexperienced physicians to provide high-quality anesthesia management, academic society guidelines restrict its use to skilled physicians (Tsutsui 2026). Notably, this gap did not arise incidentally but reflects intentional control by the medical professional community. Our findings challenge the conventional assumption that rapid adoption is universally desirable and call for a reevaluation of that premise.

Keywords: user innovation; diffusion of innovation; user community; communities of practice

Introduction

Early research on user innovation focused primarily on the process by which users themselves generate innovation. As research progressed, attention also shifted to how the innovations created spread. In fact, it has been reported that many user innovations do not achieve widespread adoption, and even when they do, the pace of adoption is slow (Hinsch, Stockstrom, and Lüthje, 2014; Jeroen, Eric von, et al., 2015). As research continued, factors that promote the adoption of user innovations were also identified. This paper examines the diffusion process of "AsisTIVA," an automated anesthesia system jointly developed by Japanese anesthesiologists and Nihon Kohden Corporation.

AsisTIVA is a highly innovative product, and there are few existing products with which to compare its diffusion speed. Nihon Kohden Corporation had anticipated that over 100 facilities would adopt the system within three years of its launch, but as of 2024, only nine facilities had adopted it. This study views the adoption as lagging behind the manufacturer's expectations and seeks to clarify the reasons for this.

Our previous research demonstrated that professional guidelines established by anesthesiologists intentionally suppressed the adoption rate to ensure patient safety (Tsutsui 2026). Based on this finding, this paper introduces the concept of a "user

requirement gap"—the discrepancy between the users anticipated during development and those recognized by the professional guidelines.

Why User Innovation Does (Not) Diffuse

"Market Failure" in User Innovation

Professional users possess numerous characteristics that distinguish them from general consumers. They possess high levels of specialized knowledge, are highly motivated because innovations are directly linked to their work, and form peer groups among themselves. Therefore, since it is assumed that innovations spread more easily in environments where communication among adopters is facilitated (Rogers 2005), innovations developed by professional users may also spread easily to other professional users (Franke and Shan 2003).

However, previous research has shown that many innovations, despite having potential value for other users, do not become widely adopted (de Jong et al. 2015). One reason for this is "market failure." This is because the benefits of diffusion are externalities for innovators, limiting their incentive to invest in diffusion activities (de Jong et al. 2015; von Hippel et al. 2017). This problem has also been observed in the healthcare sector, where physicians often make little effort to promote the use of off-label drugs developed by users (von Hippel, DeMonaco and de Jong, 2017).

User Community Engagement

On the other hand, several studies have identified peer communities and direct interactions among users as key factors that promote diffusion (Hienerth and Lettl 2011; de Jong, Gillert, and Stock 2018). In particular, opportunities for potential adopters to learn directly from experienced users appear to facilitate adoption in professional settings. In the healthcare sector, Hinsch, Stockstrom, and Lüthje (2014) analyzed the development and adoption processes of user innovations and found that opportunities for potential adopters to directly experience the technology under the guidance of individuals familiar with it are the strongest drivers of adoption. Furthermore, de Jong, Gillert, and Stock (2018) focused on the process from the emergence of user innovation to "first adoption" and demonstrated the role of communities as a factor in bridging the gap that exists during this period.

In the aforementioned research on the diffusion of user innovation in the medical field, direct interaction among users and user communities have been identified as key factors promoting diffusion. In our view, these findings suggest that a form of "communities of practice" (Lave and Wenger 1991; Wenger, McDermott, and Snyder 2002) is influencing diffusion.

"Communities of practice" is a concept proposed by Lave and Wenger (1991) that refers to learning communities modeled on the apprenticeship system. The framework described by Hinsch, Stockstrom, and Lüthje (2014)—in which "potential adopters directly experience the technology under the guidance of a tech-savvy individual"—can

be understood as an apprenticeship-like relationship formed between an expert and a learner.

Furthermore, de Jong, Gillert, and Stock (2018) define a community as "a social group of any size who share common behaviors, values, or habits" (p. 490). This definition is extremely close to the one provided by Wenger, McDermott, and Snyder (2002)—who widely established the concept of "communities of practice" in the field of management—namely, "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis."

Based on the findings of the existing research discussed above, the dissemination of medical devices might be understood as a process within communities of practice whereby knowledge and practices spread from central experts to peripheral participants.

Case: Professional Control of AsisTIVA

This study examines the case of AsisTIVA, a software application that supports total intravenous anesthesia (TIVA) by controlling syringe pumps, jointly developed by Japanese anesthesiologists and Nihon Kohden Corporation. The analysis is based on qualitative interviews with developers, company representatives, and anesthesiologists who have adopted the system, supplemented by publicly available materials.

The participants included two anesthesiologists who served as developers, three employees from the co-developing company, and five anesthesiologists who adopted AsisTIVA. During the interviews, we asked about the background of AsisTIVA's development and adoption, the anticipated impact of AsisTIVA on the anesthesiology community, and—for the anesthesiologists—the reasons they chose anesthesiology as a field, using this as a clue to understand the characteristics of the profession. The interview survey was conducted from June 2024 to January 2026. Published materials used included the journals of academic societies composed of anesthesiologists and records of lectures. From these qualitative data, we identified factors that have been overlooked in conventional research on innovation diffusion.

The influence of communities on the diffusion of AsisTIVA

Previous research suggests that professional communities promote the diffusion of user-driven innovation, particularly in professional settings where knowledge is shared among members (Hinsch, Stockstrom, and Lüthje 2014; de Jong, Gillert, and Stock 2018). These findings align with the concept of "communities of practice" proposed by Lave and Wenger (1991), which emphasizes learning through participation in professional communities. Our previous research has demonstrated that the adoption of new products progresses within communities of practice (Tsutsui 2011). By analyzing drug adoption data for physicians belonging to the same specialty who trained at one department and currently work at another hospital, we demonstrated that if their former department adopted a specific drug, those

physicians were more likely to adopt the same drug at their current workplace. Within communities of practice, not only does information flow easily, but decision-making among members is also likely to influence one another because it is grounded in shared tacit knowledge (Nonaka and Takeuchi 1995) (Tsutsui 2011). Furthermore, since both the developers of AsisTIVA and potential adopters belong to the anesthesiology community, we initially expected that the influence of the community would promote adoption.

However, our study found limited evidence that institutional affiliations or alumni networks significantly influenced adoption decisions during the early stages of diffusion. While community-based diffusion may gain importance in later stages, the current diffusion process cannot be fully explained by community influence alone. Nevertheless, since AsisTIVA is currently in the early stages of diffusion, it remains possible that physicians will decide to adopt it under the influence of the community in the future.

Discrepancy Between Intended Users and Authorized Users

A key finding from the survey concerned the discrepancy between the users envisioned during the development phase and those authorized by professional guidelines.

The development of AsisTIVA was driven by a shortage of anesthesiologists in Japan. As the number of surgeries increases, the workload on anesthesiologists has been growing year by year. Furthermore, the regional imbalance in the distribution of anesthesiologists is becoming more severe; while personnel are concentrated in urban areas, rural regions continue to face a chronic shortage of anesthesiologists. Attempts to automate anesthesia were pursued as a promising means of addressing these challenges. Additionally, standardization and uniformity in anesthesia management are crucial for ensuring patient safety, and from this perspective, automation technology was considered a potentially effective solution (Hagiwara H. 2024, Nihon Kohden Corporation).

One of the developers states, “We want to create a ‘compass’ for anesthesia practice. A skilled artist can draw a beautiful circle by hand, but this is not easy for an unskilled person. However, with a compass, anyone can draw an accurate circle. Similarly, our goal is to enable high-quality anesthesia management even for those who are not skilled anesthesiologists.” Thus, AsisTIVA was designed to reduce variability in anesthesia management caused by differences in experience and to ensure stable medical care.

On the other hand, strict guidelines were established to ensure the safe use of AsisTIVA. There were also strict restrictions on the anesthesiologists permitted to use it, requiring experience in managing at least 300 cases of TIVA. As a result, only highly skilled anesthesiologists were authorized to use the system.

It can be inferred that this discrepancy between the intended users and the authorized users limited its adoption in the short term.

Practical Applications by Anesthesiologists

The nature of the procedure differs significantly between anesthesia administered using AsisTIVA and the conventional method of manually administering anesthetics. Users developed practical adaptation strategies in clinical settings and identified the added value of AsisTIVA. One anesthesiologist explained that during surgical emergencies, because AsisTIVA continuously monitored the patient's vital signs, the anesthesiologist was able to focus on the surgical field. Through such operational adaptations, users devised ways to incorporate the system into their clinical practice.

These findings suggest that the adoption of technology in the medical field involves not only clinical data but also the accumulation of operational knowledge within professional practice.

Rethinking Diffusion Speed

In this section, we present a theoretical explanation for the relatively slow adoption of AsisTIVA within the anesthesiology community.

The Gap in User Requirements

In classical research on innovation adoption, the influence of product characteristics and adopter attributes (Rogers 2005) has been emphasized as key factors affecting the pace of adoption (upper center and right sides of Figure 1). Subsequent research on the diffusion of user innovations has identified limited incentives for innovators as the primary factor delaying the adoption of such innovations (upper left of Figure 1). However, this explanation is insufficient in the case of AsisTIVA. The developers actively promoted its adoption through conference presentations, journal publications, and opportunities for clinical observation.

On the other hand, Tsutsui (2026) demonstrated that while professional guidelines may slow short-term adoption, they support safe implementation in the long term. Specifically, guidelines function to promote adoption in the long term by suppressing the rate of adoption in the short term, thereby mitigating the risk of accidents associated with a sudden surge in users. However, the reason why adoption within the anesthesiology community remains relatively slow has not yet been fully explained.

Therefore, this study focuses on the mismatch between the users envisioned during development and those recognized by professional guidelines (lower part of Figure 1). We define this mismatch as the "user requirement gap." AsisTIVA was originally

designed to support less experienced anesthesiologists by stabilizing anesthesia management. However, current guidelines restrict its use to experienced physicians. This discrepancy narrows the pool of potential adopters and slows adoption in the early stages.

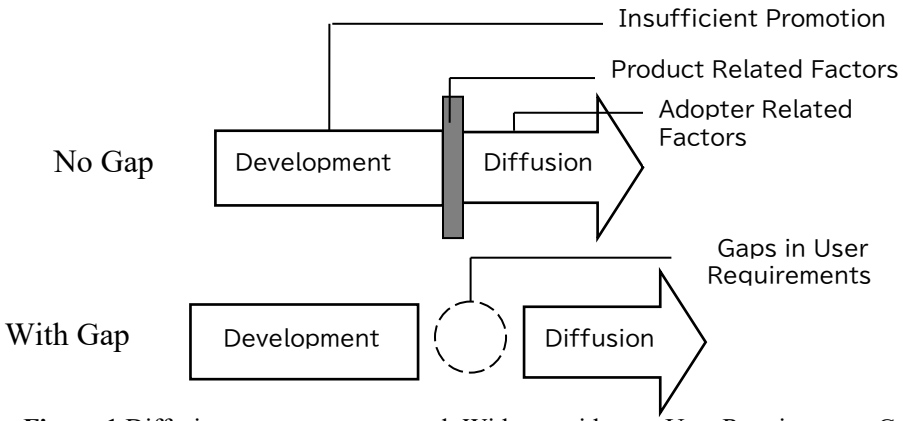

Figure 1 Diffusion processes compared: With vs. without a User Requirements Gap

Reinvention as a Means to Bridge the Gap

One requirement for bridging this gap is "reinvention" by existing users. Previous research has also suggested that reinvention promotes adoption by adapting innovations to local clinical practices (Rogers 2005; Overbye-Thompson and Hamilton 2025). In the case of AsisTIVA, reinvention occurs not through modifications to the device itself, but through the adaptation of clinical usage and operational practices.

Unlike software or consumer products, medical devices cannot be easily modified after approval. This is because changes require additional regulatory procedures. As a result, users adapt how the device is used in the clinical setting rather than modifying the device itself.

According to interview data, anesthesiologists gradually established practical methods for collaborating with AsisTIVA during surgery. Users learned how to allocate roles between human judgment and automated monitoring, particularly in emergencies requiring rapid response. This accumulation of tacit knowledge helps bridge the "user requirement gap."

Through interview surveys, it was revealed that, as AsisTIVA is an unprecedented medical device, the current guidelines are strictly set with a strong emphasis on safety. On the other hand, there was also a recognition that there is room to reconsider future operational methods once sufficient operational experience and knowledge regarding safety have been accumulated.. In this sense, adoption depends not only on the innovation itself but also on the gradual development of the

professional knowledge necessary to ensure its safe use.

Conclusion

This study examined the adoption of AsisTIVA, a user-invented medical device developed by anesthesiologists. Existing research has primarily attributed the slow adoption of user-invented devices to a lack of adoption incentives for innovators. However, the case of AsisTIVA suggests a different mechanism.

We identified a “user requirement gap” between the users envisioned at the time of development and those recognized by professional guidelines. Since safety is the top priority in clinical settings, adoption initially depends on experienced users who accumulate tacit operational knowledge and clinical evidence. Furthermore, the very process of accumulating this knowledge and evidence serves as a condition enabling the long-term adoption of AsisTIVA.

These findings suggest that a delay in adoption is not necessarily a failure. In specialized environments such as medicine, controlled adoption can function as a mechanism to ensure safety and support long-term adoption. These findings call for a reevaluation of the conventional implicit assumption that “rapid adoption is always desirable.”

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Feedback and Revisions:
I sincerely appreciate the reviewers' valuable comments. The revisions are as follows:

I clarified the contribution and necessity of this study. In particular, I now explicitly articulate that the study theoretically positions the User Requirements Gap, a factor that has not been sufficiently addressed in prior research on user-innovation diffusion.

I surveyed conference presentations and journal articles published by the academic society to which the majority of Japanese anesthesiologists belong. In addition, I conducted semi-structured interviews with physicians—using broad guiding questions to

encourage open-ended responses—and analyzed the qualitative data to identify factors that have been overlooked in existing diffusion research.