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Organizing for Emerging Welfare Technology: Launching a Drug-Dispensing Robot for Independent Living

Jon Aaen

ORGANIZING FOR EMERGING WELFARE TECHNOLOGY: LAUNCHING A DRUG-DISPENSING ROBOT FOR INDEPENDENT LIVING

Research paper

Aaen, Jon, Aalborg University, Aalborg, Denmark, jonaaen@dps.aau.dk

Abstract

Emerging technologies, such as robots, virtual homecare, and sensor technologies, have considerable potentials to transform health- and eldercare. These so-called welfare technologies (WTs) are expected to increase the quality of services, empower citizens, improve working conditions for professionals, and reduce costs for care providers. However, as this transformation this involves both technological development and radical changes in how these services are organized, many promising WTs fail to advance beyond the pilot stage and create value on a large scale. This paper reports the results of a longitudinal case study of the emergence of a service robot in primary healthcare, from project launch to testing, development, and evaluation. Seeking new ways of organizing emerging technologies, nine Danish municipalities and a consortium of four private companies launched a collaborative project, aiming to develop and implement the use of a drug-dispensing robot for patients living at home. The analysis traces how project managers respond to competing concerns on innovation strategy, testing, coordination, and user mobilization and how these critical decisions shape the project's trajectory. As such, the paper sheds new light on how to understand and manage competing concerns in the process of organizing emergent WTs.

Keywords: innovation process, healthcare robot, competing concerns, welfare technology, longitudinal case study

1 Introduction

Emerging technologies, such as robots, virtual homecare, and sensor technologies, are expected to radically transform healthcare and eldercare (Hofmann, 2013; Nickelsen, 2018). In Nordic welfare states, these types of emerging technologies are commonly referred to as welfare technologies (WTs) and are typically associated with high expectations in terms of enabling new service opportunities, reducing costs, increasing citizens' self-reliance, and improving working conditions for caregivers and service professionals (Aaen, Nielsen, & Elmholdt, 2018). Despite their strategic importance and growing investments in them, few WTs have been implemented with proven successful practical use (Bygstad & Lanestedt, 2017; Lo, Waldahl, & Antonsen, 2019; Søndergaard, 2017). In many cases, the most challenging aspect does not seem to be developing the technological component itself but organizing the transition from initial invention to a value-creating solution on a large scale (Christensen & Nielsen, 2017; Wade, Taylor, Kidd, & Carati, 2016). Failing to address this innovation problem represents a significant threat to the digital transformation of welfare services, including neglected opportunities to increase care recipients' quality of life, missed efficiency potentials for service providers, and unrealized market potentials for technology developers (Aaen et al., 2018). As such, many WTs remain in the emergent phase of the technology life cycle (Luftman, 2004), with their practical applications and benefits remaining largely unrealized (Day & Schoemaker, 2000).

With limited and fragmented research, we have little understanding of the challenges involved in transitioning the emerging phase of WT's into value creating applications on a large scale (Aaen, 2019). To promote this research agenda, this paper presents a longitudinal case study of the emergence of a service robot for aiding patients with medication management. Seeking new ways of organizing WT projects, nine Danish municipalities and a consortium of four private companies launched a partnership, aiming to develop, implement, and scale up a drug-dispensing robot for patients living at home. The robot's expected benefits include reduced costs (fewer caregiver visits), increased safety (fewer medication errors), improved working conditions (automation of monotonous workflows), and patient empowerment (patients' responsibility for their own medication consumption). Realizing these benefits depends on radical transformations in how the municipalities aid patients at home with their medication – from prescription to consumption. As demonstrated in this study, organizing such emerging technology involves multiple decisions across and within participating organizations and is characterized by competing concerns on innovation strategy, testing and development, agency coordination, and user mobilization. The case provides an excellent research opportunity to contribute to practical problem-solving concerning WTs, while developing new theoretical understandings of how to organize emerging technologies. This paper follows the launch of the drug-dispensing robot (2013–2019) and tackles this research question: *How can managers understand and respond to competing concerns in the process of organizing emergent WTs?*

The paper makes two contributions. First, as a new approach to WT innovation, the empirical examination contributes with valuable discoveries and observations on how to engage in and execute WT innovation on a large scale. Second, by tracing how competing concerns shape the trajectory of the innovation process, the paper takes initial steps toward conceptualizing how organizing for emerging technologies unfold as an ongoing process of interrelated critical decisions embedded in competing concerns.

2 Characteristics of emerging welfare technologies

In the Nordic welfare states, the term *welfare technology* is mostly used to describe the emergence of a wide variety of citizen-facing technologies that aim to transform the delivery of healthcare and eldercare services, typically with the collaboration of citizens (end users), frontline employees, service organizations, and technology companies (Aaen et al., 2018). Examples of WTs include telecare services for independent living (Cook et al., 2018), GPS-tracking devices for people with cognitive impairment (Procter, Wherton, & Greenhalgh, 2018), smartphone applications for symptom monitoring (Kettlewell, Phillips, Radford, & Dasnair, 2018), sensor systems for digital night surveillance in nursing homes (Nilsen, Dugstad, Eide, Gullslett, & Eide, 2016), and robotic vacuum cleaners in eldercare facilities (Nielsen, Andersen, & Sigh, 2016). Outside of the Nordic countries, these types of technologies are also known as assistive living technologies.

Lo et al. (2019) argue that difficulties in organizing and creating value from WTs arise due to three aggregated characteristics. First, WTs are *interdisciplinary* and require new combinations of competencies in ICT and in healthcare to enable the necessary adaptation of both technology and work routines that arise in the implementation process. However, asymmetric knowledge and competing professional logics in service organizations and WT suppliers can complicate the necessary communication and contribute to difficulties in WT innovation. Dupret and Friborg (2018) demonstrate this asymmetry in their study on interprofessional collaboration in Danish healthcare and rivalry in professional hierarchies. They note how healthcare professionals, on one hand, are assigned roles as primary end users of technology; on the other hand, they are subjected to an organizational culture of zero failure and discouraged from experimenting with and deviating from official procedures. In contrast, technology developers are explicitly encouraged to engage in the creative pursuits of experimentation (Dupret & Friborg, 2018). Similarly, Greenhalgh et al. (2012) point to competing discourses on the organizing vision of WT projects across different stakeholder groups as hampering the introduction of WTs. The authors suggest that stakeholders in WT projects focus on facilitating interdisciplinary dialogue in which different values, world views, and priorities are made explicit and acknowledged to establish a more broadly coherent organizing vision on the use of WTs.

Regarding the second characteristic, Lo et al. (2019) argue that WT solutions are *interconnected* with other technologies, implying that WTs should not be perceived as isolated or stand-alone products but viewed from a system perspective to ensure the necessary technological and organizational compatibility. However, this characterisctic also creates a form of path dependence, where previous choices influence current possibilities. For instance, the choice (made many years ago) of implementing an electronic patient record system would influence future options and the trajectory of new WT projects connected to or interacting with this digital infrastructure. This interdependency is further complicated by rapid technological development, making extensive long-term planning difficult and necessitating sufficient room for adjustments.

Concerning the third characteristic, noting the increasing and pervasive digitization of welfare, Lo et al. (2019) understand WTs as part of the *ubiquitous computing* paradigm, linking physical and virtual spaces in new ways, with the potential to fundamentally transform organizations and work processes rather than merely increase efficiency. This characteristic both emphasizes and challenges the need for comprehensive planning because what changes will occur can often be unpredictable when organizing emerging technology, stressing the need for flexibility and continuous involvement of stakeholders throughout the innovation process. As such, organizing emergent WTs will likely be a cumbersome process with many uncertainties and involving different and often contradicting stakeholder interests.

3 Theoretical background: Competing concerns in innovation processes

> *"Invention is essential to start the process off, but it is not enough. Taking that brilliant idea through an often-painful journey to become something that is widely used involves many more steps and a lot of resources and problem solving on the way"* (Boer & Bessant, 2004, p. 7).

From a process perspective, WT innovation is not perceived as an outcome (i.e., the emergence of a new idea or a final product) but as a sequence of events that takes an idea from inception to development and implementation. This sequence neither unfolds in an orderly and linear manner nor occurs at random (Van de Ven, 2017). Research on innovation processes points to different kinds of complexities that managers must navigate across different organizational levels, often involving multiple actors from different cultures and contexts. Garud, Tuertscher, and Van de Ven (2013) argue that rather than seeking to simplify such complexities, it is more fruitful to harness them as generative forces for sustaining ongoing innovation. A central theoretical foundation in this regard constitutes the dynamics between path dependence and path-creation mechanisms (Garud & Karnoe, 2001; Garud, Kumaraswamy, & Karnoe, 2010). From this perspective, history and initial conditions are still relevant. However, agents can deliberately shape paths in-the-making to temporarily overcome the constraining effects and harness the complexities as the innovation process unfolds. Furthermore, viewing agency as part of a distributed and emergent system of interactions between social and material elements, this perspective does not focus on a single change agent but on interdependencies and interactions in a system of intra- and inter-organizational processes involving multiple organizational levels simultaneously. Thus, managing these innovation complexities involves balancing a diverse and often contradictory set of concerns.

This focus on contradictions has received increasing attention in the innovation process literature (Langley, Smallman, Tsoukas, & Van de Ven, 2013). These studies assume *"a pluralistic world of colliding events, forces, or contradictory values that compete with each other for domination and control. These oppositions may be internal to an organizational entity because it may have several conflicting goals or interest groups competing for priority"* (Van de Ven & Poole, 1995, p. 517). The contradictions are viewed as a whole, consisting of two opposing elements (a thesis and an antithesis) and the struggle or the relation between them. Usually, multiple contradictions are simultaneously at play, each with elements becoming more or less dominant as the process unfolds (Cho, Mathiassen, & Robey, 2007). The outcome of a contradiction can be establishing a new synthesis (and a new set of thesis and antithesis), continuing an existing state of affairs by suppressing or preventing the mobilization of the opposing element, or converting into conflict between entities with opposing concerns (Askedal & Flak, 2017;

Van de Ven & Poole, 1995). Consequently, competing concerns and contradictions can be generative forces for change but may also lead to failure when implementing technologies in contested institutionalized settings (Dobson & Nicholson, 2017).

Though still heavily under-researched, this perspective's potentials in the context of WT innovation have been demonstrated by a few studies. For instance, studying the adoption of a telehealth innovation, Cho et al. (2007) find that the trajectory of the innovation process is shaped by how inherent contradictions are managed or (temporarily) resolved within and across the network of involved stakeholders. Noteworthy contradictions include *medical versus business interests* and *emerging versus institutionalized work practices*. In their study on the implementation of eHealth in municipal healthcare in Norway, Askedal and Flak (2017) apply a similar approach, finding *effective service versus efficient service* and *technology enthusiasm versus reluctance to change* as the major contradictions among different stakeholders. Following this line of research, this study is set up to help uncover the competing concerns involved in organizing WTs and to provide an understanding of the key mechanisms involved in how agents can shape the trajectory of emergent technologies.

4 Method

To investigate competing concerns in WT innovation, I conducted a longitudinal case study of the emergence of a drug-dispensing robot in primary healthcare from the initial idea to evaluation (2013–2019).

4.1 Research setting and case

The idea for the drug-dispensing robot for independent living arose as a result of a public tender, in which nine Danish municipalities sought a new solution for aiding citizens in taking their medication. Developed by a consortium of four companies, the robot offers a new technology-enabled service to care recipients while involving major organizational changes in the service delivery. The consortium consists of a robot development company, a software company in charge of integrating the robot software with the information systems in the healthcare sector, a pharmacy for centralized packing of medication, and a logistics and service company in charge of delivering medication to the citizens' homes and responding to emergency calls. The robot is installed in private homes and automatically retrieves information about the patients' medicines, based on their doctors' prescriptions, as recorded in the municipalities' electronic care journals. The robot uses this information to order medication at the pharmacy, remind the patients to take their medication, and check the actual doses before dispensing the pills into a cup. If a patient does not take the pills, the robot alerts the service company representative, who calls to remind the patient to take the medication. Finally, the robot logs the process and transmits the data to the electronic care journal, making the activities transparent and accessible to the municipalities. Figure 1 visualizes this *whole solution* for managing medication from prescription to consumption.

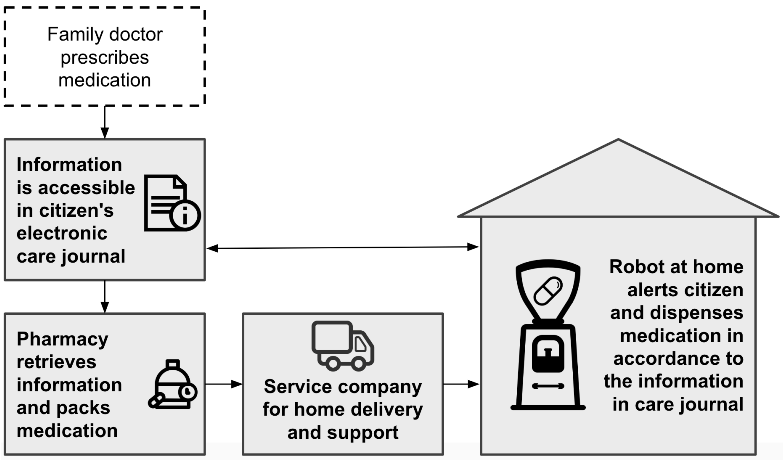

Figure 1. The process surrounding the drug-dispensing robot for independent living, from prescription to consumption.

A centralized project team across the nine municipalities and the consortium coordinates the innovation process from the prototype to the whole solution. The analysis focuses on these organizing decisions made by this project management team.

4.2 Data collection

As visualized in Figure 2, the longitudinal research design includes both retrospective and real-time data collection, from project launch to evaluation, with the data collection consisting of a combination of various types and sources (Langley et al., 2013).

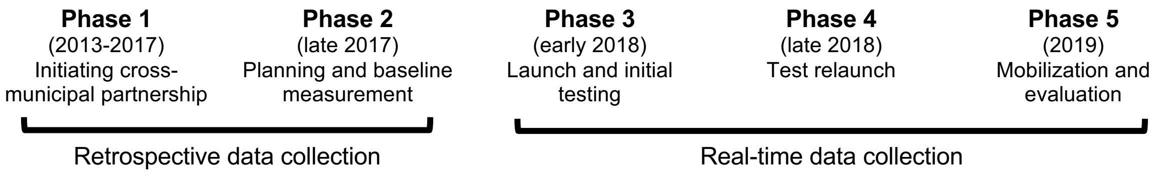

Figure 2. Longitudinal research design

As the project attracted substantial political attention and media publicity, the case is well described through public reports and other documents. Hence, as summarized in Table 1, a broad range of accessible documents helps chronologically trace critical events and activities as the project unfolds. However, as these processes rarely unfold as envisioned when roadblocks or new opportunities are encountered, the plans must be changed according to new expectations, concerns, and organizing practices.

To capture shifts in expectations, contemporary experiences, and concerns, I conducted recurring semi-structured interviews with the key actors involved in the project at all organizational levels, including project managers in the municipalities, developers in the company consortium, and frontline care professionals. I conducted regular interviews with project managers (approximately one every four months) and ad-hoc interviews with developers and frontline care workers when relevant (e.g., before, during, or after a test and development iteration). The interviews varied in length, depending on the number of issues that needed to be addressed at the time of each interview. Focus group interviews with care professionals were conducted in two municipalities (two participants each), discussing expectations, concerns, and implications for practice. Finally, I conducted a focus group interview with three top-level managers from the private companies. The formal interviews were digitally recorded, while notes were written during the informal interviews (e.g., brief phone conversations and lunch meetings during the midterm seminar).

Data type	Source	Quantity
Interviews	Municipal management	7 interviews (378 minutes) 1 informal interview (unrecorded)
	Care professionals and team coordinators	2 focus groups (105 minutes) 1 interview (31 minutes)
	Developers (private company consortium)	1 focus group (101 minutes) 1 interview (71 minutes) 2 informal interviews (unrecorded)
Archival documents	Applications and public tender	10 public tender documents (204 pages) 6 strategy documents (27 pages)
	Project plans and reports	5 project plan documents (28 pages) 1 product evaluation report (17 pages)
	Project newsletters	4 newsletters (8 pages)
	Presentations and information materials	4 websites (7 pages) 8 slide decks (203 pages) 1 flowchart (1 page)
	Press	18 news articles (24 pages)
Seminars	Launch seminar (November 2017)	2 slide decks (43 pages)
	Midterm seminar (February 2019)	5 presentations (90 minutes)

Total	*57 documents (519 pages)* *7 presentations (43 pages and 90-minute recordings)* *9 interviews (480 minutes)* *3 focus group interviews (206 minutes)*

Table 1. Data collection

4.3 Data analysis

The robot project is full of partial victories, setbacks, contradictory values, and competing concerns on technology and organizing. Though this rich narrative is compelling in itself, the aim is not merely to tell an account of the emergence of a robot in primary healthcare but also to make theoretical contributions for managing competing concerns when organizing emerging technologies.

The analytical approach is iterative and abductive to unravel the innovation process as it occurs, while developing a conceptual understanding of the relationship between emerging technologies and organizing. This approach implies synthesizing and connecting empirical observations to existing theoretical understandings back and forth to generate new conceptual insights and plausible explanations (Langley et al., 2013). In the early iterations of the study, the analytical focus was exploratory and straightforward, aiming to map out the significant events, objectives, challenges, and central actors and their concerns about the project. To manage the complexity of the case, the analysis followed a temporal bracketing strategy (Langley, 1999), resulting in a timeline consisting of five phases of the robot project, as portrayed in Figure 2. As the study progressed, it was possible to begin identifying the recurring themes and theoretical mechanisms in each temporal bracket. In particular, two underlying patterns began to emerge in the later iterations of the analysis: 1) path-creating mechanisms of how agency and changing contexts from previous periods affected subsequent events in current periods and 2) how five types of competing concerns shaped critical moments in the innovation process.

5 Analysis: Emergence of a drug-dispensing robot

For each of the five phases, this section presents 1) an account of significant activities and challenges surrounding the emergence of the drug-dispensing robot, 2) competing concerns on how to approach the challenges, 3) the project managers' path-creating decisions, and 4) the impact on the project's trajectory.

5.1 Phase 1: Initiating cross-municipal partnership (2013 to early 2017)

Phase 1 began in 2013 and centered on the strategies to identify mutual demand and organize the coordination between the suppliers and the municipalities in need of WTs. The phase ended in 2017 with the establishment of a cross-municipal partnership and the decision to engage in the innovation of a drug-dispensing robot for aiding citizens with their medication in their own homes, prompting the next phase.

5.1.1 Key activities: Identifying problems and solutions

Based on previous experiences with the unsuccessful implementation of existing WTs and the limited success with small-scale bottom-up projects, nine Danish municipalities sought new practices for organizing WT innovation projects. A partnership was expected to reduce the individual municipalities' costs of engaging in WT innovation while increasing the demand for specific WT solutions and thereby promote viable business models for solutions that could be implemented on a large scale. The new partnership was anchored on top-level management in the elderly, health, and disability administrations (or their equivalent) of the participating municipalities.

The partnership's first objective was to decide on a mutual need suitable for WT. The nine municipalities annually spent a total of 158 million DKK (≈ €21 million) on assisting almost 6,200 citizens in managing and dispensing their medication at home. Over half of the cost was for the transportation of service professionals (nurses or social and healthcare assistants) driving to and from the citizens' homes. Additionally, the manual and repetitive tasks of unpacking and administering the dosage of medicines risked human errors with potentially fatal consequences. Finally, the problem of medication aid was a strategic focus of the Danish Agency for Digitization, which provided additional funding for testing and evaluating WTs for medication aid. By settling on medication aid as a mutual need, the next challenge was how to identify and/or develop a suitable solution.

5.1.2 Concerns: Imitator vs. inventor strategy

The municipalities discussed two competing strategies for selecting a solution. The first option was to incrementally improve the existing organizational setup and practices for medication aid, using available technologies in the marketplace (imitator strategy). This approach was applied in another project, which also received funding from the Danish Agency for Digitization to evaluate existing products, such as SMS reminders and pillboxes, on a larger scale. The second strategy was to innovate and radically transform the service and the process of delivery by developing new solutions to meet municipal demands (inventor strategy). After the initial market research with potential suppliers, the nine municipalities agreed on the second option.

> *We have examined the market but found that none of the existing solutions could fully meet the needs we demanded. Therefore […], we require an innovative solution that does not exist in the Danish market. We aim to engage in a contract with a supplier for the development, testing, and implementation of a whole solution for medication management.*
> (Municipal project manager in a press release, 2017)

However, by seeking to innovate an unspecified solution, determining the expected benefits became more ambiguous compared to those of an imitator strategy, as retrospectively noted by the developers, represented in the following quote concerning the proposed business case evaluation:

> *To us, it sounds strange to say that "you do not want the existing solutions in the market; you want a solution that is not fully developed, and you want to be a co-developer of the project." Still, at the same time, you decide in advance that the main benefit should be transportation. If this is the case, they should not choose our solution. Then, they should choose a "pillbox with a timer on top."*
> (Interview with a product manager from the developer consortium)

5.1.3 Path-creating decision

The organizing approach was the so-called function-based public tender to facilitate a systematic dialogue between the developers and the municipalities by specifying the needs and setting up a number of functional requirements for an otherwise unspecified solution. This resulted in a 100+-page document describing the needs, current work processes, and functional requirements for a technological solution in detail. However, the municipalities withdrew the initial tender as none of the proposed solutions was considered sufficient. Following the then ongoing market dialogue with different private companies, the tender was successfully relaunched, resulting in a contract and a formal project organization consisting of the nine municipalities and a developer consortium in September 2017. The winning bidders offered a solution centered on a drug-dispensing robot to handle the entire value chain, from the doctor's prescription to the patient's consumption. The consortium was a new entity comprising four companies from diverse industries that had not collaborated before. For the participating municipalities, the project formalization involved a sophisticated hierarchical coordination structure with a cross-municipal steering committee, project managers in participating municipalities, a selection of operating areas for testing (in each municipality, each with 1–2 coordinators), and finally, care workers as points of contact for the participating citizens.

5.1.4 Impact on project's trajectory

While this approach clarified many aspects by describing the municipal demand, this inventor strategy also created numerous uncertainties for the process. First, it created a vast inter-organizational partnership where not only nine municipalities needed to collaborate, but also four companies seeking to transform the entire process of medication aid. Second, as the solution was new for both the participating municipalities and the market, the source of initial knowledge regarding the technology and expected benefits came from the developers and must then be further created and evaluated as part of the project. Third, the focus on functional requirements created unspecified success criteria regarding non-functional requirements, such as system performance and reliability, resulting in the neglected assessment of technological maturity. Finally, though an inventor approach was applied, the project management team remained somewhat reluctant to commit resources for testing. This led to competing concerns on whether to test on the least or the most care-demanding citizens (Phase 2) and whether the project entailed product testing or product development (Phase 3).

5.2 Phase 2: Planning and baseline measurement (late 2017)

Phase 2 began in late 2017 and revolved around how to facilitate product development and testing with limited resources. The phase ended with a set of criteria to determine potential test users, paving the way for the project launch in the next phase.

5.2.1 Key activities: Preparing for project launch

After the contract was signed, the first four months consisted of conducting a baseline evaluation and project planning. The assumption was that the robot was technologically mature and reliable in dispensing the right medicine and therefore ready for testing. Thus, the project plan focused on testing, evaluating, and determining the business case rather than product development. The project plan followed a stage-gate logic, emphasizing product testing and evaluation in two major stages. Stage 1 (Test and development) was scheduled from September 1, 2017 to January 31, 2019, with an external consultant responsible for the evaluations, including the initial baseline analysis and the business case assessment. Based on these results, the nine municipalities would then assess if they wished to proceed with the project and engage in Stage 2 (Procurement and implementation).

5.2.2 Concerns: Test on least vs. most care-demanding citizens

Accordingly, the test design and execution and evaluation in Stage 1 would constitute a potentially decisive factor for the project's trajectory. This plan created a challenge on how to organize the test in a way that would enable new innovative exploration and simultaneously provide data comparable to the baseline. Despite the consensus that the testing should unfold in small steps in terms of enrolling citizens, the issue on whom to enroll was heavily discussed. The developer consortium's suggestion was to begin testing on the least care-demanding potential users as they were considered "low-hanging fruits" with the least complicated medication consumption and the most cognitive abilities to give useful feedback.

> *Usually, when introducing new technology, you start with the "easy citizens" to ensure that you get good and constructive feedback, then expand to the "semi-difficult citizens" and finally the "hardest" or most vulnerable citizens. You do this also because you want to build up knowledge in your own organization.*
> (Interview with a product manager from the developer consortium)

However, this approach would result in expensive test runs for the municipalities because they would be required to arrange several daily home care visits to supervise the robot during each drug-dispensing event for citizens who otherwise would only need weekly or biweekly assistance with administering their medication.

> *The problem is that we do not want a situation where we need more visits to a citizen for testing the robot. [...] There are some financial aspects here [...]. Of course, the consortium*

wants more test users faster, and it would be easy if you could allocate extra visits. But it is not desirable for us to grant additional visits.
(Interview with a municipal team coordinator for enrolling test users)

Therefore, the municipalities wanted to perform the test on the most care-demanding citizens as they already received home care visits for each drug consumption under the service setup at that time, making testing on these citizens more practical. This option was also perceived as more attractive in terms of the expected business case since the initial baseline measurement noted that potentially, the best business case would concern the least healthy citizens as they received the most visits. In contrast, the developers argued that the solution and its benefits were still embedded in uncertainty. Instead of thinking in the context of business cases from day 1, they argued for a more open approach by exploring which changes the technology would bring to the work processes and the organization for a wide range of user groups.

5.2.3 Path-creating decision

The project managers decided to establish a list of criteria to determine which citizens would be eligible to participate in the testing. Initially, the developers' concerns were suppressed in favor of those of the municipalities as the criteria only included citizens living at home, who were in need of assistance with their medication multiple times a day (the most care-demanding citizens). These criteria were heavily and continuously disputed because the developers feared that too many potential users might be excluded and that important learning opportunities for product development and evaluation might be missed.

We strongly disagreed with the municipalities' exclusion criteria for potential test users [...]. In order to prepare your organization for WT, you have to say that "we include and test on all citizens whom we believe are likely to benefit from the technology."
(Interview with a product manager from the developer consortium)

Consequently, this decision did not resolve the contradiction between these two competing concerns. The dispute persisted until the difficulties in enrolling a sufficient number of test users in later stages (Phase 5) made it necessary to expand the test criteria, resulting in a new synthesis. Meanwhile, the municipalities' initial reluctance to commit additional resources for testing was reminiscent of the competing concerns regarding the inventor strategy. In this phase, the municipalities' bold ambition of developing a new-to-market solution was followed by a more timid and conservative choice concerning resource commitment and an immediate focus on business case evaluation.

5.2.4 Impact on project's trajectory

The initial stage-gate project planning and emphasis on business case measurements (in combination with the aim to reduce costs in WT innovation) raised competing concerns on whether to test on the least or the most care-demanding citizens. This issue proved particularly important for mobilizing sufficient test users in Phase 5.

The worst thing is that the project has been hampered by the fact that the inclusion of citizens has been too limited because the municipalities thought that they should only test on the most vulnerable citizens.
(Interview with a product manager from the developer consortium)

5.3 Phase 3: Launch and initial test (2018)

Phase 3 began in January 2018 with the project launch and the initial small-scale testing in some citizens' homes. Due to many technical and organizational problems, the test was prematurely stopped, prompting the next phase.

5.3.1 Key activities: Testing in a real environment

Expecting a technologically mature product, the project managers were eager to begin testing the solution's feasibility in real-world settings to assess the need for organizational adjustments, measure the performance, and evaluate the business case. The challenge was then to determine how to ensure the practical feasibility of the solution while measuring the expected benefits.

5.3.2 Concerns: Technological vs. organizational aspects of the innovation process

A recurring notion expressed by the project managers in the municipalities was that this project concerned organizational matters even more than technological ones, as exemplified in the following quote:

> *I have a rule of thumb regarding welfare technology. I say that 10–20% concerns technology, and 80–90% concerns organizational development. By that, I mean that I'm confident we will make the technology work. But it is not a simple task to change and implement new cultures and routines. So, it is not just about the machine. It's about turning things upside down in terms of how to solve the tasks. We are going to think about medication aid in new ways. We are going to change our daily practices.*
> (Interview with a municipal project manager)

Thus, as the municipalities perceived the robot as technologically mature, they focused on clarifying the need to change daily practices for medication aid. However, stressing that the municipalities sought an inventor strategy, the developer consortium emphasized the importance of further technological development to minimize the need for changes at the work-practice level.

> *The more we can avoid training people in new systems, the better. I don't think we need to train nurses in new systems to do something new. They have plenty of systems to keep track of. Therefore, existing systems must be integrated into the robot [...]. We should aim to develop a technological solution without the staff having to learn a new system. I think that is important.*
> (Interview with a product manager from the developer consortium)

5.3.3 Path-creating decision

The real-world testing of the robot with care recipients commenced during the project launch in January 2018. Unfortunately, due to technical difficulties, quite a few participants soon quit the project. Despite the then ongoing problem solving and adjustments in the robot and its software to make it dispense the medicines accurately, difficulties persisted. After only 1.5 months, the project management team agreed to prematurely suspend the tests to avoid unnecessary worries and disturbance of the citizens since the technology was regarded as too immature at that time.

> *In retrospect, we have probably been too naive. We did not anticipate this lack of product maturity and the need for development. When we made the tender, the consortium presented a technology that was ready for testing in real-world settings. [...] That is why I called it a product-testing project. But if I have to redefine the project now, I will call it a development project. I know that the contract states that we must develop and test a solution, but everything that has happened so far should have taken place in the production facility of the consortium. But that's something we've discovered along the way. I don't know how we could have tackled it in any other ways.*
> (Interview with a municipal project manager)

Accordingly, the project plan needed adjustments to include the creation of a simulated test environment that synthesized the two concerns by focusing on both technological and organizational development (Phase 4).

5.3.4 Impact on project's trajectory

Apart from delaying the project for six months, the decision to suspend the testing had implications for the project by hampering user and staff mobilization in future tests due to poor first impressions.

> *It is not unproblematic if you expect a solution to be ready for testing in a real environment, and it turns out it is not. After all, we cannot have a robot company and a software company to run around the machine in the citizens' homes. It is also a massive burden for our employees when things do not work. First, they lose faith in the project and the solution. And secondly, it creates a lot of unnecessary hassle. So, it is really "code red" at the moment.*
> (Interview with a municipal project manager)

5.4 Phase 4: Project relaunch (2018)

As the initial testing was prematurely suspended, Phase 4 consisted of six months of optimization and process reconfiguration in a simulated environment.

5.4.1 Key activities: Refinement and coordination

In subsequent months, the robot's software and hardware were continuously improved in simulated environments situated in municipal offices, involving care professionals and connected to the municipalities' digital infrastructures. Likewise, the workflows and the procedures regarding ordering, packaging, and delivering medicines were optimized. Furthermore, there was a significant focus on optimizing the integration between the robot and the municipalities' electronic care systems. Thus, a key challenge in this phase involved how to coordinate agency within and across participating organizations and with external stakeholders.

5.4.2 Concerns: Centralized vs. distributed agency across multiple organizational levels

For the municipalities, the notion that this project heavily required organizational transformation emphasized the importance of distributed agency across multiple organizational levels to encompass contextual differences, ensure local commitment, and transfer important knowledge across developers, care workers, and municipalities.

> *I know what can be done in practice [...]. We had a period [when] we found a lot of mistakes. I think it was really good that I, as a nurse, participated in the simulated tests. I contributed with realistic scenarios where we enacted changes in medication, changing the dose, or simulated temporary pauses in consumption, etc. [...]. I don't think the consortium was fully aware of these issues.*
> (Interview with a participating nurse)

As there could be significant differences across the municipalities, the workflows and the contextual factors varied in all nine municipalities. The reported differences included which tasks were delegated from nurses to assistants or the economic potentials in saved transportation time due to the municipalities' geographic differences. Therefore, coordination was needed to transfer knowledge, not only vertically from the work-practice level to project management, but also horizontally across the different use contexts. However, the consortium was concerned that this distribution of agency did not fit very well with scaling the innovation.

> *I don't think many municipalities are experienced in scaling WT [...]. We have approximately 10–12 people assigned to this project in the consortium. However, the municipalities must involve 40 people. And we only have 15 machines running at the moment. And already they consider the need to include more people. Soon, we will have 100 machines running in real environments. This might affect 500 people if it continues like this because they have to involve so many teams and different professional groups that need to be informed: care workers, assistants, nurses, project managers. There are so many people who need to be involved in this. I think this comes as a surprise for the municipalities, too.*
> (Interview with a product manager from the developer consortium)

5.4.3 Path-creating decision

To optimize the solution and prepare the robot for testing in real environments, the developers and the municipalities achieved major developments and adjustments through continued coordination. This process involved balancing centralized coordination by clearly defining and organizing the roles of each project partner and aligning the work processes and information systems, while enabling more informal ad-hoc coordination.

> *We have a coordinator for the individual citizens, who is a contact person within the municipality. So, if the care workers experience something, they report it to the municipality's contact person, who reports back to the cross-municipal project manager, who reports back to the corporate consortium. That is how it is on paper. However, here, in the beginning, the companies also have direct contact with the employees to make it run more smoothly.*
> (Interview with a municipal project manager)

Thus, within each test municipality, coordination was organized in small project teams with team managers and frontline employees. The frontline employees were assigned the roles of both innovation champions (testing and demonstrating the innovation at the work-practice level) and gatekeepers (finding suitable citizens to participate in the test, as well as gathering and channeling information to the project management). As stated by an employee, *"we are the projects' eyes and ears."* Much of this ad-hoc coordination occurred through video conferences and phone conversations due to the geographic distances between the project partners (not only due to the different municipalities involved but also because the robot manufacturing company was located in a foreign country, while the software company was based in another part of Denmark). However, this virtual setup concentrated important knowledge on a few persons, making the project vulnerable to staff turnover, which unfortunately occurred for several key positions (including the project manager and coordinators) in the municipalities during the testing.

5.4.4 Impact on project's trajectory

While the project management succeeded in organizing agency in and across the participating municipalities and the developers, it initially failed to address the need for additional agency by an external stakeholder group—the family doctors. The project had been designed based on the assumption of minimal involvement of the family doctors.

> *We hope that the solution will not involve the doctors because it can cause some problems for the project. We aim to organize the project in a way that it is only within our domain.*
> (Interview with a municipal manager)

Initially, the doctors were expected to prescribe medication using the shared medical record system from which each municipality's electronic care journal system could retrieve the necessary information concerning each citizen's medication. However, it turned out that this practice varied locally, for instance, if the doctor prescribed medicine from a specific pharmacy. Thus, in some cases, the adoption of the robot would imply a minor one-time adjustment from the family doctor. To prevent doctors from being showstoppers, the municipalities eventually needed to negotiate a temporary deal with the family doctors' association to pay a small fee to the doctors per citizen added to the test run.

5.5 Phase 5: Mobilization and evaluation (2019)

The final phase (Phase 5) consisted of mobilizing potential users to ensure substantial data for evaluation. This phase ended in September 2019, with a final evaluation report and the decision to continue the project.

5.5.1 Key activities: Mobilizing users and product evaluation

Based on the simulated test, the steering committee considered the solution ready for the testing phase in real environments. However, the greatest challenge in this phase proved to be enroll enough citizens who would fit the criteria for testing within the time frame.

5.5.2 Concerns: Technology-intrinsic vs. social aspects for user acceptance

The challenge in mobilizing test users was rooted in both technology-intrinsic and contextual factors for user acceptance and adoption. For instance, some frontline health professionals reported that potential users declined the robot because they considered it unsafe or its design unappealing (technology-intrinsic barrier), while other potential users refused it for fear of losing social contact if the daily medication visits would be replaced with the robot (social barrier).

The test coordinators experienced that even the slightest errors could make the users lose confidence in the technology. This loss of confidence meant that although the latest version of the robot at that time operated reliably and with high accuracy, experiencing just one or a few minor errors of the robot could completely undermine local support and lead to user abandonment and non-adoption.

> *In a project like this, there is very much focus on the 0.04% error margin instead of celebrating that we have achieved a success rate of 99.96%. I think this is related to the fact that, unlike the existing manual solution, our system is completely transparent […] right down to the individual pill in each dose for each individual citizen. […] The 99.96% exceeds the level we agreed upon by far […]. But because we give users and customers access to this data, they begin to focus on the few microscopic errors instead of the obvious success we have achieved.*
> (Interview with a project manager from the developer consortium)

However, while several test users reportedly abandoned the project during the initial testing due to technical issues, social barriers to accepting the robot became more dominant reasons for the difficulties in enrolling test users in this phase.

> *I think there is a general skepticism about technology among many of our citizens [...]; during testing, we only enroll citizens who already receive assistance with medication management. And that makes it more troublesome to accept the technology because they may feel they are losing something, and they know that if they decline, the staff will return to business as usual.*
> (Interview with a municipal project manager)

5.5.3 Path-creating decision

Despite the significant improvements in the robot's functionalities, design, and reliability during the previous phases, it remained a challenge to mobilize test users. The organizing response was to shift the strategy from addressing technology-intrinsic barriers (such as demonstrating the robot's accuracy) to addressing social and contextual barriers. Most notably, this revised approach included a new synthesis of the competing concerns regarding the inclusion criteria for potential users. More healthy citizens also became eligible for testing the robot (thereby, the municipalities accepted the need to allocate additional visits for testing). The municipalities also considered whether to shift the onboarding strategy and target recent applicants for the municipal medication services so that the project would overcome social barriers, such as the reluctance to change among the citizens using the existing manual service.

> *Going forward, I think it will be easier for rolling out the robot on a large scale if we decide to offer the robot to new citizens in need of medication assistance.*
> (Interview with a municipal project manager)

Finally, in its last organizing response, the project management prolonged the test and evaluation stage, as well as enabled involving a smaller number of citizens in municipal care centers and health clinics to ensure "a sufficient volume" of test users during Stage 1.

5.5.4 Impact on project's trajectory

Despite several interventions, the original goal involving 100 test users was far from reached as only 35 users were active by the end of Stage 1, which naturally affected the basis for evaluation. Consequently, the project management considered the external evaluation insufficient and postponed the decision on the procurement and implementation of the drug-dispensing robot (Stage 2) until March 2020. However, experiencing that the robot was at that time operating reliably, the three test municipalities agreed to continue testing the robot and enrolling additional users. Meantime, one of the municipalities invited an additional external evaluator to conduct a supplementary assessment of the business case.

5.6 Summary of findings

Table 2 summarizes the key activities, competing concerns, organizing responses, and impacts on the project's trajectory.

Phase	Key activity	Competing concerns	Path-creating decision	Impact on project's trajectory
1. Initiating cross-municipal partnership (2013–2017)	Identifying mutual needs and potential solutions through coordination between suppliers and municipalities	Imitator (applying existing products) versus inventor strategy (actively developing new solutions to fit municipal needs)	Applying an inventor strategy, the municipalities created a function-based public tender for an unspecified solution.	An inter-organizational innovation setup with nine municipalities and four companies
2. Planning and baseline measurement (late 2017)	Planning product development and testing with limited resources	Test on least versus most care-demanding citizens	The project management created a list of criteria for test users, focusing on the most care-demanding ones.	Polarized perspective on whom to include and difficulties in enrolling sufficient test users
3. Launch and initial testing (early 2018)	Initial small-scale testing in citizens' homes to ensure practical feasibility	Technological development versus organizational transformation	Technical difficulties led to the premature suspension of the initial testing and the creation of a simulated test environment.	Project delay and future difficulties in mobilizing potential users and staff due to poor first impressions
4. Project relaunch (late 2018)	Coordinating agency within and across participating organizations to improve the solution	Centralized versus distributed agency	A mix of hierarchical structures and informal ad-hoc coordination within the project organization	Successful internal coordination for product development but neglected external agency from doctors
5. Mobilization and evaluation (2019)	Mobilizing care professionals and end users for large-scale testing in real environments	Technology-intrinsic versus social aspects to user acceptance	Shift in focus from technology-intrinsic to social/contextual aspects by expanding the potential user group	Failed mobilization of users within the formal test period Initiated supplementary evaluation and continuance of collaboration

Table 2. Summary of case analysis

6 Concluding remarks

This longitudinal case study of the launch of a drug-dispensing robot for independent living has addressed *how managers can understand and respond to competing concerns in the process of organizing emergent WTs.*

With its valuable empirical observations, this case study contributes to the understanding of the cumbersome process of organizing emerging WTs. In addition to WTs being interdisciplinary, interconnected, and ubiquitous (Lo et al., 2019), this research provides insights on how WT innovation unfolds in collaboration among diverse stakeholders that ascribe different expectations, assumptions, and concerns to the innovation activities. Previous research illustrates how different stakeholders have conflicting organizing visions for WTs that should be mitigated through dialogues among multiple stakeholders, such as care recipients, formal and informal caregivers, service organizations, policymakers, and technology developers (Askedal & Flak, 2017; Cho et al., 2007; Greenhalgh et al., 2012). By tracing how competing concerns shape the trajectory of the innovation process, the analysis demonstrates how these concerns relate to one another and arise due to differences in expectations and assumptions, as well as how the organizing responses operate as *path-creating mechanisms*. Thus, the longitudinal perspective applied in this study shows that, given the dynamic and unpredictable nature of WT innovation, responding to competing concerns requires a flexible *path-in-the-making* approach with an ongoing series of interrelated decisions and priorities shaping the trajectory. Consequently, as this *shaping mechanism* creates a degree of irreversibility where previous decisions have consequences for future maneuverability in the innovation process, it becomes critical for project managers to identify these path-creating decisions as they occur. When identified, highlighting competing concerns during these critical decisions enables project managers to recognize different aspects surrounding the challenges in WT innovation and identify possible organizing actions and responses (Aaen, 2019).

Among the practical implications, the findings indicate that a narrow focus on the target user group and the business case evaluation early on can impede the exploration that is necessary for innovating emerging WTs. Furthermore, the differences in concerns are not only matters of interdisciplinary and asymmetric knowledge between care professionals and technology developers. For instance, regarding onboarding new users, the study demonstrates how technological and social aspects affect user acceptance, with early technical difficulties hampering the possibility to enroll future test users despite substantial product improvements and safety measures. While developers and project managers mainly focus on the robot's future potentials, citizens and care professionals are far less forgiving of errors in early product testing. Accordingly, to avoid technology-skeptical users' loss of confidence in the project, managers seeking to apply an inventor strategy for WT innovation should carefully assess technological maturity in a simulated environment *before* initiating real-world testing. Finally, to create lifelike scenarios capable of revealing potential issues, this simulated environment should not be limited to the facility of the technology developers but be situated locally in the municipalities, involving care professionals and connected to each municipality's digital infrastructure.

6.1 Limitations and further research

As an explorative case study of a still emerging technology, this research has several limitations. Notably, as the project just finished its initial testing, development, and evaluation (Stage 1), it is not yet known whether or how this solution would succeed in being implemented on a large scale or how the activities, competing concerns, and path-creating decisions during the project launch would affect the future steps of procurement and implementation. Consequently, more studies are needed in order to theorize on the challenges and the complexities involved in organizing emerging technologies in municipal healthcare. However, as the large-scale implementation of WTs is notoriously difficult, the cases of successful WT organizing are rare.

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