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Competing Concerns in Welfare Technology Innovation: A Systematic Literature Review

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COMPETING CONCERNS IN WELFARE TECHNOLOGY INNOVATION: A SYSTEMATIC LITERATURE REVIEW

Research paper

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Abstract

Welfare technologies (WT) such as telecare and service robots are expected to improve and even radically transform service delivery in health- and eldercare. Yet despite political awareness and financial investments, many studies report promising inventions that fail to become implemented on a larger scale. Current research draws a fragmented and heterogeneous picture of this problem, with divergent implications for practice. In this article, I review and discuss the extant literature and identify eight competing concerns that are central to how WT can become implemented on a large scale. By highlighting and contrasting practical and theoretical positions in this emerging and interdisciplinary research topic, I contribute conceptually to the understanding of the competing concerns in WT innovation that managers and policy-makers must balance in order to support the critical transition from small-scale invention to large-scale implementation.

Keywords: Innovation, Upscaling, Diffusion, Adoption, Welfare technology, Assistive technology, Literature review.

1 Introduction

Digital welfare technologies (WT) such as telecare, service robots, virtual home care, and tracking technologies have the potential to improve and transform service delivery in health- and eldercare by supporting citizens in their daily lives, reducing costs, and offering a better work environment for health professionals (Hofmann 2013). The promises of these technologies are manifested in political strategies for digitally transforming welfare services – and in growing markets influenced by both demand pull (aging population and lack of care workers) and technology push mechanisms (developing new innovations) (Aaen, Nielsen, & Elmholdt, 2018; MacLachlan et al., 2018; European Commission, 2018).

However, it is difficult to realize the expected benefits of welfare technologies – even when inventions demonstrate viability in initial testing, it is far from given that they will become implemented on a larger scale (Shaw et al., 2017; Christensen & Nielsen, 2017). Indeed, scaling up promising inventions and diffusing them to reach a larger population is a challenging operation that often fails (Bartel & Garud, 2009; Dougherty & Hardy, 1996; Garud, Gehman, & Kumaraswamy, 2011; Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). This problem represents a significant challenge for the digital transformation of welfare service delivery. Failing to upscale and create value through welfare technologies might result in missed market and growth potentials for technology developers (the private sector), missed efficiency gains for service providers (the public sector), missed opportunities for improving flexible working conditions for frontline employees (care professionals), and missed opportunities for improving the quality of life for the recipients of care (citizens) (Aaen, Nielsen, & Elmholdt, 2018).

Greenhalgh et al. (2004) conducted an extensive literature review on the diffusion of innovation in healthcare and found that it was not single factors that determined successful implementation of a technology, but rather the dynamic interaction between them. Expanding this work, Greenhalgh et al. (2017) proposed a new framework for evaluating "non-adoption" and the upscaling challenges of healthcare

technologies, arguing that the more complicated an innovation was, the less likely it was to be successfully implemented on a large scale. Other researchers proposed that the limited scaling of WT was caused by a lack of awareness among users (Cook et al., 2018), a lack of technical expertise among caregivers (Wisniewski et al., 2019), disconnected policy initiatives (MacLachlan & Scherer, 2018), or unresolved ethical considerations leading to low user acceptance levels (Ienca et al., 2018). Yet because most empirical researchers investigating welfare technologies have focused on developing, assessing, and testing new technologies, it is time to take stock of the major challenges involved in implementing and scaling WT innovation (Wade et al., 2016; Segato & Masella, 2017).

The existing literature creates quite a fragmented and heterogeneous picture of WT innovation, making it a difficult-to-grasp topic with divergent views and inconsistent recommendations for practice. To remedy these shortcomings and help develop the research agenda for WT innovation, I review the current literature by tackling the following research question:

> *What are the competing concerns in managing the critical transition from small-scale welfare technology inventions to large-scale implementation?*

The paper contributes by identifying eight competing concerns in the current literature that are central to the innovation and large-scale implementation of WT in health- and eldercare. While it is valuable to synthesize what we already know, it is equally important to stimulate new conversations. By highlighting and contrasting the research positions in this emerging and interdisciplinary topic, I pinpoint new research directions and promote conceptual clarity on the different factors influencing WT innovation. Ultimately, I help to determine effective strategies and interventions on the user, organizational, market, and policy levels.

Throughout the paper, I use "welfare technologies (WT)" as an umbrella term for a wide range of citizen-facing innovations in health- and eldercare. Overall, these innovations aim for improved service delivery, and they are often developed and implemented in collaborations that involve citizens (end-users), care workers, service organizations, and technology companies (Aaen, Nielsen, & Elmholdt, 2018). Examples of WT include telecare services for independent living (Cook et al., 2018), GPS tracking devices for people with cognitive impairments (Procter et al., 2018), smartphone applications for planning daily activities and to monitor symptoms (Kettlewell et al., 2018), and sensor systems for digital night surveillance in nursing homes (Nilsen et al., 2016). Outside of Scandinavia, these types of technologies are often referred to as "assisted and active living technologies" (Florez-Revuelta & Chaaraoui, 2016), "ambient assisted living" (Maan & Gunawardana, 2018), or simply "assisted technologies" (Smith et al., 2018).

There is no universally accepted terminology for or definition of describing the transition from small-scale invention to large-scale implementation. To ensure different perspectives on this critical part of WT innovation, the search string I used in this study contained several partially overlapping terms such as "diffusion" (e.g., Oderanti & Li, 2016), "upscaling" or "scale-up" (e.g., MacLachlan et al., 2018; Proctor et al., 2018), "adoption" (e.g., Kamesawa et al., 2018), and "technology transfer" (e.g., Smith et al., 2018).

In Section 2, I describe the methods I used to search, select, analyze, and synthesize the extant literature.

2 Methods

Literature reviews are critical for uncovering research gaps in emerging interdisciplinary topics and advancing research and theory (Webster & Watson, 2002). For this review, I focus on synthesizing a fragmented stream of literature while at the same time analytically contrasting prevailing positions into abstracted competing concerns. This review method consists of systematic search, screening and selection processes, and in-depth analysis, as Tranfield et al. (2003) suggested.

2.1 Article selection strategy

I aimed to collect a wide range of papers with relevance to welfare technologies (=welfare tech*), assistive technologies (=assist* tech*), or assisted living technologies (=assist* living* tech*). I established the search keywords through an iterative and comprehensive process that led to a broad selection of different terminologies. The final search string included "upscaling/scale-up", "adoption", "diffusion", "spread", "roll-out", "technology transfer", "implementation process", "acceptance", and "uptake." I searched the Scopus database for research articles and books that were published up to and including August 2018, with the earliest selected article dating back to 1997. Assuming that past quality conference papers would have reached a journal outlet, I only included conference papers that were presented within the last six years (2013–2019). Similarly, if a journal version of the same research project existed, I excluded the earlier conference paper version.

The search resulted in a total of 972 potential candidates, 97 of which I selected for inclusion in the final dataset. I included articles if they focused specifically on welfare technologies and had diffusion, scale-up, adoption, or similar processes as their focal concepts. I excluded articles studying the use of other types of healthcare technologies (e.g., Electronic Patient Record-systems or surgery robots) or the development of WT from a purely technical perspective.

Figure 1 visualizes the article search and selection process.

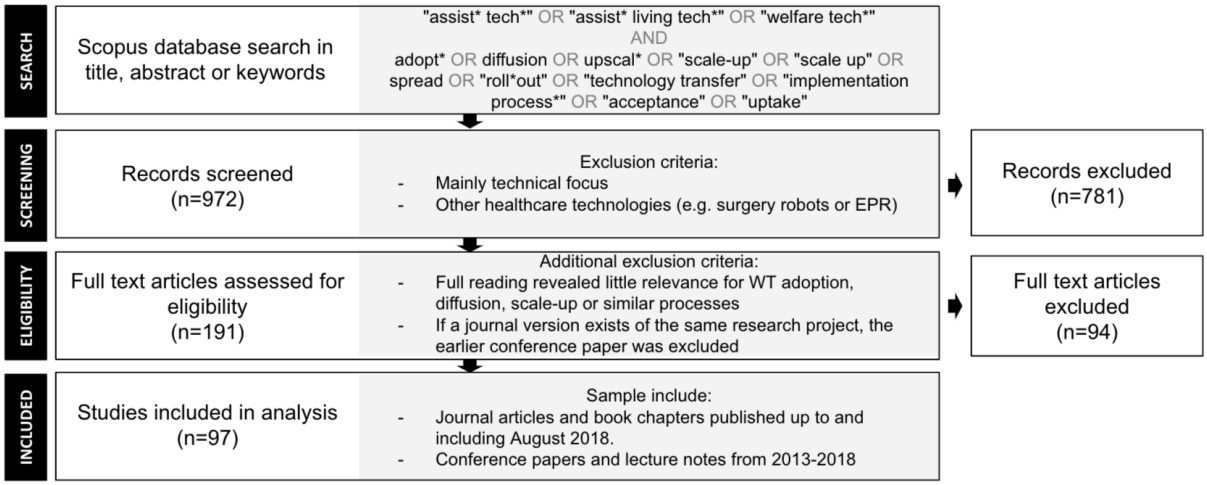

Figure 1. Article search and selection process.

2.2 Analysis and synthesis

Following Tranfield et al.'s (2003) recommendation, I synthesized the literature in two steps: a brief descriptive analysis quantifying the type of research, publication outlet, type of WT, empirical setting, and frequency of the keywords followed by a thorough qualitative thematic analysis.

For the thematic analysis, I summarized the existing knowledge and differences in the literature. The process was open and iterative, with initial coding resulting in numerous observations. As the review progressed, patterns and themes of different theoretical and practical implications for WT innovation began to emerge. Finally, I analytically abstracted these themes into eight aggregated and competing concerns structured in four analytical levels. On the *user level*, I found competing concerns on whether low user acceptance was rooted in intrinsic or contextual factors of WT and whether the primary decision-maker for user acceptance was the care recipient or the caregiver. On the *organizational level*, I found competing concerns on whether WT implementation should be artifact-driven or system-driven and whether implementation should be centrally managed or unfold in decentralized processes. On the *market level*, I found competing concerns on whether WT should be tailored for specific niche markets or target mainstream consumer markets; I also found competing concerns on whether low market uptake was a consequence of lacking viable business models or of neglected marketing. Finally, on the *policy*

level, I found competing concerns on the extent of governmental interventions and whether policy strategies should focus on technology push vs. demand pull mechanisms.

Figure 2 contains an example of the thematic analysis process from the results in selected articles to themes in implications for managing WT innovation and ending in the aggregated level of competing concerns.

Results in selected articles (illustrated quotations)	Implications for WT innovation	Competing concerns
"The esthetics of a device and user experience may – in daily life – be equally or even more important for users" (Njiboer, 2015 p. 37).	Intrinsic attributes of the technology as drivers for user acceptance.	User level Intrinsic vs. contextual drivers for user acceptance
"The analysis shows that technology generations differ in their opinions about aging as well as their assessment of assistive ICT. Attitude towards aging, gender, education, health status, and other attitudes form a multifaceted picture of influences on the acceptance" (Schomaker et al. 2018, p. 149).	Attributes of users and social context as drivers for user acceptance.	
"It is essential that especially older workers receive adequate training for a new technology before its introduction" (Rantanen & Toikko 2017, p. 141).	WT implementation requires digital literacy and user training.	Organizational level Artifact-driven vs. system-driven implementation
"The study showed a change in workflow, as the cooperation between the citizen and the professional developed. New roles occurred for the professionals" (Sølling et al. 2014, p. 219).	WT implementation requires the creation of new practices and routines.	
"The new generation of technological systems need to be designed in a way that everyone, regardless of physical impairment, can use and interact with them" (Taherian & Davies 2018, p. 655).	WT development should be integrated into mainstream consumer markets to increase uptake.	Market level Mainstream vs. niche market approach
"Central to these issues seems to be the tailoring of technology or technologies to the specific needs of each community-dwelling older adult and the work that is needed by stakeholders to support this type of service delivery on a large scale" (Peek et al. 2016, p. 2).	WT solutions need to be tailored to niche markets to fulfill specific needs.	
". . . a successful strategy for welfare technologies requires a digital infrastructure perspective . . . It is important to realize that digital infrastructures cannot be 'designed' in the same way as systems; rather, they grow more organically" (Bygstad & Lanestedt 2017, p. 300–301).	Governmental institutions should facilitate, not plan and design.	Policy level Laissez-faire vs. active public sector approach
". . . the goal of an EU-wide market of accessible technology can be achieved using EU State aid law . . . a more targeted use of EU State aid law can lead developers to increase the production of accessible goods, to adjust or reduce prices and to provide consumers with a greater degree of choice" (Ferri 2015, p. 137).	Governmental institutions should play an active role in supporting WT market development.	

Figure 2. Example of the coding process from initial analysis to competing concerns.

3 Findings

3.1 Quantitative and descriptive overview of the identified articles

The selected articles display fragmented and emerging bodies of literature, with 61 of the 97 articles being published within the last four years and coming from a total of 59 different sources. As of now, the discussions primarily persist in health informatics journals (including high-ranking outlets such as *Implementation Science*, *Journal of Medical Internet Research*, and *Journal of the American Medical Informatics Association*), with limited entries in information systems management and e-government journals (exceptions include papers in *Transforming Government: People, Process and Policy* and *Hawaii International Conference on System Sciences*). The journals with the greatest number of records include *Disability and Rehabilitation: Assistive Technology* (10), *Technology and Disability* (9), *International Journal of Healthcare Technology and Management* (6), *Journal of Assistive Technologies* (4), and *Studies in Health Technology and Informatics* (4).

As shown in Figure 3, almost half the included papers are qualitative case studies. Generally, the quantitative surveys have rather small sample sizes (n) and are published in conference proceedings or lecture notes (e.g., n = 64 in Heek & Ziefle, 2018; n = 166 in Schomakers et al., 2018). Four mixed-method studies explore different stakeholders' views and barriers to WT uptake through interviews (Pal et al., 2017), focus groups (Heuvel et al., 2012; Ward et al., 2017), or workshops (Glende et al., 2016) in combination with surveys. I also included 19 literature reviews that consolidate partial insights on descriptive overviews of WT design (e.g., Ienca et al., 2018), WT acceptance among certain user groups (e.g., Yusif et al., 2016), or various business models for WT (Oderanti & Li, 2016). Finally, I included 11 research commentaries on different empirical, theoretical, or normative positions for WT uptake and diffusion (e.g., Smith et al., 2018; MacLachlan & Scherer, 2018; MacLachlan et al., 2018).

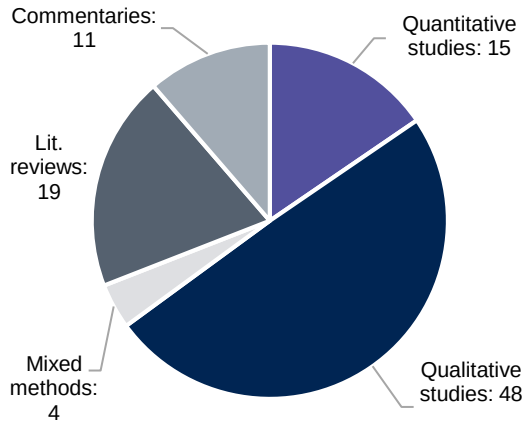

Figure 3. Type of research.

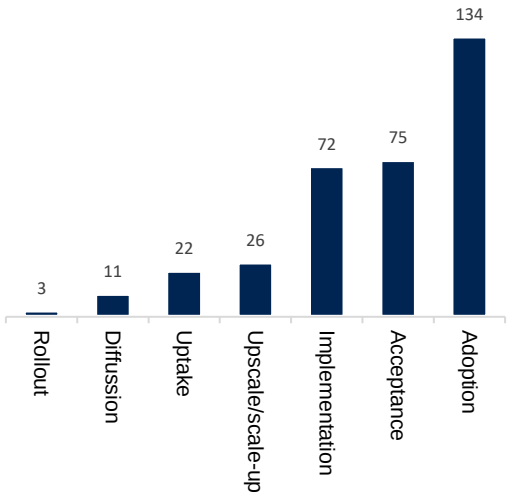

Figure 4. Total keyword frequency in abstracts (including spelling variations).

Despite being a fragmented research field, most of the identified papers begin in a similar way: by pointing to the gap between the high expectations for WT and a seemingly low use and market uptake in practice. In general, the papers acknowledge multiple barriers for scaling up WT, such as lack of awareness among potential users, general concerns toward technology and fear of losing human contact, poor technical usability, lack of digital literacy among users, and the cost of acquisition, implementation, and operation (e.g., Maan & Gunawardana, 2018; Wisniewski et al., 2019; Taherian & Davies, 2018; Cook et al., 2018). However, while I was establishing the search string, I identified a number of different perspectives and terminologies that researchers used to describe and analyze the transition from small-scale WT inventions to large-scale implementation. As shown in Figure 4, the most frequently used terms are "adoption", "acceptance", and "implementation." These differences are somewhat reflected in the studies' scopes and analytical levels, with "acceptance" mainly being applied on the user level, "implementation" and "rollout" on the organizational level, and "uptake" on the market level. Yet despite diversity in terminologies and levels of analysis, the included studies address the same real-world problem of WT innovation, but with very different and often opposing practical and theoretical implications. I structured these insights into eight competing concerns that form central challenges and perspectives for WT innovation.

3.2 User level

From a user-level perspective, the issue of how WT can be implemented on a large scale is first and foremost a matter of users accepting or rejecting the technology. In this regard, I identified two competing concerns.

3.2.1 Intrinsic vs. contextual drivers for user acceptance

The first set of competing concerns centers on whether the primary drivers for user acceptance of WT are found in the intrinsic characteristics of the technology (e.g., technological readiness) or in the context/environment (e.g., societal readiness).

Acceptance studies of WT typically take an invention-centric focus on users' perceptions of the technology artifact, claiming that WTs fail or succeed based on their usability and fit for their users (Pal et al., 2017). For instance, Ward et al. (2017) found that the top three reported enabling factors for consumers to buy a WT were 1) believing that a product would really make a difference, 2) a feeling that costs were affordable and worth it, or 3) a belief that the product would make life safer at home. Thus, what makes WT successful is its user appeal (Nijboer, 2015) both in terms of appearance (Robinson et al., 2014) and in terms of functionality, usability, safety, and cost (Glende et al., 2016). These decisions are often formulated as a tradeoff between perceived functionality or added value and users' concerns regarding technology, such as privacy implications and costs (Yusif et al., 2016). I found similar tradeoff logic between perceived functionality benefits and technological concerns in studies on professional caregivers' attitudes toward using WT in their everyday working lives (Heek et al., 2018).

However, dealing with low user acceptance goes beyond product design to encompass users' cognitive cost–benefit tradeoffs when considering the gains and pains of the use of technology and the available alternatives (Peek et al. 2014). Studies such as Vichitvanichphong et al.'s (2014), Weegh & Kampel's (2015), and Schomakers et al.'s (2018) claimed that the acceptability and successfulness of WT adoption depended on multifaceted contextual factors such as the receptivity of the possible users, socio-cultural aspects, and attitudes toward aging and health conditions. For instance, a small-scale survey (n = 64) by Heek and Ziefle (2018) suggested that attitudes toward care in general were relevant for the acceptance of WT. While investigating the potential use of assistive robot innovations, Wu et al. (2016) found that although older adults with mild cognitive impairments reported difficulties in managing some of their daily activities, they expressed a desire to keep doing things on their own using alternative coping strategies to maintain independence and a certain desired self-image. Similarly, Cook et al. (2016) studied the adoption of a telecare service among referred patients and found that adopters ("users") had accepted that they had a health-related need that could be met with WT equipment, whereas most "non-users" did not accept having such a need. Correspondingly, Rantanen and Toikko (2017) found that caregivers'/professionals' intention to introduce new WTs in their work depended on factors such as professional background/education, general attitude toward technologies, perceived capacity to learn to use the applications, and perceived opinions from their colleagues. Additionally, Sølling et al. (2014) found that professionals' perception of what was "good" care could be a critical barrier to the acceptance and adoption of WT. Thus, this perspective suggests a focus on perceived needs that influence the acceptance of WT rather than the attributes of the WT artifact itself. Finally, these contextual factors are not static but develop and evolve with personal experience and/or expected challenges related to independent living (Peek et al., 2017). For instance, previous positive experiences of using WT can make it easier to introduce new technologies (Rantanen & Toikko, 2017). Wisniewski et al. (2019) found a curvilinear relationship between informal caregivers' perceived need for WTs and the patient's condition, as WTs were not perceived as needed in the early stages of the patient's disease but were at the same time seen as less useful in advanced stages that required constant supervision and managed care. Therefore, Peek et al. (2014) recommended keeping track of potential users' perceived needs for technology in order for potential users to coordinate the introduction of new WT accordingly.

3.2.2 Care recipients vs. caregivers as primary decision-makers for user acceptance

A frequently reported key characteristic of WT is that its use typically involves multiple stakeholders – either directly or implicitly – such as professional care workers and/or family and informal caregivers in addition to the recipient of the care (e.g., Kamesawa et al., 2018; Peek et al., 2014). Furthermore, WT can serve multiple purposes, such as improving the independence and wellbeing of the care recipient while at the same time supporting and reducing the caregiver's workload (Cook et al., 2017). In order

to introduce WT on a large scale, it is therefore critical to understand the social dynamics for user acceptance and to identify whom to target. Thus, the second set of competing concerns relates to whether the primary decision-makers for user acceptance are the care recipients or the caregivers.

Heek et al. (2018) argued that professional caregivers played a decisive role in the acceptance of WT in professional care settings, whereas in informal settings, Cook et al. (2017) found that family caregivers felt responsibility for the decision to use the WT even without the client being aware of the referral. Bouwhuis (2016) presented similar observations, where technologies were rejected even without involving the recipient of care. This reveals that in some cases, the primary client is treated as an "accidental stakeholder" somewhere at the end of the implementation process. From this perspective, it is less critical to what degree the recipient of care accepts the technology, but instead it is important to examine how other stakeholders accept the WT.

Yet most technology acceptance model (TAM) studies on WT consider the recipient as the primary user and sole agent making the choice to adopt the technology (e.g., Pal et al., 2018; Chaurasia et al., 2016). Opposing scholars criticize these studies for neglecting the concept that WT implementation involves many stakeholders who have their own interests at heart; they argue that this may separately or collectively block adoption and usage irrespective of end-users' acceptance (Bouwhuis 2016; Kamesawa et al., 2018; Peek et al., 2014). For instance, as Kamesawa et al. (2018) pointed out, if the use of a WT increased the workload of care workers, it might create problems with acceptance among the care workers—and likewise, even if the care workers accepted a WT, its practical use could be problematic if it was incompatible with the physical or mental attributes of the care recipient. From this perspective, user acceptance of WT unfolds in social settings with family, friends, professional caregivers, and peers, all of whom have an influence (Peek et al., 2014; Garg et al., 2014).

3.3 Organizational level

Adoption and implementation of WT often involve multiple stakeholders and creation of new practices. This results in two additional competing concerns in terms of how to organize WT implementation.

3.3.1 Artifact-driven vs. system-driven implementation

The third set of competing concerns involves the extent to which WT implementation should be centered around the technological artifact focusing on user training and technology support, and to what extent WT implementation should be managed in a system perspective in which several interacting factors need reorganizing.

Introducing new WT artifacts involves a change to existing practices to at least some degree. To authors such as Rantanen and Toikko (2017) and Taherian and Davies (2018), this means that service organizations should ensure that users (professionals and/or care recipients) obtain sufficient skill levels to operate a new technology before introduction. In fact, inadequate user training has been reported as a key barrier to WT implementation in several studies (e.g., Hall et al., 2017; Karlsson et al., 2017). Other "artifact-driven" barriers to implementation include the costs of acquisition and maintenance (e.g., Ward et al., 2017) and technical support (Gilham et al., 2017). From this perspective, the implementation and spread of WT is limited by the amount of resources that are needed to buy, learn to operate, and maintain the technology.

However, as potential users are often not only reluctant to adopt new WT but are also likely to abandon it after the initial introduction, other authors argue that the "sustainable implementation" and routinization of WT is a complex organizational challenge that begins rather than ends with initial adoption (Sugarhood et al. 2013; Sølling et al. 2014; Procter et al. 2018). Accordingly, MacLachlan and Sherer (2018) proposed a "systems thinking" approach in which several interacting strategic and situational factors need to be taken into account, often in a network of different organizations. From this perspective, WT is not merely "a product that you can buy, install, and enjoy, but instead a system consisting of many components of widely differing kinds, not controllable by the user" (Bouwhuis 2016, p. 47). Therefore, implementing WT on a large scale involves extensive reorganizing with new workflows,

responsibilities, and roles for the professionals and citizens involved (Sugarhood et al., 2013). Equally important to training and infrastructure is to consider informal procedures and tacit knowledge, such as "invisible work practices," when addressing WT's scalability and sustainability (Procter et al., 2018).

3.3.2 Centralized vs. decentralized approaches to large-scale implementation

The next set of competing concerns revolves around whether WT implementation should be managed through a centralized effort or unfold as a decentralized process in a network of autonomous agents.

From a centralized perspective, WT implementation fundamentally depends on vertical decision-making, with a lack of centralized goal-setting and strategic planning being an essential barrier to the implementation of WT (Sølling et al., 2014; Rantanen & Toikko, 2017). This also means that organizations need to plan appropriately for managing the respective needs and expectations for different user groups when introducing new WT (Vishwanath et al., 2009; Smith et al., 2018). Following this position, it is necessary to find new ways to limit the number of stakeholders involved in paying for, installing, and using WT in order to reduce complexity and make implementation feasible (Bouwhuis 2016). In contrast, according to Draffan et al. (2015), what might at first seem to be conflicting interests and competing logics among different stakeholders and professional "silos" might instead point to a need for a unifying terminology in relation to WT implementation (e.g., "patient," "client," "consumer," and "user") that can be remedied through cooperation and knowledge-sharing.

Seeing WT as embedded in a socio-technical infrastructure, Cozza (2018) argued that in order to scale up WT, it would be necessary to create technical interoperability and convergence between communities of practice. However, this task becomes more difficult to manage when scaling it up as the practice communities (and user groups) increase and diversify. Therefore, Cozza called for a "participatory process" to facilitate cooperation and commitment between multiple and heterogeneous user groups. A similar notion is found in Procter et al.'s (2018) work, where they labeled "co-production" as essential for WT's scalability and sustainability. Further, Shaw et al. (2017) called for "co-design principles" to enable the creation of new situated knowledge and routines in new contexts. The underlying assumption in this decentralized implementation approach is that "a technology that 'works' for one individual in a particular set of circumstances is unlikely to work in the same way for another in a different set of circumstances" (Shaw et al. 2017, p. 2). Ultimately, this also implies that caregivers and service providers should be able to opt out of adopting a certain WT (Wisniewski et al., 2019).

As Peek et al. (2016) and Devlin et al. (2016), among others, noted, the assumption that WT implementation depends on contextual factors reveals an inherent tension between aiming to personalize technology implementations and aiming to deploy WT on a large scale by embracing innovative co-design. While Devlin et al. (2016) saw "robust management" and continual communication as essential for the large, multi-agency implementation of WT, Peek et al. (2016) noted that managers themselves expressed a need to collaborate outside of their own organization in order to enable successful WT implementation.

3.4 Market level

On the market level, two competing concerns revolve around business strategies and economic models for WT rollout.

3.4.1 Mainstream consumer products vs. professional niche products

The fifth set of competing concerns is centered around the question of whether WT is a niche market in which products should be tailored for specific contexts in order to be effective for a heterogeneous user group, or if developers instead should integrate assistive aspects into mainstream technologies through "universal design" principles as a means to eradicate stigmatization, increase user adoption, and make product development more economically viable.

Many researchers argue that the best way to scale up these technologies is through "universal design" principles so that everyone, regardless of disability or illness, can use and interact with them. For instance, MacLachlan et al. (2018) pointed to leading tech companies, such as Apple's voice assistant Siri and Microsoft's eyegaze technology, as examples of mainstream technologies with assistive elements that could contribute to everybody's productivity and quality of life. From this point of view, integrating assistive technologies into consumer markets is seen as a "win–win" strategy that creates affordable products with functional solutions for larger populations as well as potential economic gains with larger manufacturing runs that decrease production costs per unit and make products more reliable (e.g., Björk, 2009; Blackman, 2013; Bouwhuis, 2016). Furthermore, integrating WT development with mainstream consumer markets could decrease stigmatization and increase acceptance of the technologies (Taherian & Davies 2018). For instance, Wu et al. (2015) claimed that the notion of "gerontechnology," targeted specifically to older adults, contained stigmatizing symbolism that might prevent their adoption. From a usability perspective, Consel et al. (2015) argued that the heterogeneous design of WT prevented upscaling, and that establishing unifying design standards would increase learnability and ultimately scale up WT products.

However, other researchers dispute whether the widespread adoption of such universal plug-and-play WT solutions is possible, as people (with disabilities or illness) have a highly individual set of needs that might vary over time. Instead of a universal design approach targeting mainstream consumer markets, WT solutions should be specifically designed with regard to contextual factors in collaborations with users and their professional and informal networks of caregivers (e.g., Sugarhood et al., 2014; Peek et al., 2016; Procter et al., 2018).

3.4.2 Lack of viable business models vs. lack of marketing efforts

The sixth set of competing concerns centers on whether the low market uptake of WT is a consequence of a lack of economically viable business models or is due to neglected marketing efforts resulting in potential users and gate-keepers being unaware of possible products and how to acquire them.

Like any products, WT developers must address the question of who will pay for its adoption early on. Studies have shown a limited ability and willingness to pay for WT products among end-users, making it a key task to demonstrate business value for third-party economic buyers such as government programs; it reveals that these technologies are more cost-effective than alternative solutions (Schulz et al., 2014). Thus, WT will only achieve large-scale application when the business models are economically viable and provide benefits for all of the involved stakeholders (Oderanti & Li, 2017; Maclachlan et al., 2018). However, for many WT products, establishing a suitable business model remains an unresolved issue (Bouwhuis, 2016). In this regard, Smith et al. (2018) argued that WT business models should incorporate "replacement and loaner plans" to emphasize trialability for involved stakeholders before deciding on their appropriateness for a specific user and to enable the replacement of products to respond to changes in user needs (e.g., as a disability or illness progresses or if a child grows out of using a device). Thus, when establishing a WT distribution system, "a parallel system based on expected product reliability and obsolescence must accompany the rollout" (Smith et al. 2018, p. 477).

However, other researchers claim that the main issue with current business strategies for scaling up WT is a neglected focus on marketing efforts, pointing to a need for more accessible and better information for potential users of what, where, and how to acquire suitable WT products (e.g., Glende et al., 2016). To remedy this, Ward et al. (2017) proposed a broker/independent advisor model in which an independent consultant (care professional) would identify the user's needs and then select and bundle products or services into a "whole solution." Such a business strategy would require new partnerships between WT suppliers, caregivers, and care recipients and a focus on tailoring a system of service solutions rather than single-product development.

3.5 Policy level

Zooming out to the policy level, I identified two competing concerns on policy strategies for realizing the expected benefits of the welfare technologies.

3.5.1 Laissez-faire policy strategy vs. an active public sector approach

The seventh set of competing concerns is whether the lack of WT scaling is a "market failure" that should be addressed through governmental interventions, and if so, to what extent?

Ferri (2015) argued that the primary obstacle for WT was the so-called "valley of death" between WT research and development and the commercialization of the final product; further, the author stated that the strategic use of governmental programs and state aid would be necessary to provide access to capital to finance this transition. In contrast, Peek et al. (2016) pointed out that WTs are frequently abandoned when the funding stops, and that subsidizing WT development may obscure the possibility of identifying the actual need in the market. Similar skepticism is found in Smith et al. (2018), who argued that end-users and care professionals were more committed to using WT "if they 'invest in' and pay [for] a portion of the cost of the device" (p. 480).

Following Mazzucato's notion of the "entrepreneurial state," Ferri (2015) also noted that the WT market needed more complex governmental interventions beyond simply funding basic research and setting regulations. Sølling et al. (2014) suggested one such intervention, stressing the importance of the public sector providing sufficient technical infrastructure (i.e., high-speed connections to the internet all over the country) to support the large-scale implementation of WT and telecare solutions. Maclachlan et al. (2018) proposed a holistic and person-centered policy approach in which policy initiatives took into account that WT involved multiple sectors rather than "seeking to silo it" (p. 456). A similar notion can be found in Bygstad and Lanestedt's (2017) work, where they advocate, from a policy perspective, seeing welfare technologies as emerging "digital infrastructures" instead of as isolated technical artifacts. However, based on a comparative study of WT policies in Norway and Japan, the authors argued that such digital infrastructure "cannot be 'designed' in the same way as systems; rather, they grow more organically, through innovation, adoption and scaling. For policy makers, this means that the role of governments and agencies should be to facilitate, not plan and design" (p. 300–301).

3.5.2 Technology push vs. demand pull innovation strategy for WT

The eighth and final set of competing concerns relates to technology push and demand pull mechanisms for WT innovation and market shaping. For instance, studying technology-intrinsic drivers for WT adoption (e.g., product safety and privacy), Koimizu et al. (2018) recommended that policy-makers, together with other stakeholders, establish ethical guidelines to support WT development (the supply side). In contrast, focusing on contextual drivers for WT adoption, Wisniewski et al. (2019) recommended using market-shaping policies in terms of patient and caregiver education in the use of WT (the demand side). Similarly, Lane (2015) advocates for more extensive use of demand-driven policies, claiming that "governments consistently and inappropriately support an exploratory grant approach led by academia which generates knowledge in conceptual and prototype states, and instead should shift to a procurement contract approach led by industry which designs, tests and deploys commercial products and services" (p. 78).

While Ferri (2015) and Smith et al. (2018) argued for the necessity of policies engaging in both supply-side mechanisms as well as stimulating demand, the discussions on push vs. pull strategies for WT rollout are heavily under-researched, leaving researchers to speculate under which circumstances and to what extent either or both strategies may be suitable for the development and widespread distribution of WT: "Depending on a given context, Push, Pull or Push/Pull may be the best strategy. Various combinations are needed and will vary based on the human, societal, environmental and regulatory conditions. The importance of understanding these methods is to be aware of the approach to be used and that

whatever used is deliberate and assessed, so a product development process can shift or adapt in approach if necessary" (Smith et al. 2018, p. 478).

3.6 Summary of the competing concerns

Table 1 contains a summary of the competing concerns in the critical transition from small-scale WT invention to large-scale implementation.

User level	**1. Drivers for user acceptance: Intrinsic technology vs. contextual factors** • Intrinsic attributes of the technology (e.g., Heek et al., 2018; Ward et al., 2017; Yusif et al., 2016; Glende et al., 2016; Nijboer, 2015; Robinson et al., 2014) • Attributes of users and social context (e.g. Wisniewski et al., 2019; Schomakers et al., 2018; Rantanen & Toikko, 2017; Wu et al., 2016; Cook et al., 2016; Weegh & Kampel, 2015; Peek et al., 2014; Sølling et al., 2014)
	2. Primary decision-maker for user acceptance of WT: Care recipients vs. caregivers • Care recipients as the primary decision-makers for the acceptance of WT (e.g., Chaurasia et al., 2016) • Caregivers as primary decision-makers for the acceptance of WT (e.g., Cook et al., 2018, Heek et al., 2018)
Organizational level	**3. Approaches to implementation: Artifact-driven vs. system-driven** • WT implementation should be centered around the technology artifact to secure adequate infrastructure and training (e.g., Taherian & Davies 2018; Ward et al., 2017; Rantanen & Toikko, 2017; Karlsson et al., 2017) • WT implementation should be seen in a system in which several interacting factors need re-organizing (e.g. MacLachlan & Scherer, 2018; Procter et al., 2018; Bouwhuis 2016; Sugarhood et al. 2014; Sølling et al., 2014)
	4. Decision-making structure: Centralized vs. decentralized • WT upscaling depends on centralized organizational efforts (e.g., Smith et al. 2018; Rantanen & Toikko, 2017; Bouwhuis, 2016; Sølling et al., 2014; Vishwanath et al., 2009) • WT upscaling unfolds as a decentralized process in a network of autonomous agents (e.g. Wisniewski et al., 2019; Procter et al., 2018; Cozza, 2018; Shaw et al., 2017; Peek et al., 2016)
Market level	**5. Target market: Mainstream market vs. niche market** • Universal design/ assistive elements should be incorporated into mainstream technologies to reduce stigmatization and increase uptake (e.g. Taherian & Davies, 2018; MacLachlan et al., 2018; Pal et al., 2017; Blackman, 2013; Björk, 2009; Stehle & Albrecht-Buehler, 2008) • WT solutions need to be tailored to users' specific needs (e.g. Wisniewski et al., 2019; Procter et al., 2018; Peek et al., 2016)
	6. Business focus: New business models vs. increased marketing • Lack of viable business models limit WT upscaling (e.g. Schulz et al., 2014; Oderanti & Li, 2017; MacLachlan et al., 2018; Smith et al., 2018) • Lack of marketing efforts limit WT upscaling (e.g. Ward et al., 2017; Glende et al., 2018)
Policy level	**7. Extent of governmental participation: Laissez-faire strategy vs. active public sector** • The WT market needs participative and entrepreneurial governments (e.g. Ferri, 2015; Lane, 1997, 2015; Sølling et al., 2014; MacLachlan et al., 2018) • Governments and agencies should only facilitate, not plan and design WT innovation (e.g. Bygstad & Lanestedt, 2017; Peek et al., 2016; Smith et al., 2018)
	8. Policy focus: Technology push vs. demand pull • Policy-makers should establish (ethical) guidelines to support WT development (e.g., Koimizu et al., 2018) • Policy-makers should enact market-shaping policies to stimulate WT demand (e.g. Wisniewski et al., 2019)

Table 1. Summary of eight competing concerns on WT innovation in extant literature.

4 Concluding discussion

The challenges of WT innovation pose a significant threat to the digital transformation of welfare service delivery in health- and eldercare. In this review, I identified and discussed competing concerns in managing the critical transition from small-scale welfare technology inventions to large-scale implementation.

Both emerging and fragmented, the existing literature is characterized by many unresolved debates, speculations, and competing concerns. By synthesizing and contrasting these diverse positions, my main

contribution is to provide conceptual clarity on eight competing concerns that are central to WT innovation. On the *user level*, there are competing concerns on factors influencing user acceptance of WT (technology-intrinsic vs. contextual drivers and care recipients vs. caregivers as primary decision-makers). On the *organizational level*, there are competing concerns on the driving factors for WT implementation (artifact-driven vs. system-driven and centralized vs. decentralized management). On the *market level*, there are competing concerns on business strategy factors for WT (targeting niche markets vs. mainstream consumer markets and improving business model viability vs. increasing marketing efforts). Finally, on the *policy level*, there are competing concerns on the policy factors for promoting WT innovation (laissez-faire policy strategy vs. an active public sector approach and technology push vs. demand pull mechanisms).

In many ways, the abstracted positions in these competing concerns are idealized viewpoints; they are useful for highlighting different aspects surrounding WT innovation and allow researchers to think of hybrids of possible interventions and strategies. Smith et al. (2018) presented the notion of "sweet spots" in WT product development as the optimal position to best match the market and development environment. Similarly, I suspect that managers balance the competing concerns differently depending on a range of factors, such as the complexity of the innovation (Greenhalgh et al., 2017) as well as national/local policies and regulations (Bygstad & Lanestedt, 2017). However, given the dynamic and complex nature of WT innovation, it would be naïve to assume that such strategic tradeoffs can be made with full comprehension of the advantages and disadvantages of each possible configuration. Instead, balancing the competing concerns will unfold as an ongoing series of interrelated decisions and priorities throughout the innovation process, from early small-scale invention to large-scale implementation.

Looking across the eight competing concerns reveals four defining characteristics for WT innovation. Firstly, WT innovation involves multiple stakeholders (care recipients, formal and informal caregivers, service organizations, policy-makers, and WT developers). Consequently, addressing individual needs, understanding the social dynamics, and facilitating collaboration and knowledge-sharing between stakeholders are crucial actions from the technical development, business model, organizational, and policy perspectives. Secondly, WT innovation unfolds in a (complex) system with both intra- and inter-organizational processes. Thus, managing and facilitating the large-scale implementation of WT requires multiple considerations, such as digital infrastructure, user training, new practices, routines, and responsibilities. Thirdly, WT innovation is limited by both technology-intrinsic attributes (e.g., design approach, innovation complexity, usability, and trialability) and social context (e.g., views on aging/health conditions, views on "good" care, ethical implications, and privacy concerns). Thus, WT innovation needs an interdisciplinary approach in order to understand and determine effective strategies and interventions. Lastly, as WT innovation is bounded by ambiguity and competing concerns, large-scale WT implementation is not merely about "enlarging" a small-scale project, but it involves a multi-faceted transformation process with interactions between technological, organizational, market, and social factors.

Being aware of these characteristics and the competing concerns that are central to WT innovation holds both practical and theoretical contributions that are crucial to guide managers, inventors, and policy-makers to intervene in the critical transition from small-scale WT intervention to large-scale implementation.

5 Limitations and future research

This research has a number of limitations. Most notably, the coverage of the search is limited to only include English keywords in one database (Scopus), and it is likely that I missed some otherwise eligible studies in my review. Furthermore, the technology-centric selection criterion of only including studies on WT might have left out useful and complementary insights from studies on other types of innovation in health- and eldercare. Consequently, I do not claim to be exhaustive in this review, and I call for empirical studies that focus on exploring and expanding on the competing concerns and the characteristics that are central to WT innovation as well as how and under which conditions the competing concerns may be managed.

Given the identified dominance of exploratory and often a-theoretical studies in the current research, future studies should emphasize concept and theory development through longitudinal and comparative case studies of WT innovation processes – especially by incorporating Information System and innovation management theory, such as paradoxical thinking to explore how to manage conflicting demands, opposing perspectives, and organizational ambiguity in innovation processes (Lewis, 2000; Singh et al., 2009; Svahn et al., 2017). By conceptualizing eight competing concerns that are central to WT innovation, this article paves the way for new research avenues to create conceptual tools for understanding and managing the competing concerns that managers and policy-makers face whenever they engage in WT innovation.

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