

Confronting the Uncertainty of Systemic Innovation in Public Welfare Services

Harri Jalonen

Abstract—Faced with social and health system capacity constraints and rising and changing demand for welfare services, governments and welfare providers are increasingly relying on innovation to help support and enhance services. However, the evidence reported by several studies indicates that the realization of that potential is not an easy task. Innovations can be deemed inherently complex to implement and operate, because many of them involve a combination of technological and organizational renewal within an environment featuring a diversity of stakeholders. Many public welfare service innovations are markedly systemic in their nature, which means that they emerge from, and must address, the complex interplay between political, administrative, technological, institutional and legal issues. This paper suggests that stakeholders dealing with systemic innovation in welfare services must deal with ambiguous and incomplete information in circumstances of uncertainty. Employing a literature review methodology and case study, this paper identifies, categorizes and discusses different aspects of the uncertainty of systemic innovation in public welfare services, and argues that uncertainty can be classified into eight categories: technological uncertainty, market uncertainty, regulatory/institutional uncertainty, social/political uncertainty, acceptance/legitimacy uncertainty, managerial uncertainty, timing uncertainty and consequence uncertainty.

Keywords—Systemic innovation, uncertainty, welfare services

I. INTRODUCTION

THERE is strong agreement that the survival of an organization is dependent upon its ability to adopt new processes and launch new products and services. Existing studies consistently find a positive relationship between innovation capability and company survival [1]. Innovations are typically described in an affirmative light; they enable organizations to do things in a new or/and more efficient way and produce more desirable goods and services. Hence innovation can be perceived as a synonym for development. In industry, for example, process innovations can be launched to improve material use or shorten lead times, whereas in the service business innovation may manifest itself as new service offerings. Innovation capability has also been regarded as important in public organization settings. Bhatta [2] and Parsons [3], for example, have conceived ‘innovation speech’ as one outcome from the rapid rise of New Public Management (NPM) since the late 1980s. According to Bhatta [2], “governments around the world have been exhorted to be more innovative not only in service delivery, but also in all facets of policy formulation and development”.

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Faced with social and health system capacity constraints and rising and changing demand for welfare services, governments and welfare providers are increasingly relying on innovation to help support and enhance services. However, the evidence reported by several studies indicates that the realization of that potential is not an easy task [2, 3, 4]. Innovations can be deemed inherently complex to implement and operate, because many of them involve a combination of technological and organizational renewal within an environment featuring a diversity of stakeholders. Many public welfare service innovations are markedly systemic in their nature, which means that they emerge from, and must address, the complex interplay between political, administrative, technological, institutional, legal and financial matters [5].

Based on the literature review and the early findings of the ongoing innovation project – the Virtu channel; virtual services for elderly people – this paper suggests that stakeholders dealing with systemic innovation in welfare services must deal with incomplete and ambiguous information in circumstances of uncertainty. In this paper, uncertainty is seen as a condition that arises from the complex interplay between political, technological, organizational, psychological and legal issues. It is hypothesized that the development and adoption of systemic innovation in welfare services may be hampered due to uncertainty. The development and adoption of innovation is defined as an information-processing activity and a decision to make full use of an innovation [6]. Developers and adopters of innovation here refers to any stakeholder (elderly person, care worker, municipal office-holder, local politician, commercial company) who aims to develop and use the innovation.

This paper has two contributions. First, it draws on innovation literature to provide a framework with which to identify and classify the various sources of uncertainty around systemic innovation. Secondly, it develops propositions addressing the uncertainty in adopting systemic innovation in public welfare services.

The paper is structured as follows: in section 2 the concept of uncertainty is defined; section 3 introduces the ongoing innovation project, known as the Virtu channel, which serves as an empirical illustration of systemic innovation; section 4 describes the research design; section 5 presents and discusses the findings of the literature review and the ongoing innovation project; and finally, in section 6, conclusions and implications for further research are drawn.

II. KNOWN AND UNKNOWN UNCERTAINTY

Webster's dictionary [7] defines uncertainty as a state of being uncertain. It is a situation which is not ascertainable or fixed, as in time of occurrence, number, dimensions, quality, or the like. Although uncertainty has been a popular theme in organizational studies, there is no agreement on the conceptualization of the concept itself [8]. Galbraith [9], for example, has ironically stated that "a great deal of uncertainty exists about the concept of uncertainty". One of the earliest definitions of uncertainty in an organizational setting was put forward by Frank Knight. In his seminal work, Knight [10] distinguished between 'risk', defined as a measurable unknown to which probabilities can be assigned, and 'uncertainty', which are risks to which such probabilities cannot be assigned. For Galbraith [9], uncertainty means the gap between the amount of information required to perform the task and the amount of information already possessed by the organization. Galbraith's definition implies that uncertainty can be managed by reducing it or increasing the organization's ability to tolerate it [11, 12]. Uncertainty, defined as a lack of certainty, refers to the information environment where questions can be asked and where clear answers can be obtained (Brun et al. [13]. Elsberg [14] has incisively called this kind of uncertainty 'known uncertainty'. The dissociation of risk from uncertainty made by Knight [10], however, suggests that uncertainty also has manifestations other than just lack of information. Brashers [15], for example, has defined uncertainty as a state in which the details of situations are ambiguous and complex, information is unavailable or inconsistent and people feel insecure about their own knowledge or the state of knowledge in general. In other words, in addition to a lack of information, uncertainty may arise from multiple meanings for - or interpretations of - the same thing. Due to multiple and, often, conflicting interpretations [11], individuals face 'unknown uncertainty' [14]. In contrast with 'known uncertainty', 'unknown uncertainty' is a situation where increasing the amount of information is not a solution [16].

This paper uses the concept of uncertainty in two meanings: uncertainty may arise both from incomplete information and from multiple interpretations of information about innovation. While some issues related to innovation may be construed as 'known uncertainty', other issues remain within the sphere of 'unknown uncertainty'. The relationship between the new technology and the organization's production capacity is an example of 'known uncertainty' in innovation. The uncertainty is known because the key variable of new technology and its relationship to production capacity is known even though the factual values remain unclear. Usually, however, technological innovation also involves elements of 'unknown uncertainty'. That is to say that it is impossible to predict all the effects of technological innovation because these effects are dependent on unknowable actions taken in the future. In contrast to known uncertainty, which can be reduced by increasing the amount of information, people around innovation in a state of unknown

uncertainty are obliged to make interpretations on the basis of their own knowledge.

III. THE VIRTU CHANNEL AS AN EXAMPLE OF SYSTEMIC INNOVATION

Systemic innovation here refers to changes in the integrated system of social and health care practices, services, technologies and organizations that together form a new mode of operation [5]. In this paper, the Virtu channel serves as an empirical illustration of complex systemic innovation – a new kind of service model for social media and well-being for elderly people in the archipelago areas of Finland, Åland and Estonia. At the heart of the Virtu channel are a handy touch screen and a small camera, which are connected to televisions in people's homes, and a broadband connection, which functions as a link between elderly people, the Virtu channel experts and municipal care workers. The Virtu channel provides several services to elderly people, including interactive programs produced by educational organizations, municipalities, voluntary sector organizations or commercial companies; communication between elderly people and health and elderly care personnel; communication between elderly people and their relatives; and communication between elderly people themselves. The Virtu channel necessitates changes in the municipal service delivery system, in the working environment of the municipal personnel and in the organization of elderly care [17]. The Virtu channel can be deemed systemic innovation because 1) it is founded on change in the supply and demand of service provision, 2) it requires changes to the organization and the motivation of production, 3) the value it generates has not been generated before, and 4) its value creation is based on the co-operation between various public and private organizations [5].

On the whole, the Virtu channel provides a new service delivery system in which elderly people are not seen merely as service receivers but also as active participants and developers of the provision. At best, the Virtu channel also enables the birth of a unique virtual community, in which different actors (elderly people and their relatives, educational organizations, technical service providers, municipalities, commercial companies and voluntary sector organizations) from different locations are able to co-operate with one other.

IV. RESEARCH DESIGN

The method used in this paper is a combination of systematic literature review [18] and case study [19]. By performing a systematic literature review, this paper integrates existing information and provides a theoretically founded framework for understanding various aspects of the uncertainty of innovation. The role of the case study is to provide real-world examples of how uncertainty manifests itself in specific systemic innovation.

The systematic literature review was conducted using Boolean searches in the following databases: *ABI Inform ProQuest*, *EBSCO*, *Elsevier Science Direct*, and *Emerald*. The four databases include a large number of scientific journals

that focus on innovation. The search was confined to peer-review journals. This choice is in line with the rationale behind the systematic literature review methodology: the accuracy and reliability of the review can be enhanced by focusing on studies of good quality [18]. The term 'innovation' was rated as so important that it had been included in the title of an article, and was connected to the term 'uncertainty' (or its synonyms 'complexity', 'ambiguity', 'equivocality', based on Zack [12]) which had been included in the abstract of an article) by the Boolean search operator 'AND'. The search based on that definition was conducted on May 2011 and yielded 1,075 articles.

The 1,075 articles were analyzed as follows. First, the abstracts of the articles were read cursorily. In the majority of the articles where uncertainty (or a synonym of uncertainty) was mentioned, it was not used to describe the nature of the innovation process but was just a word like any other. Eliminating those papers that only mentioned uncertainty (or its synonym) of innovation but did not specifically focus on it reduced the number of articles to a total of 124. In the second phase, the 124 articles were read in full. The focus of this phase was on an analysis of the articles in terms of their subject area and type of innovation, their theoretical framework, their methodology, and the uncertainty related to innovation. The objective of this phase was, on the one hand, to ensure that the studies were relevant to the purpose of this paper, and, on the other hand, to compose an extensive list of sources of uncertainty in the innovation process as mentioned in the articles. The articles were labeled with as many factors of uncertainty as were identified in them. The number of identified uncertainty factors was 18 and included technological uncertainty, technical uncertainty, market uncertainty, commercial uncertainty, competitive uncertainty, consumer uncertainty, environmental uncertainty, regulatory uncertainty, legal uncertainty, societal uncertainty, political uncertainty, economic uncertainty, organizational uncertainty, resource uncertainty, decision-making uncertainty, acceptance uncertainty, task uncertainty, and behavioral uncertainty. The third phase of the analysis consisted of reducing and combining the sources of uncertainty. After several combining and restructuring cycles undertaken with the help of mind mapping and earlier classifications identified in reviewed literature, the eight-factor classification of uncertainty in innovation processes was compiled.

The eight factors are:

- 1) Technological uncertainty
- 2) Market uncertainty
- 3) Regulatory/institutional uncertainty
- 4) Social/political uncertainty,
- 5) acceptance/legitimacy uncertainty
- 6) Managerial uncertainty
- 7) Timing uncertainty
- 8) Uncertainty

The factors creating uncertainty in systemic innovation are discussed in detail in the next section.

V. FINDINGS AND DISCUSSION

A. Technological Uncertainty in Systemic Innovation

The relationship between technology and innovation is close. A main thrust of innovation research has focused on technology-based innovations. Rogers [6], for example, has emphasized that most of the new ideas, the dissemination of which has been analyzed, are technological innovations. The relationship is so close that the words 'innovation' and 'technology' are typically used as synonyms. Despite its promise, ICT has also brought new challenges. As Coughlin [20] has pointed out, technology has a 'Janus face', implying both new solutions as well as new problems. From the point of view of this paper, the dualistic nature of technology can be seen as a cause that creates uncertainty perceived by its adopters. Two causes of technological uncertainty can be found in the reviewed literature, where innovators encounter technological uncertainty in terms of both product specification and production processes [6, 21]. When it comes to product specification, the innovation's technical feasibility, usefulness, functionality or quality is at least partly unknown [1, 22, 23]. In addition to product specification, technology causes uncertainty in respect of production processes. That is to say that the organization cannot fully understand the skills and knowledge required to succeed in using new technology [24, 25]. It is important to notice that uncertainty related to specification of technology and necessary organizational capabilities are interconnected. As Weick [26] has put it, "while technologies always had stochastic events, the unique twist in the new technologies is that the uncertainties are permanent rather than transient".

Without questioning the arguments that the newness of the technology is positively correlated to uncertainty [27] and that public sector innovations are by nature incremental [28], it seems that, based on the findings from the literature and the Virtu channel project, technology-based innovation is a source of uncertainty in the public sector, particularly in welfare services. In the Virtu channel, uncertainty arises due to the fact that municipalities suffer from a lack of knowledge concerning the feasibility and usefulness of virtual services in elderly care. One specific concern within the Virtu channel is the relationship between technology-enabled virtual services and human care. As Coughlin [20] has noted, a frequent concern by ageing services providers and elderly people is the loss of human care as high-technology enables remote care alternatives. Moreover, while virtual services contain the promise of a better future, the exploitation of that promise is difficult because users in municipalities have little experience of technology-based care. The Virtu channel creates uncertainty because the new knowledge requirements are directed not only to one municipality but to the whole welfare service system. The literature review and early findings of the Virtu channel project support the following proposition:

Proposition 1: Ambiguity in the specification of the technology and the lack of knowledge needed to use the technology create uncertainty, which may hamper the

development and adoption of systemic innovation in public welfare services.

B. Market Uncertainty in Systemic Innovation

The idea of innovation implies that it is invented and implemented in order to meet the needs (real or perceived) of the market. The reviewed literature shows that the market environment for innovation is also a great source of uncertainty. Uncertainty follows from the needs of customers, the actions of competitors, and the prices of substitutive commodities [29, 30, 31, 32].

Given the fact that innovations in the public sector are typically incremental by their nature, it is reasonable to expect that market-based uncertainty manifests itself differently compared to the private sector. Instead of real and well-articulated customer needs, many innovations in the public sector are 'motivated' by the need to improve the productivity of public service provision [5]. Therefore, the behavior of competitors and the price development of competing products and services only play a minor role as a motivator for innovation in the public sector. This holds true for the Virtu channel project as well. One of the main reasons for its launch was concern about the service provision in a state of rapid ageing and increasing costs of social and health care. Although many elderly manage everyday life and have a good ageing, they are still a challenging target group from the point of view of new technology. A tough question is whether the virtual services really help old people to embrace the changes that come with ageing [33]. Instead of an offering from the service provider, the focus should be on the needs of the elderly people. The true customer value of innovation is only achieved when the virtual services are configured with the service wholeness in a way that fulfils the needs of elderly people. However, this is not an easy task, especially due to the unclear need for virtual services. The reviewed literature, supported by the early findings of the Virtu channel project, implies that in order to develop virtual services that are useful to the elderly people it is important to understand the nature of growing very old. Following the argument by Coughlin [20], it can be argued that businesses who seek to commercialize new technology and governments who have broader policy interests must address and balance multiple challenges introduced by new technologies. This means, among other things, that instead of just developing virtual services for enlightened and autonomous customers who are able to make intentional and smart choices between different alternatives, developers of virtual services must also take account of elderly people who are not used to new technology due to disability or lack of experience. This leads to the second proposition:

Proposition 2: Unclear customer needs and a heterogeneous clientele create uncertainty, which may hamper the development and adoption of systemic innovation in public welfare services.

C. Regulatory/Institutional Uncertainty in Systemic Innovation

Paradoxically, regulations and institutions play two opposing roles in innovation processes. On the one hand, they can be used to facilitate innovation efforts by reducing uncertainty around innovation [34, 35]. Intellectual property rights that support and promote the fair and equitable sharing of benefits that arise from the development of a given innovation are an example of facilitative regulation. On the other hand, regulations and institutional arrangements may turn out to be obstacles and become a source of uncertainty. Ensuring that the innovation does not pose a threat to the citizens or society as a whole may result in slow development and adoption of the innovation. [36], for example, have pointed out that the complexity of institutional arrangements may block the dissemination of innovation and constrain change. Similarly, [37] has found that instability in government funding of innovation can lead to weakness in the innovation network.

Basically, the above holds true in public welfare service innovations. In the Virtu channel there are at least two regulatory and institutional issues that should be approached from the standpoint of uncertainty. First, given that the goal of the Virtu channel is to become a new kind of service system, it implicitly challenges existing working practices within the interface between public and private. Regulations and institutional arrangements are needed in order to support the co-operation between municipalities, firms and the third sector. However, these arrangements can also be a source of uncertainty. This is especially the case when, for example, regulations fail to guarantee firms' innovation efforts. Since the Virtu channel is in its early development phase and no clear markets exist yet, the technology developing firms may be reluctant to 'put their cards on the table' if they are uncertain about whether their innovation efforts will be secured by regulations. Adapting Foster [35], the result may be a 'system failure', by which he refers to the institutional structure that either obstructs or cannot facilitate innovation. Following Foster's [35] argument further, it can be claimed that measures to promote innovation can be challenging and create uncertainty because they "require an understanding of emergent industries that a public sector administrator may not have".

Second, in addition to uncertainty felt by firms, regulations may also cause uncertainty for municipalities when they plan the adoption of technology-based service innovations in elderly care. 'Information steering' - an activity that is an integral part of the implementation of public policy - is an illustrative example. Information steering deals with the right, based on a position or expertise, of a steerer (e.g. a ministry) to aim at influencing the behaviour of a steerable (e.g. a municipality). The implicit assumption is that the aim of information steering is not only to steer and control the operations of municipalities and other local-level actors but also to promote and support the independent development of the local-level actors [38, 39]. However, besides its good intentions, information steering has its downside. Information

steering as a form of activity has been regarded as equivocal with detrimental practical implications. An example of the equivocality of information steering is inconsistent guidelines concerning the number of employees in elderly care. On the one hand, the equivocality arises due to the content of the guidelines and, on the other hand, due to interpretations made within municipalities. Despite the root cause of the equivocality, what is more important in the context of systemic innovation, such as the Virtu channel, is the result – i.e. the uncertainty regarding what is allowed and what is not. Therefore, the third proposition states that:

Proposition 3: The equivocality of regulatory and institutional arrangements creates uncertainty, which may hamper the development and adoption of systemic innovation in public welfare services.

D. Social/Political Uncertainty in Systemic Innovation

There is strong agreement that innovations do not occur in isolation but are developed and disseminated in interfaces between different stakeholders [6, 40, 41]. Interaction plays a crucial role, particularly in systemic innovation, which refers to development activities that involve a change in multiple interdependent components [42]. Interaction is required for both developing new ideas and implementing them as new practices. Thus it is not surprising that a growing number of welfare services are nowadays provided by co-operation between the public and private sectors. The attractiveness of co-operation is the result of a logic that argues that the innovation challenges in welfare services are solved by combining the complementary and substitutive capabilities possessed by different organizations.

Without questioning the promises related to interaction, it is important to note that interaction is also a significant source of uncertainty. This is because interaction is a process whereby the diversity of political interests among stakeholders is revealed. In other words, with interaction, the political aspects of innovation become visible. Paradoxically, in seeking to reduce uncertainty, the stakeholders engage in relationships with each other that in and of themselves lead to political uncertainties [43]. The Virtu channel project is no exception. Although the project is in its embryo state, there are several political issues that may create a conflict of interest and increase uncertainty around virtual services. A common theme is that they arise from complex changes in the relationships between municipalities, service providers, technology developers and customers with their own interests from which new patterns of interaction emerge [44, 45]. The findings from the Virtu channel project are consistent with the earlier studies that have stressed that innovation has the potential to disrupt power structures and work routines within an organization [29, 46, and 47]. While the definition of innovation adoption as an information-processing activity [6] implies that decisions around innovation can be improved with better information, it should be noted that with innovation comes political judgments [48], which, in turn, may lead to unexpected behavior. The role of political judgments is especially significant in welfare service innovations that typically take

place in mixed-sector co-operation. While co-operation increases the innovation potential in welfare services, it also creates complicated organizational interlacings with political interest conflicts, which, in turn, may lead to a situation where this innovation potential remains unrealized [49]. This leads to the fourth proposition:

Proposition 4: Interaction between different stakeholders reveals their political interests, which, if conflicting with each other, increase the uncertainty and may hamper the development and adoption of innovation in public welfare services.

E. Legitimacy/Acceptance Uncertainty in Systemic Innovation

In addition to interaction challenges, the developers of innovation should be interested in their acceptance and legitimacy [25]. On the basis of the reviewed literature, the legitimacy of innovation can be divided into two categories: cognitive and socio-political legitimacy [50]. Cognitive legitimacy refers to the knowledge base that is needed in using innovation, whereas social-political legitimacy stands for the congruence of the individual's values with the organization's norms and culture. Innovation loses its cognitive legitimacy if it contradicts the knowledge and experience possessed by the potential user. Innovation's social-political legitimacy is at risk if individuals feel that an innovation is inconsistent with their 'world views' or organization's norms.

The findings from the literature suggest that it would be fruitful to address the Virtu channel from the standpoint of legitimacy. Following the eloquent question posed by Latour [51] in Moensted [52], one can ask what ultimately legitimates the innovation: is it that people will be convinced once the innovation [the Virtu channel] works, or is it that the innovation [the Virtu channel] will work when all the relevant people are convinced? In the Virtu channel project it seems that virtual services are not developed on the basis of well identified customer needs but more on the basis of the interests of educational organizations and technology providers. Information gained by participatory observation suggests that the legitimacy of the virtual services in elderly care is not self-evident. A little pointedly, technology-based services represent a threat for individuals (i.e. care workers; customers) and collectives (i.e. profession-based interest groups). This finding is consistent with arguments stated by Coughlin [20], who has found several technology and ageing trade-offs, of which two are especially relevant in the context of the legitimacy of virtual services such as the Virtu channel. The first trade-off is functionality versus complexity. With increased functionality comes increased complexity, which, in turn, reduces the capacity of many old people to understand the working of the system. The more complex the system (e.g. the Virtu channel), the more likely it contradicts the cognitive capabilities of the elderly people. The second trade-off relates to high-tech versus high-touch. At the heart of this trade-off is the fact that although technology offers great potential for improving the lives of elderly and those who care for them, it profoundly changes the way we live. For example, the fact

that high-technology enables remote care alternatives raises the fundamental question of whether everything that is technologically possible is humanly desirable. Consequently, 'high-tech' innovation (e.g. the Virtu channel) may induce contradiction between technologically possible and the 'world views' of the elderly and their carers. In doing so, the result may be uncertainty as to whether the innovation should be accepted or rejected. As Bhatta [2] has noted, "a risk in innovation is that organizations attempting it could lose legitimacy". Thus the fifth proposition states that:

Proposition 5: If innovation contradicts with the individuals' cognitive capabilities, their basic values or the organization's norms, the result is legitimacy/acceptance uncertainty, which may hamper the development and adoption of innovation in public welfare services.

F. Managerial Uncertainty in Systemic Innovation

Defining innovation as 'novelty in action' includes the idea that innovation is a change [53, 54] or transformational process [55] that challenges rational management models [35, 56]. The reviewed literature concurs that innovation requires intuition – the novel insight into problems that does not directly result from a rational and structured thought process. Innovation involves incremental or radical discontinuity with the past. In doing so, innovation always functions as a certain kind of disruptive behavior within an organization. Since innovation refers to thinking both differently and unconventionally, and to experimenting and implementing new ideas, it is understandable that innovation is a process that implicitly implies risk and the possibility of failure. The reviewed literature shows that the risk inherent in innovation and the possibility of failure are the most important factors in creating uncertainty in the managing of innovation. Uncertainty arises from a lack of knowledge regarding the effectiveness of management activities that may be used to support innovation behavior in risky situations where a fear of failure exists.

Risk-avoiding and fear of failure play a remarkable role in innovation processes in public organizations [2, 3, 4]. They encourage people towards playing safe. At its worst, the result is a behavior of doing nothing. Early findings from the Virtu channel project indicate that this kind of behavior is a distinct option. The logic of playing safe is understandable: since the usefulness of the Virtu channel cannot be known a priori, municipalities may be motivated to postpone the adoption of virtual services. In other words, they bid to avoid uncertainty related to the consequences of innovation. While accepting the notion presented by Ortt and Smits [25] that "innovation is not matter of optimizing, but a process of trial and error", the evidence suggests that it is much easier said than done. Furthermore, there is another source of managerial uncertainty around innovation: the complexity of innovation embedded in inter-organizational contexts. Mitleton-Kelly [57], for example, have pointed out that rethinking existing norms of behavior and ways of working has emerged from interaction between different actors, which, in turn, has meant "moving into a zone of discomfort and uncertainty".

Uncertainty related to appropriate management practices can also be identified in the Virtu channel project. There are no clearly defined answers to questions such as what kind of enabling practices can be used in supporting innovative action in complex interaction between technology providers, municipalities, educational organizations and other stakeholders? It seems that the adoption of innovation is fundamentally an emergent process that is highly dependent on complex interaction in local situations [49]. Emergence results from the process whereby each agent in the elderly care domain (i.e. municipal office-holders, local politicians, care workers, clients, and other stakeholders) is continually deciding which other agent it will engage with, and what information and other resources it will exchange with them [58]. It is the complex interaction between the innovation, the intended adopter(s) and a particular context that determines the adoption of virtual services in elderly care [59]. This leads to the conclusion that innovation management in complex welfare systems is "somewhat of a black art" [60]. Based on the literature review and early findings of the Virtu channel project, the following proposition is presented:

Proposition 6: Managerial uncertainty in innovation due to fear of failure and risk-avoiding behavior, and due to complex interaction between different stakeholders, may hamper the development and adoption of innovation in public welfare services.

G. Timing Uncertainty in Systemic Innovation

The timing of action has become a crucial element in contemporary organizations. Macdonald and Jianling [61], for example, have emphasized the fact that, due to short-lived product life cycles, the speed-to-market has become a critical success factor for organizations. Jalonen and Lönnqvist [62], in turn, have demanded predictive business – a management perspective by which they refer to the early recognition of business opportunities and threats and to agile reaction to changes in the organizational environment. Time is also an implicit element of the definition of innovation. Innovation refers to new implemented ideas. As noted before, the novelty of innovation depends on the context. This means that an idea, practice or object seen as novel at some point and in some place may fail to be accorded the status of innovation at some other time and in some other place. Despite the subjectivity of such novelty, however, the innovation literature concurs that timing is a crucial driver for successful innovation [61, 63, 64].

The classical dilemma is to innovate early, but not too early [61]. The innovation literature describes two kinds of time-related uncertainties that are useful in the context of this paper. The first relates to the fact that knowledge increases as time passes. In other words, the earlier the entry, the more uncertainty there is [61]. The early stages of the innovation process are uncertain due to the "high perceived variability and low perceived analyzability" of the tasks in question [30]. As the process progresses and more information is made available, variability will decrease and analyzability will increase [30]. Secondly, time-related uncertainty reveals itself

in the later phases of an innovation project. Gibbons and Littler [29] and Gales and Mansour-Cole [8], for example, have found that uncertainty may persist or even increase as innovation projects progress. That is to say that while uncertainty may be high in the early phases of an innovation project, uncertainty is unproblematic because only a limited number of individuals are involved in resolving uncertainty in the early phases of an innovation project. As an innovation project progress and reaches full-scale production, more individuals are involved, which, in turn, creates the uncertainty that Gales and Mansour-Cole [8] call problematic. The findings from the Virtu channel projects are parallel with other studies. Timing is also critical in the Virtu channel, albeit not an easy task. The evidence from the Virtu channel project suggests that since the project is in its early stage, the stakeholders lack information regarding, for example, the short and long-term consequences of virtual services compared to the traditional service delivery model. In other words, they feel uncertainty due to the high perceived variability and low perceived analyzability of the tasks needed to conduct the project. As noted, the Virtu channel project is in progress, which means that it is not possible to empirically study any time-related uncertainty that may appear in later stages of the innovation process. However, intuitively, and also by exploiting findings from other studies [5], it can be supposed that in complex welfare innovations – such as the Virtu channel – that take place in fluid multi-stakeholder environments, the perceived uncertainty may paradoxically increase as the process progresses. One special form of time-related uncertainty follows from the nature of municipalities. Compared to private organizations, municipalities are much more likely to experience direct political interference in operating decisions. This could probably be the case in the Virtu channel project as well. One can imagine, for example, that the adoption of virtual services in elderly care is dependent on the political atmosphere of the (local) society. If the atmosphere is against technology-based services, it is likely that citizens and other stakeholders in democratic societies use their right of appeal and other measures in order to hinder or at least postpone the adoption of innovation. Thus a kind of ‘slowness’ in innovation adoption in the public sector can be seen as “a price of democracy”.

In summary, while in the early stages of the innovation process, uncertainty is based on a lack of information; in the later stages, where more individuals are involved, uncertainty is a result of ambiguity in the information. Therefore, the seventh proposition states:

Proposition 7: Timing uncertainty manifested in the form of “lack of information” or “ambiguity of information” may hamper the development and adoption of innovation in public welfare services.

H. Consequence Uncertainty in Systemic Innovation

Innovation, by definition, is an information-centered process in which the potential adopter collects information on the innovation’s benefits and disadvantages before making a decision on adoption or rejection [6]. The reviewed literature

concur that the adoption of new ideas is difficult, even when they are apparently useful, and becomes even more difficult when the consequences of innovation are unknown. Despite the perceived usefulness of innovations, they are not always supported because the processes and outcomes are unpredictable. Researchers acknowledge that the adoption of an innovation may be hindered by the uncertainty of its short and long-term consequences [34, 35, 55, 65]. Before adoption, it should be ascertained as well as possible whether or not the innovation is a better solution to existing problems than the old practices or other new ideas. The potential adopters have to have essential information about the innovation in order to diminish the uncertainty. This, however, contradicts the ‘true nature’ of innovation – i.e. the potential value contained in innovation does or does not materialize in the future, which entails uncertainty because knowing the future is always incomplete. In other words, the consequences of innovation can only be known retrospectively.

Despite the positive connotations associated with the concept of ‘innovation’, however, it is argued that in addition to direct, intended and desirable consequences, innovation may have indirect, unintended and undesirable consequences [6, 66]. Consequences are direct when they trigger an immediate response to an innovation, whereas indirect consequences are the second-order results of direct consequences. Desirable consequences refer to functional and undesirable ones to the dysfunctional effects of an innovation within a social system. Anticipated consequences are the intended and recognized effects of an innovation, while unanticipated consequences refer to its unintended and unrecognized effects.

A publicly expressed objective of the Virtu channel is the delivery of care services from a distance to elderly patients living at home. In addition that, the Virtu channel can be viewed from the standpoint of service productivity. The logic is that the productivity of welfare services can be improved either by producing more outputs of better quality at the same cost or by producing the same number of the same quality at less cost [67]. The Virtu channel, like many other telecare systems, involves a range of services, including virtual visiting, reminder systems, home security and social alarm systems, with the overall aim of avoiding expensive hospitalization and aiding ageing in one place [68]. The Virtu channel’s intended and desirable consequences for elderly people include an increase in the sense of safety and better interaction between elderly people and their friends and relatives.

Nevertheless, there are also several indirect, unintended and undesirable consequences of the Virtu channel to be identified. A negative complexity externality may be mentioned as a potential example of the indirect consequences of a complex systemic innovation such as the Virtu channel. This is because systemic innovation requires co-operation between the public, private and voluntary sectors, which, in turn, creates a complex service bundle that includes the perpetual novelty arising from the interaction and connectivity of elements in a given innovative context [35, 45, 57]. Uncertainty exists

because the connectivity of elements and perpetual novelty makes prediction of the consequences of the innovation impossible. This means that, in addition to planned outcomes, detrimental side-effects of the innovation may exist that might paradoxically become obstacles to renewal. Adapting Coughlin [20], it can be suggested that if things go badly, a loss of privacy, equity and dignity for the elderly people may emerge as undesirable and unintended consequences of virtual services.

Overall, advance evaluation of the consequences of an innovation such as the Virtu channel is difficult because of the characteristics of the services, such as the intangibility of the outputs and the strong role of clients in the production process. Laihonen & Lönnqvist [61], for example, have stressed that both the inputs and the outputs of service operations typically have intangible elements. Furthermore, it has been argued that in many cases, the real effects of service interventions can only be defined based on their long-term effectiveness. In addition, the purpose of welfare services is to increase the well-being of the citizens instead of producing monetary value based on the quantity of output sold.

It is also important to notice that there may be indirect and unanticipated, yet also positive, consequences of innovation. Innovation may have long-ranging intangible outcomes. It is reported that virtual services can, for example, facilitate remote communication and relationships with people that are important in the care of the elderly in their homes and for social interactions [70, 71]. At best, this may encourage elderly people to stay longer in their homes. It is also important to notice that a consequence of an innovation is typically subjectively evaluated by each client in relation to their expectations based on earlier experiences, the image of the service provider and many other intangible factors [69]. Based on the literature review and early findings of the Virtu channel project, the following proposition is presented:

Proposition 8: Possible indirect, undesirable and unintended consequences create uncertainty, which may hamper the development and adoption of systemic innovation in public welfare services.

VI. CONCLUSIONS

Employing a literature review methodology and case study, this paper has identified, categorized and discussed different aspects of the uncertainty of systemic innovation in public welfare services. Uncertainty may have two forms: 'known uncertainty' (i.e. lack of information) and 'unknown uncertainty' (i.e. multiple interpretations). This paper argues that uncertainty can be classified into eight categories: technological uncertainty, market uncertainty, regulatory/institutional uncertainty, social/political uncertainty, acceptance/legitimacy uncertainty, managerial uncertainty, timing uncertainty and consequence uncertainty.

Different manifestations of uncertainty have been linked to the adoption of innovation in the form of eight propositions. Although the propositions are based on the literature review and early findings from the ongoing innovation project, it

should be noted that these propositions are not indisputable. The classification of the uncertainty factors of systemic innovation into eight separate categories may be considered contrived. This is because, by definition, systemic innovation emerges from the complex interplay between various elements. The interdependencies between the uncertainty factors are implicitly derived from the very nature of the systemic innovation. Just as an example, the uncertainty regarding the legitimacy and acceptance of an innovation within welfare service providers is highly dependent on its perceived usefulness for their customers, which, in turn, is dependent on the providers' understanding of their customers' needs. Furthermore, it should be noted that the relationship between uncertainty and development and adoption of innovation is not straightforward. One cannot conclude that when there are conflicting interests (social/political uncertainty) in respect of any given innovation, for example, the result would always be a rejection of the innovation in question. Instead of setting up causal relationships, the propositions made here are more conditional in nature, forcing one to pay attention to important matters. It should be also emphasized that this paper has addressed uncertainty as detrimental for systemic innovation. Intuitively thinking, connecting uncertainty with inconvenience is understandable. Nevertheless, what is important to notice is that in the context of innovation, uncertainty has two faces. On the one hand, uncertainty is a state that causes dissatisfaction within organizations. The reason for that is obvious: individuals and organizations simply feel dissatisfaction because they do not know how to proceed in an uncertain situation. On the other hand, uncertainty also has positive implications for innovation. Hanft and Korper [48], for example, have argued that uncertainty may actually improve decisions around innovation because it can help to achieve agreement when "honest differences in fact and values might otherwise lead to intransigence". Foster [35] goes along the same line, seeing uncertainty as a necessary condition of innovation. Foster [35] admits that in a state of uncertainty, people have different and often conflicting beliefs that can result in many mistakes and errors. However, mistakes and errors are crucial because they can be eliminated and replaced by better beliefs in a process of competitive selection. Thus "errors and mistakes are not a bad thing; they are a necessary part of the process that generates economic growth" [35].

From a practical point of view, this paper helps to identify some of the possible blocks to systemic innovation in public welfare services. As an example, this paper emphasizes the various, often conflicting, stakeholders' interests, which may disrupt power structures and work routines within welfare services. In order to capitalize on the potential of innovation, this paper proposes that specific championing roles (e.g. the organizational maverick, the network facilitator, the transformational leader and the organizational buffer) in innovation might be established [72] with the aim of preventing escalating conflicts of interest turning into organizational inertia. Furthermore, in line with the work by Weick [73] March [74], Zack [12] and Brun et al. [13], among

others, this paper suggests that there are different 'knowledge problems' around innovation. 'Known uncertainty' of innovation can best be reduced by acquiring information and exploiting existing knowledge, while 'unknown uncertainty' around innovation can be addressed by acquiring interpretive knowledge and exploring new knowledge.

This paper also provides information for policy makers. It suggests, for example, that systemic innovation may be fostered by reducing uncertainty in relation to the regulatory/institutional environment of the innovation. In practice, this requires at least two things to be in place. On the one hand, governments should assure innovative firms that their efforts will be guaranteed, and, on the other hand, governments should provide municipalities with clearer guidance about how certain technologies may be used in the care of the elderly.

From a scientific point of view, increasing the understanding of uncertainty in innovation might perhaps eventually also provide new insight into notions associated with successful innovation. Since this paper has addressed 'uncertainty' as negative, or at least problematic, for innovation adoption, it would be interesting to focus on the positive effects of uncertainty in innovation in future research.

ACKNOWLEDGMENT

This article is part of the 'Virtual Elderly Care Services on the Baltic Islands' (VIRTU) project and has been funded by the European Regional Development Fund and Turku University of Applied Sciences. For more information on the VIRTU project, please go to www.virtuproject.fi.

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