Worklife Ergonomics in eHealth Co-Creation Governance

"You can't manage what you don't measure"

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***Abstract*—This is a conceptual article where we seek to combine the concepts of information systems frameworks and newer co-creation literature as a means to devise a model for servitization and digitalization. Servitization and digitalization are two megatrends that affect healthcare and public services along with other sectors in general. A new model is needed to prescribe how governance in an increasingly changing world of modern healthcare could be undertaken in a successful manner. The concept of good worklife ergonomics is studied, both as a prerequisite and as a success factor. This article proposes that the moderating, risk mitigating, factor of broadly based employee involvement in all phases from planning and design to implementation will greatly improve quality in both innovation-process, and outcomes. A case-study from a public homecare living lab eHealth-project in Norway is visited to highlight some of the challenges ahead. Our discussion and conclusion end up devising the proposed model, and further research into how this model can be implemented is recommended.**

Keywords-Co-creation; servitization; digitalizaton; healthcare; eHealth; worklife ergonomics.

I. INTRODUCTION

The purpose of this article is to develop a conceptual process-model for co-creation in eHealth innovation, that also supports a good worklife ergonomics for employees. The article is a result of a cross-disciplinary collaboration, between one medical doctor, specializing in health and work environment, and two doctors of philosophy in social science, with management information systems as speciality.

In many industrial countries, people live longer, but habitually with chronic diseases, due to better living standards and medical treatment advances. These changing population demographics mean there is an increasing demand for healthcare services [1]. eHealth technologies accompanied by changes in healthcare delivery processes and services, offer possibilities for a lower cost healthcare system, needed to meet future increases in demand for services. These changes can be referred to as servitization transformation [2] and put an emphasis on the interaction with customers that requires providers to offer customized and total solutions [2]. Digitalization capabilities support such servitization through employees' involvement and codetermination of what should count as key performance indicators. Digitalization is "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business" [3].

But, such change-projects often meet unforeseen barriers. Objections may be raised by the various professional groups themselves. Poor rooted changes risks leading to inferior solutions over time, which may work against their purpose. In Norway, primary care and homecare is a concern for the public sector; municipalities. Generally, new technologies and working methods, as well as new service providers, will have to absorb all the "tacit knowledge" inherent in the public organization to add new values to the services in an efficient manner. If employees are involved, they may be more inclined to become a driving force in the pursuit of a servitization strategy, that relies on developing digitalization capabilities, because the process of defining performance criteria promotes organizational learning [4].

In Norway, primary healthcare and homecare is the concern of the municipalities. Local government-initiated eHealth pilot-projects are often unconnected experiments. A shared and common process management methodology for both development and implementation phases, that incorporates employee involvement and collaboration, will arguably be a useful tool for public sector change leaders who want to introduce new technologies and working methods, or invite new service providers that relieve or complete the overall welfare offer to citizens. We will term this as Co-creation governance ('Co-creation' as a term is disseminated further in Section IV). Such a tool will be useful in the complex task of maintaining quality for both service recipients and service providing personnel – employees in the healthcare system. Lenka et al. [2] has recently proposed a model for co-creation between a product or service vendor and end-consumers. But, in eHealth innovation in the Norwegian context, system vendors, and health care providers are most often separate entities, so the health care provider generally add value through the combination of human services and the application of technology, not technology alone. Seen from the point of view of the health care provider, the research and development challenge can be put as:

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- How employees' involvement is ensured in eHealth co-creation governance?
- How this involvement contributes to ensuring performance quality on all levels of responsibility?

A potential solution to this challenge is the development of a shared digital capability to continually improve service quality. When in place, this capability will ensure that internal and external service producers act through a continuous quality improvement cycle from plan, check, act, and correct that improves service quality over time. This understanding of digital capabilities is in line with Lenka et al.'s model. But this article argues that this capability must be developed along two dimensions of co-creation or collaborative innovation:

- Horizontally along the chain of value co-creation, from ICT-vendor, through service-provider to home care service users, but also
- Vertically along a line of innovation-process governance, from front-stage service-personnel employees to top-management.

These capabilities must subsequently be built "bottom up" with the involvement and participation of all relevant municipal employees, ensuring that new and increasingly more technology enabled work processes still remain employee friendly, and thus improve the quality of worklife of employees as well as patients' quality of life [5]. This article will also show how Lenka et al.'s aspects of digitilization, servitization and co-creation are linked to our highlighted aspects of (worklife) ergonomics, Business Performance Management, and (Information System) governance.

Ergonomics is an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently [6]. Ergonomics is the science of designing the workplace, keeping in mind the capabilities and limitations of the worker and in such way, fulfil the goals of occupational health and safety, and productivity of employees [7]. The implementation of new digital services in healthcare involves several new work tasks, and thus represents new work processes and potential risk factors at the workplace. Knowledge of this should be addressed to prevent potential negative health effects among employees. This article proposes the term worklife ergonomics as a holistic term that encompasses the system of service production that spans over workplaces and involved employees. As such, worklife ergonomics as a concept considers the whole information system with people, processes and technology. Employee engagement and involvement brings a new and needed perspective into co-creation servitization, and digitalization.

Effective Business Performance Management, and (Information System) governance are important factors in achieving successful innovation, and the authors will show that such management tools need to be activated in parallel with the system- and service development processes. Employee involvement in the creation and execution of such management tools will serve to ensure the goals are met, and risks for failure are mitigated.

The rest of this article is structured as follows: In Section II, the authors shortly renders the methods used; literature search, and a comparison of the findings from this, with a research project performed in a Living Lab context. In Section III, the results from the literature search is presented; ergonomics in organizational change in general (A), and in the context of eHealth (B). In Subsection C, the result of the comparisons with application of concepts the case study is presented. In Section IV, using the Lenka et al. model as a guide, we propose a model for governance that incorporates principles for good worklife ergonomics in eHealth. In Section V, we conclude that the proposed model may contribute to meeting the research challenges proposed in this introduction and also devise avenues for further research.

II. METHOD

To devise a conceptual model of worklife ergonomics, we conducted a literature review to explore how ergonomics are used in relation to the concepts of eHealth, digitalization and co-creation. The authors were looking for principles in the literature that could guide us conceptually in designing a system that would encompass good worklife ergonomics.

A literature review was performed in October 2017. Using Google scholar, the literature was searched for articles containing the criteria (search string); ergonomics AND digitalization AND servitization AND health AND employees. By using such Boolean-logic operators; 'AND', the authors ensured that the findings where narrowed to only articles including all the key-terms, thus covering the desired context. This search and screening, resulted in three articles that provided concepts with substantially new insight (the rest of the articles screened, only briefly touched the key criteria).

The identified concepts from literature (see III, Results, Section A and B), were compared with findings from discussions from awareness-workshops in an eHealth Living Lab action research project in a municipality in Norway (see III, Results, Section C). In this project, the research team (including the authors of this article) held six awareness workshops together with representatives from the municipality (a joint project manager, ICT manager, management and employee representatives from municipal homecare and nursing services). The workshops focused on these topics:

- Stakeholder analysis
- Service design and 'design thinking' methods
- ICT-business as innovation partners (ref. co-creation with ICT-system vendors)
- Capabilities and organizational learning
- Enterprise performance management, and
- Scaling up innovations from a Living lab.

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Two of the authors also visited design workshops where front-line personnel employees in home nursing, together with municipal healthcare-department managers and eHealth researchers, discussed issues and requirements related to a specific service innovation, the use of digital night surveillance for patients in need of this, staying at home, with use of cameras with video conferencing functionalities.

III. RESULTS

The results are presented in relation to the key terms of the literature search. The identified articles offered design principles that can govern good worklife ergonomics in eHealth co-creation processes.

A. Ergonomics in co-creation – the role of employees

Neubauer and Stary [8] describe ergonomics as acknowledging the role of employees in innovation as leading to both improvements and financial benefits, through human-centred design.

Human-centred design for interactive systems promotes the following key principles [8]:

- The design is based upon an explicit understanding of users, tasks and environments
- Users are involved throughout design and development
- The design is driven and refined by user-centred evaluation
- The process is iterative
- The design addresses the whole user experience
- The design team includes multidisciplinary skills and perspectives.

Of advocation policies that could improve on this, Lopez-Gomez et al [9] suggest:

- Promoting the access to highly qualified personnel to develop new concepts and service innovations in-house
- Developing training methods for personnel to be able to adapt innovations acquired from external sources
- Need to better adapt curricula in education and training schemes to the demands of service economy
- Recognizing informal learning so as to increase the attractiveness of continuous training for employees
- Promoting modern innovation management approaches that better support creativity and autonomy of service workers [9]

B. Operationalizing these principles in eHealth

While the forgone citations are from industrial contexts, Beaumont et al [1] focus on service-design in eHealth, and propose that socio-technical, human-centred design approaches are better alternatives to techno-centric design. The article promotes joint innovation tools like service blueprints [10][11] and stakeholder analysis [5] in the form of Systems Scenario Tool (SST) [12]. SST combines stakeholder, and system gap-analysis.

The key points in the article are [1]:

- Telehealth equipment and services offer opportunities for bridging the future gap between available health resources and demand created by an increase in life expectancy.
- Current use of telehealth is limited by inadequate business models and service designs that fail to generate successful partnerships and value for customers and suppliers.
- Traditionally, healthcare providers have taken a techno-centric approach to the implementation of new technologies, which often results in unforeseen barriers to success.
- Design and implementation of new services can benefit from a socio-technical approach, which gives equal consideration to both social and technical aspects of a complex system.
- Co-creation of value requires new tools, such as the System Scenarios Tool, which provides stakeholders with a holistic framework to help model the implications of service offering and business model choices.

C. Design principles applied on a Living Lab project

Comparing these organizational design principles with experiences from the Living Lab project workshops, methods such as stakeholder analysis [5], and service blueprints (op. cit.), as devised in Beaumont et al, found in the literature review [1], proved to be useful in helping to design new services. To the known service blueprint template for process notation (swim lane diagram) we found it useful to add a band for step purpose and key performance indicators, see Fig. 1. In addition to showing the process following a timeline or sequence (steps), the process diagram shows activities at different levels of the information system. The levels include both those parts that are visible to the end-user and the processes back stage, below the “line of visibility” [11]. Adding the purpose of each step purpose makes it possible to extract user stories to form a system requirement documentation for hand-over to Information Technology Infrastructure Library methods (ITIL) [13]-[15] or agile system development [16], and refined further to precise technical architectures and instructions to ICT-system engineers. At the same time, adding key performance indicators can be a starting point for defining inputs to a joint enterprise process and performance management system.

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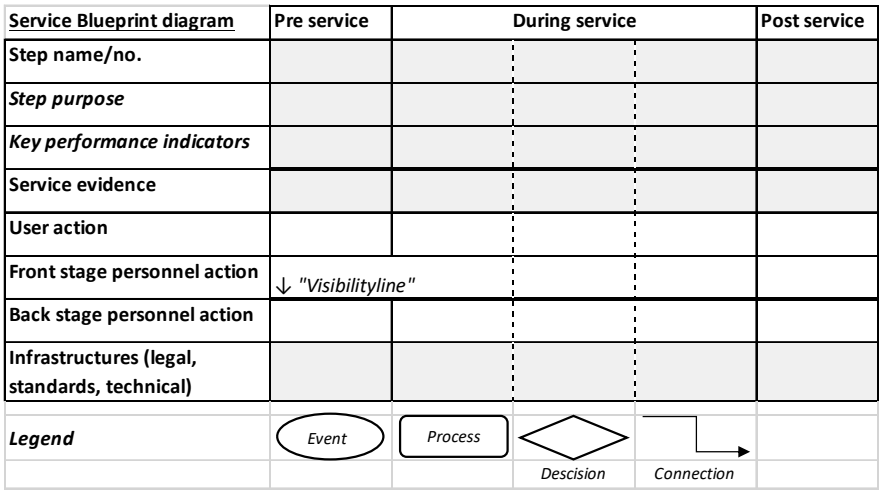

Figure 1. Service Blueprint diagram template, with “lanes” for purpose and performance indicators added

By adding the iteration of a workshop with all involved front-stage and back-stage personnel-employees, like in the Living lab-case (see Section II; Method), more aspects of a proposed innovation can be explored, before expensive investments and changes are made. Although our process modelling exercise showed the proposed camera-surveillance case to be technically feasible and may give potential benefits to homecare patients, it also showed that such an innovation also has major implications for the worklife for e.g., home nurses, as well as legal and privacy-issues in general, that needs to be examined and discussed further. The status, as this article is being written, is that the camera-surveillance case has been postponed, while other innovation-paths are explored; e.g., a new contact-centre and alarm-reception central.

IV. PROPOSITION

This article proposes that enterprises that want to succeed with eHealth innovation and co-creation over time, need to secure the involvement of their frontline personnel, because they are key to establishing a Business Performance Measurement system. There are numerous definitions of what a Business Performance Measurement system contains. In a literature review, Franco-Santos et al. [17] identified these main features [17]:

1. Performance measures
2. Objectives/goals
3. Supporting infrastructures (including data acquisition and analysis)
4. Targets (gauges – does the enterprise meet its targets)
5. Causal models (what are drivers for successful performance)
6. Hierarchy/cascade (organization, delegation of concern)
7. Performance contract (negotiated contractual relationships with stakeholders)
8. Rewards (incentives)

Co-creation is a relatively new term. It has become part of the slogan and strategy of many universities. But what does it mean in practice and where does the term come from? A recent review by Galvagno and Dalli [18] traces the term back to three theoretical perspectives including service science, innovation and technology management, and marketing and consumer research. The literature on co-creation operates on two levels of analyses: company centred vs. customer experience centred. Apparent themes in the literature include co-creating value through customer experience and competence, service innovation, including digital customer involvement. Today, service science and marketing play a major role in the literature and refer to the involvement of customers in the supplier's product- and service development. In information systems research and management research, the term co-creation has been used by, among others, Grönroos and Voima [19], and Lenka et al. [2].

Lenka et al. have provided a model that will explain the connection between "megatrends" in industry and working life; digital development and change ("digitalization") and development of a service culture in production-oriented environments ("servitization") through co-creation processes. As authors, we agree with Lenka et al., that an important prerequisite for success is the development of digitalization capabilities in service-based organizations. These digitalization capabilities in turn, will govern the "Value Co-creation" mechanisms; consisting of two main mechanisms; one linked to needs analysis (perceptive mechanisms) and one linked to design and construction cycles (responsive mechanisms). Between these two (from observation to design and construction), knowledge about measurement

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points is transferred to goals and values that form the basis for implementation of the service (in design and construction). Both mechanisms must be repeated for each overlapping link in the value chain.

Moreover, we propose that the change work done in these overlapping links in the value chain can be expressed (including the core, the actual digitalization capability) as Deming Cycles (Plan-Do-Study-Act), see Fig. 2.

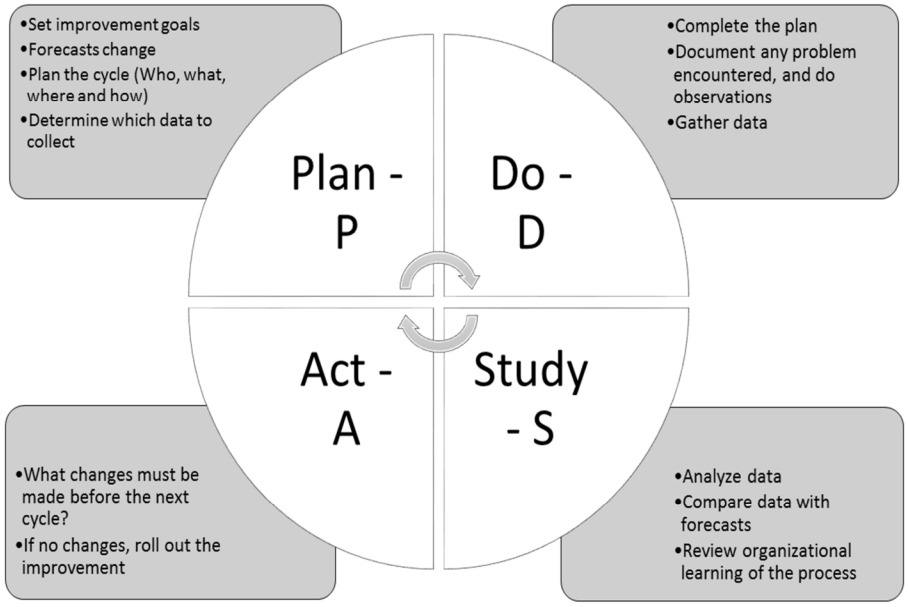

Figure 2. Deming cycles

Iterative development-cycles like this allow the time for involvement of both external and internal stakeholder groups, and should include discussing goals and measurements. The saying “You can’t manage what you don’t measure”, referring to our sub-title, is attributed to both W. Edwards Deming and Peter Drucker.

Focus in achieving worklife ergonomics will be the relationship between the observational input and response outputs from the service co-creation and system co-creation cycles as a prerequisite for successful eHealth co-creation governance. Lenka et al. states, that value is added at each part of the chain, as new actors bring in new experiences, see new opportunities and add new value to the service. This includes the service consumers themselves, and their next-of-kin. The measurement system will be a trigger for new innovations, while being a missed "GPS" guidance system, to find the way [20]. Such a system will also act to spur organizational learning, providing incentives that motivate and intensify innovation [20].

To stay relevant, since the frames, and context, of the eHealth area is rapidly changing, we believe that the overall quality system (Process and performance management system) itself must be agile and subject to at least annual evaluation (a slower Deming cycle), while the services that the system controls, go through its many and fast Deming cycles. Together, these form a proposed conceptual process-model for co-creation in eHealth innovation, that also supports good worklife ergonomics. The concept is illustrated in Fig. 3.

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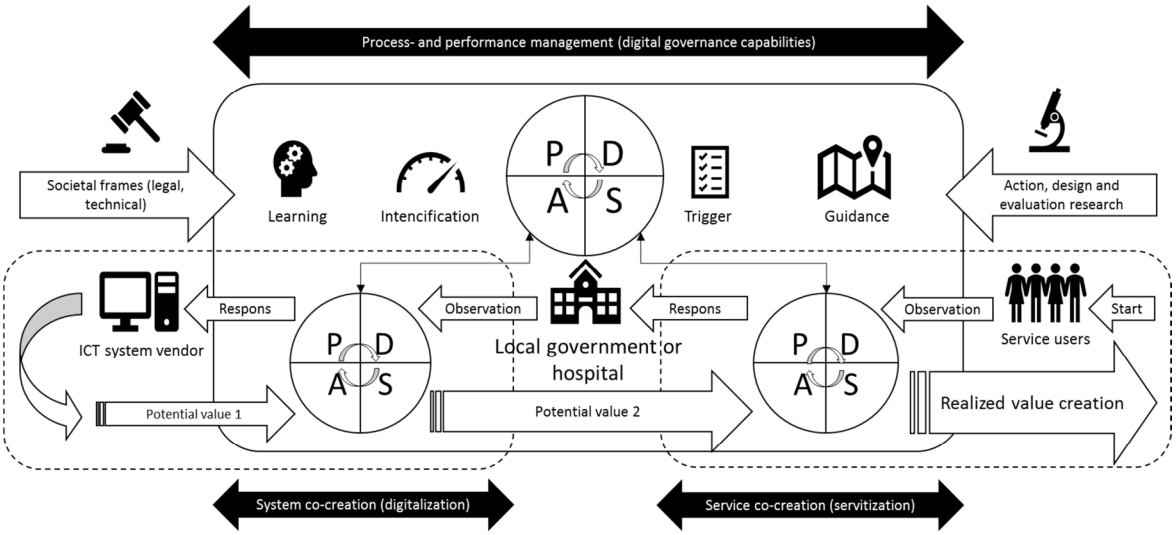

Figure 3. Process-model for co-creation in e-Health innovation; The ecosystem (Based on Lenka et al., 2017)

When it comes to the Plan-Do-Study-Act cycles in the value-chain (system co-creation, service co-creation) – different process modelling tools, like swim lane diagrams, can be used to visualize, convey, and discuss the consumer journey with stakeholders, using e.g., "Service Blueprint" or similar [10]-[21].

All in all, the goal is that the entire ecosystem is set in a state of continuous improvement and value innovation, and that a shared and improved service culture in the municipalities and their partners, (servitization), develops through digital transformation. This secures the ability to go back and start again, if necessary.

V. CONCLUSION AND FUTURE WORK

This article has shown that for the purpose of establishing a Living Lab concept, and achieving digitalization and servitization throughout the organization, the following elements are necessary; digital governance capabilities, process and performance management methods and systems that align new technologies with high quality work processes (worklife ergonomics), and appropriate tools to visualize and communicate processes and services with end-users, as well as different professional employee groups involved, front stage and back stage. By involving employees though iterative project-cycles and achieving a general consensus on what goals and measures should count, the necessary sorting and maturing of ideas is achieved, so that failed changes can be avoided before too great investments are made and lost.

Other factors that are necessary are processes that align local service strategies with central government legal and technical frames (compliance). In Norway, much of this is still in the making, and health information systems are generally not interoperable, but a joint information infrastructure is under development in mid-Norway (a joint health information platform and the "One resident – One joint health journal" project), and is expected to go national in 2022 [22]. More research is needed on how these different eco-systems (central, local) can be efficiently combined.

More research is needed into innovative means of capturing both qualitative and quantitative data about end-users or patients' using "Big data"; combining e.g., social media and transaction data from the service systems. More action, design and evaluation research are also needed for devising how the proposed model (Fig. 3) can be implemented and operationalized in a manner that ensures both employee and end-user involvement and commitment for achieving a high quality, lower cost health care system, while maintaining a high quality of worklife.

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