

Current challenges of healthcare co-creation and testbeds

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Abstract

In the recent years, co-creation – especially in the form of testbeds – has been more and more utilized in healthcare sector. As is common in the Northern Europe, most of the testbed services are offered by public sector organizations, such as higher education institutes. These kinds of organizations have core functions, that are often defined in the law, and co-creation in one form or another, may not be included in the functions. It follows from this that the operational maturity may differ significantly from one testbed to another. This paper investigates the current state of the Finnish healthcare testbeds, their “good” and the “bad”. The data used in this review was collected during the development of Health Care Testbed Maturity Assessment instrument (HCTM). During the development, a series of so-called friendly audits were performed on Finnish testbeds, during which the testbed operators’ insider views were collected for later use alongside data used for instrument development. This article will summarize these views, provide a current view to the Finnish healthcare testbeds, and conclude with practical remarks on how to develop the maturity of Finnish healthcare testbeds.

Keywords: healthcare, instrument development, Finland

Introduction

Co-creation in the field of healthcare has been a current topic in Northern Europe for some time now – both in theory and practice. The reasons for this continued interest vary, but one aspect remains constant. To ensure that the field can keep up with the advances of the surrounding world – especially those that are related to technology – it needs to renew itself from time to time. In this, practice-oriented co-creation and constant dialogue between the health service providers, end-users, and innovators from within and without the field, is of the essence [1].

Recently, testbeds have become the de-facto tool for co-creation, especially in the Scandinavian setting and in the U.K. [2,3]. Testbeds, like other concepts of similar nature (e.g., living labs), emphasize the “interplay” between different actors with a shared interest in improving the current way of working [4,5]. The tools for this improvement may vary, and they typically do. For example, the company may focus on improving its product or service over the course of co-creation, while the involved clinicians may focus on improving the underlying processes or practice [4]. In this, “different side of the same coin” is an apt depiction.

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As long as these vectors – or interests – in co-creation are parallel, and there is no fundamental conflict between the involved actors, co-creation can be a fruitful endeavour. One that is coupled with the renewal of the field through an agency – a solution developed in a testbed. As the roots of this interplay are deep in everyday work, the context of use for the tested solutions, testbed as a concept, has close links to the field of Work Informatics (WI). The theoretical framework focuses on phenomena that occur on the border between work and technology [6], ones that testbed activities bring to light during the testing.

While testbeds are a stage for the co-creation and renewal of the healthcare sector, they are also a service. This can be a challenge in Scandinavia, especially in Finland, where most healthcare testbed services are offered by public sector organizations, such as higher education institutes and public health service providers [7,8]. For organizations like these, offering co-creation services, or any kind of services with a price tag and value proposition, is often a path less travelled.

These kinds of organizations have core functions that are typically mandated in national legislation. In simpler terms, education institutes educate, and healthcare organizations provide care. None of these organizations exists primarily for the purpose of offering services that help create new services in the field of healthcare [9]. It follows from this mismatch between core functions and co-creation that testbed services perform on a level that is less than desired from the perspectives of the companies (i.e., customers).

To help the healthcare testbed service providers (that is, public organizations with different core functions) to understand where they are in terms of the level of service, an instrument suitable for evaluating the maturity of testbed services was created in the *Health Campus 2.0* project. The 2-year project was funded by the Academy of Finland and ended in 2022. During the project, an evaluation instrument was created and tested in the form of a friendly audit with 11 Finnish healthcare testbeds.

While the development process produced primarily quantified data about different aspects of maturity, the process also yielded emic [10], or insider views, of the current state of healthcare testbeds in Finland. This paper aims to investigate/describe the current maturity status of Finnish health care testbeds in terms of the "good" and the "bad". This paper will provide current information on strengths and weaknesses of Finnish healthcare testbeds. As the title suggests, the focus of investigation is more on weaknesses, as the pose primary challenges for testbed operators to overcome in terms of a) improving the quality of operations, and b) answering to the testbed users' – or customers' – needs.

Material and methods

This study was a pilot study, and the data was collected with an instrument developed for the study purposes. The instrument development process followed the steps defined in [11]: item generation, face validity, content validity with an expert panel and testing (Figure 1). The first step, item generation, focused on the factors that would describe the basic characteristics of the subject, the maturity of a healthcare testbed [12].



Figure 1. Development Process of the Instrument (overview).

In the next step, the identified maturity factors were brought into scrutiny. These were resources, facilities, marketing and communications, repeatability, contract models, certification and standards compliance, and time at the market area [8]. These factors were used in formulating ones that were regarded, at the time, as final ones. These were operations, ecosystems, facilities, personnel, funding, quality, and marketing and dissemination [13].

The factors, and the more detailed items on each factor, were first evaluated by the research group, and after a review round, by an expert panel (7 members). Most of the expert panel members had Ph.D. degrees, and their experience in the field testbed and healthcare innovation activities varied between 2 and 10 years. The experts' review included assessing clarity, importance and relevance evaluation for each instrument item using a four-point scale (from 1=not clear/important/relevant to 4=highly clear/important/relevant). The experts also commented on the content and coverage of the instrument and suggested new items to be included in the instrument.

The data collection and actual pilot testing followed after revisioning, and it covered 11 healthcare testbeds in Finland. The pilot testing was conducted as a friendly audit, as the focus of the testing was the instrument, not the maturity of the testbed. In the friendly audit, the testbed managers, and other operatives, were asked to self-assess the current functions of their testbed with the instrument

without any form of formal proof that could have been used in a more formal evaluation. The primary audit data was collected using Webropol 3.0 programme. The testbed representatives could choose the most suitable answer for each question in the instrument.

Each testbed was audited independently, with one or two representatives from the testbed. Due to the geographical distances, and the current Covid-19 situation in Finland, auditions were conducted online. Each audit performed lasted approximately one hour, during which they answered a set of questions in each factor. If the representative needed help with some items, the researchers clarified what was meant by the question and wrote down remarks for later work with the phrasing. After the friendly audit, the representatives could provide feedback on the instrument and discuss openly the healthcare co-creation in Finland. After the audit, the research group provided feedback for the testbed, including strengths and weaknesses related to the maturity and suggestions for improvement that could be implemented immediately or in near future. The data was stored in a secure environment and used in accordance with the agreement on the processing of personal data, which was provided to the interviewees prior to an audit. All interviewees had an opportunity to decline from the audit.

The secondary audit data (feedback, discussion, and comments on questions) were selectively

transcribed (non-verbatim summary) individually by all participating researchers. The average length of transcription was 500 words (one A4 page) per researcher. This data was used primarily for rephrasing the questions in each factor, but due to their narrative content, it was possible to use them as the primary source of data in this article. The primary audit data was analysed using descriptive statistics, including means, medians and maximum and minimum for each testbed and instrument factor. Due to the sample size (number of testbeds), it was not possible to analyse the data using inferential statistics. The secondary audit data was analysed using content analysis; the findings were categorised into positive (the good) and negative (the bad) aspects of maturity, creating the following sub-categories: commitment, support and facilities (the good), and resourcing, funding, specialisation and quality (the bad).

After the pilot testing, the finalized instrument was formulated, and the primarily quantitative results, the level of maturity from friendly audits, were analysed for publication purposes. The finalized instrument was named *Health Care Testbed Maturity Assessment instrument (HCTM)*.

Results

The good

Commitment. One thing that the interviewed testbed representatives repeatedly underlined was commitment. Regardless of the resourcing and role allocation challenges, all representatives were highly motivated and confident in their services. Partially this enthusiasm could contribute to the novelty of the testbeds, as most of the testbeds had operated for two years or less. On the other hand, with one exception, the representatives had worked with healthcare innovation activities more than that and had realistic expectations of what working with co-creation and innovation activities in Finland would entail.

As a matter related to commitment, all representatives portrayed a sense of purpose, and pride in their work, referring to themselves often as healthcare “reformers” and “innovators”.

Support. The testbeds were evaluated on two levels; as units of their own and as units that were part of a background organization, which provided the bulk of the used resources, facilities, and administrative support (incl. law services) to the testbed (Figure 2 below). The relationship between the testbed and the background organization (such as higher education institutes or hospitals) was commonly depicted as a healthy one, and testbed activities were supported by the organizations – at least for the time being.

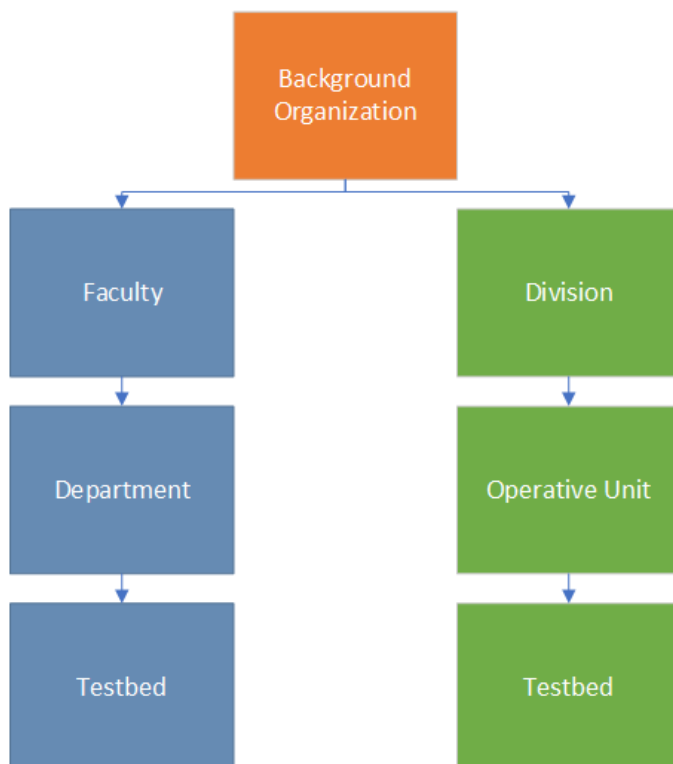


Figure 2. Testbed and background organization, example.

Facilities. As a matter related to the support of the background organization, the facilities of the evaluated testbeds were on a good level. Some of the services were provided in simulation centres and similar facilities that were also used for teaching or training. Only in one case, the facilities were reserved solely for the testbed services, and even in that case, the facilities were also used for supporting the practical planning of the new hospital building (e.g., patient rooms).

Facilities also translate to other things besides mere “walls”; it also includes equipment and furnishing, which can be specialized in the healthcare domain. Besides hospital cots and similar tools of the trade, the testbeds also hosted more specialized gear, such as patient simulators, that have come a long way from CPR dummies of the past. Primarily due to their association with educational activities, the testbeds also hosted specifically built

environments, such as the insides of an ambulance, that were available for testbed services.

The bad

Resourcing. While motivated, the people working with testbed services are few. In all cases, the representatives reported that there was a person responsible for testbed activities, but the person was also a kind of a “jack-of-all-trades”. This means that the person providing the actual service was also responsible for the bulk of marketing, drafting agreements, strategy work, writing funding applications... the whole nine yards that one can imagine as tasks and duties in a healthcare testbed (well, excluding cleaning the facilities).

This kind of resourcing which is unarguably stretched too thin in every case encountered during the interviews, seems to resonate with misalignment between the core functions of the

background organization and testbed services. Even though deemed as an important function that contributes to teaching, training, research, etc., the primary resourcing and more permanent positions are put on core functions. If there is time, and especially if there is external funding, the testbed services are ramped up accordingly.

Naturally, the lack of resourcing impacts other functions of the testbed services. When the representatives described how their marketing activities are carried out and how new customers are acquired, it was done by the same generalists who perform every other activity as well. During the interviews, only two testbeds reported that they have part or full-time resources available (from the background organization) who support them with their marketing-related endeavours. In the same vein, there was only one testbed who stated that they have a formal marketing plan that they are executing (or trying to execute, resourcing considered).

Funding. In all cases, the testbeds reported that their activities are partly – or even entirely – dependent on external funding. As external funding was portrayed in most cases as the lifeblood of the testbeds, it was also the activity that periodically (that is, when a specific call like European Regional Development Fund was open) drained almost all resources available for the testbed.

Only in two cases, the formulation of the well-being service counties that was about to happen at the turn of the year (in 2023, after the interviews), the representatives expected that their testbed services would be funded fully and continuously by the counties. While the realization of this expectation was not evident at the time, it seems that the representatives were at least partially correct, and counties fund these testbeds as part of their research, development, and innovation activities.

While this is an improvement, there are still issues of funding that need to be addressed. As public organizations primarily receive their funding for core functions, funding the testbed services can be challenging. More so in the healthcare sector, where personnel resources are scarce nowadays. It may follow from this that while testbed services can be considered as important, staffing them from the core functions may not be an option. However, if the testbed services can be linked to core functions, for example, as an extension of the third mission of the universities [14], the situation may vary.

On a darker note, there were two issues that were shared by all testbeds, where the problems of the Finnish healthcare testbeds are the most evident. The first one was lacking specialization.

Specialization. Amongst the 11 interviewed testbeds, the similarities amongst the ones hosted by universities of applied sciences [8] were striking. Five testbeds reported that they focused on the co-development of consumer-side applications that measure individuals' well-being (such as sports trackers) in simulated facilities (i.e., laboratories).

While the consumer-side markets for these kinds of wellness products (health, fitness, nutrition, appearance, sleep, and mindfulness) are staggering, with estimates of US\$8.09bn in the EU by 2027 [15], it is doubtful that the Finnish testbed services in that domain area have the necessary market reach – or can offer the level of quality in their testbed services required by the industry.

Quality. Level of quality – or, more specifically, lack of quality assurance functions, is the absolute worst trait amongst the Finnish healthcare testbeds. With a singular exception, the testbeds operated on an ad hoc basis – problems were addressed as they occurred, services were provided primarily based on intuition and experience, and customer feedback

was not routinely collected. Another aspect of this lack of formality and process-oriented operation was that the services themselves were commonly abstract, without a name or a price tag.

At the core of these problems with the Finnish healthcare testbeds, is the mismatch between core functions of the background organization, and testbed service provisioning. While details of this mismatch have been reported earlier [16], they can be summarized as follows. Firstly, if testbed services are not core functions of the background organization, they are commonly resourced in a piecemeal fashion; the existence of the testbed may rely solely on external funding (projects), and the services are run by people who are primarily assigned to core functions (such as teaching).

Secondly, a derivate of the first problem, the testbed services are not sufficiently promoted to attract a wider clientele. That is, there is a constant fear that if the testbed services become too popular, there is not enough resources to run the core operations. Especially in healthcare domain, this is a real problem as resources have become scarcer than ever.

Another way to approach this mismatch is to investigate value creation. In testbed functions, the value creation primarily (not solely) occurs on the customer side (provider of the solution to be tested) and not on the user side (testbed service provider). However, in the healthcare domain, and how testbed services are typically organized in Finland, value creation is expected to occur on the testbeds service provider side. As the central notion in testbeds is co-creation, finding a balance between these kinds of value expectations is a vital component.

Discussion

Based on the maturity assessment, healthcare testbeds should focus on developing their quality assurance functions, for example, by conducting a formal evaluation and developing their documentation of processes. They should also invest in competent personnel, including the testbed's own permanent personnel, which can be completed with temporary personnel based on the testing needs. The testbeds should also have varying facilities, both authentic facilities, such as hospital wards or nursing homes, and simulated facilities, such as simulation centres or test laboratories. Simulated facilities are suitable for early-phase testing of new innovations, for example, when testing the user-friendliness of a particular product. Still, authentic facilities are required when testing a new product or solution that is intended for patient care.

Healthcare testbeds should also be part of larger innovation ecosystems and networks. The ecosystem or network can be regional, national, or international. With the help of an ecosystem or a network, the testbed can find the best partner organisations that complete each other's competencies and focus areas and can offer various testing facilities. Ecosystems and networks can also build bridges between testbeds and public procurement [9]. The testbeds should also invest in marketing their testbed activities so that the health technology companies find the testbeds. The testbeds should highlight their strengths and focus areas on marketing to find the best matching companies. With clear roadmaps and process descriptions, especially startup companies may find the best testbed to enter the market [9]. The ecosystems and networks may also be beneficial in marketing to receive larger visibility to testbeds.

While talking about ecosystems, and more specifically about integration into the surrounding

business ecosystem, an interesting opportunity for healthcare testbeds has arisen after the completion of the Health Campus 2.0 project. The newly (2023) formulated well-being service counties in Finland are exploring new ways to organize their research, development – and acquisition – processes. This creates unique opportunities for healthcare testbeds operating in the public sector to be integrated into acquisition processes and overall renewal of the field.

In this, a) collecting needs from operational units and b) using them for steering testing in associated testbeds is of the essence. In other words, validated needs could be used for prioritizing testing in the testbeds and even be linked to the development strategies of the counties via innovative acquisition processes.

On the business side, needs-based testing could not only help in ensuring the matching of the solution to an actual need, but it could also help in finding the first and the most important reference customer for their new solutions. Nowadays, one problem in Finnish healthcare markets is that the companies need to find their reference customers outside Finland and then return to home markets with the reference – or ignore home markets completely [17,18].

Another aspect worth noticing comes from sustainable development. Globally, healthcare sector accounts for 1-5 % of global environmental footprint [19]. In Finland, emissions from the sector accounts for 4.2 % of Finland's carbon footprint [20]. Taking these factors into account when offering testbed services, moreover services that are linked to acquisitions, opens new opportunities for business on both “ends” of co-creation – testbed services and tested solutions [21–23].

Sustainable development should contain both environmental and social aspects. The environmental aspects contain, for example, the life cycle of materials and products, and the social aspects contain, for example, equality in recruitment and wages. In addition, many health technology companies nowadays may have plans and processes for sustainable development, meaning sustainable development processes are also required from organisations providing testbed services.

Finally, we argue that formal assessment of service maturity should become the norm in the context of healthcare testbed services. To serve this purpose, we have developed an instrument that covers a broader range of maturity-related aspects, from running daily operations to marketing and to re-sourcing the offered services.

Organizations offering healthcare testbed services should understand that formal maturity assessment will become even more important if the services are offered as a part of a wider service network, such as a European Digital Innovation Hub (EDIH) or a business development-focused network (e.g., Nordic Proof). Without formal assessment, there are no guarantees of service quality, no clear understanding of the strengths or weaknesses, and no path forward in terms of service development.

These issues become of the utmost importance when the testbed services are to be offered on a business basis, practically on the same level as the core functions (or even as a part of them). In addition, the customers of the testbed services should expect formal assessment, especially in the situation when the testbed offers some level of validation to their product, for example, in the form of a reference or a certificate. A certificate that is based on ad hoc operations and informal opinions is rarely more significant than a bumper sticker.

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Conflict of Interest

The authors declare no conflicts of interest.

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