Finnish Journal of eHealth and eWelfare

SCIENTIFIC PAPERS

VERTAISARVIOITU
KOLLEGIALT GRANSKAD
PEER-REVIEWED
www.tsv.fi/tunnus

Maturity of health care testbeds – A qualitative mapping at the Nordic context

Emilia Kielo-Viljamaa[1], Eva Collanus[2], Janne Lahtiranta[2], Antti Tuomisto[2]

[1] Novia University of Applied Sciences, Turku, Finland; [2] University of Turku, Turku, Finland

Emilia Kielo-Viljamaa, PhD, RN, Senior Lecturer, Novia University of Applied Sciences, Henrikinkatu 7, 20500 Turku, FINLAND. Sähköposti: emilia.kielo-viljamaa@novia.fi

Abstract

This qualitative mapping aimed to report health care testbed activities in Finland and two other Nordic countries and describe the maturity of these testbeds. The data were collected in 2021 with semi-structured interviews from twelve organizations, of which seven were university hospitals, four universities of applied sciences and one primary health care organization. The data were analyzed using deductive content analysis based on previously identified maturity factors: resources, facilities, marketing and communications, repeatability, contract models, certification and standards compliance and time at the market area. According to the results, there were testbed activities in all participating organizations. The testbed activities mainly were funded from various projects, and the staff mainly consisted of single employees. The testbed facilities were both real-life environments and test or simulation labs. The marketing and communications were based on web pages, social media, events and networks. The repeatability was ensured primarily with usability testing, and the contract models were under development in most organizations. Certification and standards of compliance were rare. Time at the market area was relatively short in many organizations as the activities were mainly testing single products or services rather than continuous co-creation. Testbed activities in the health care and higher education organizations are merging with the daily operations in Nordic countries. Specialization within the organizations was seen, for example, robotics, rehabilitation or medical devices. Testbed organizations highlighted the need for more structured and coordinated processes and activities in order to ensure the management, quality and effectiveness of their testbed services.

Keywords: health care sector, maturity

Introduction

The testbed can be defined as a platform that allows companies and other co-creation participants to develop, experiment and test their new products and services in a real or simulated environment [1]. The right environment and real applica-

tion situations can demonstrate the safety and usefulness of the tested products and services [1]. The platform can be either physical or virtual [2].

Testbeds, *also known as test labs, living labs or innovations labs*, can be in different contexts like a hospital, school or airport contexts [3], and the customer can be anything from a startup company to a large enterprise or public organization [2]. In this paper, the focus is on health care testbeds in hospital and higher education contexts. In the previous literature, testbeds or living labs in health care have been used, for example, in developing dementia care [4], primary health care [5] and health promotion and rehabilitation [6]. Instead of only testing, new and existing services or products can also be co-created together with the company and the health care ecosystem [7].

In terms of usefulness, one particular aspect that separates testbeds from laboratories and similar (off-site) testing environments is value creation. Regardless of the domain, the primary interest of the companies using the testbed services lies in creating business value (i.e., revenue). However, especially in the health care domain, the value creation of the participating individuals (e.g., end-users or clinical experts) is realized elsewhere [c.f. 8]. In the domain, the value is created in the work processes of the individuals, which is, more often than not, a synonym for patient care. Finding a balance between the value creation of different stakeholders is not always simple, especially in Finland, where health care testbeds rarely operate as business units.

Health care testbeds can be organized by both public and private sectors. However, in Finland, the most known testbed environments (or networks of testbeds) are Health Campus Turku, HUS Testbed, OuluHealth Labs, and Kuopio Living Lab [1] - all of them organized by universities, university hospitals and/or cities and other public sector organizations. When something is innovated specifically for the public sector, the co-creation participants can be “citizens, companies, third sector organizations and/or universities” [9]. Haukipuro et al. [3] have listed many benefits companies get when participating in co-creation and testbed activities. For example, it enables cooperation and direct interactions with customers and product end-users and gives a use case and a reference to the companies.

Testbeds' maturity (readiness) can be assessed based on their operations, which can be assessed using factors or elements [10-12]. Examples of maturity factors in the health care context have been identified in the previous literature; resources, facilities, marketing and communications, repeatability, contract models, certification and standards compliance and time at the market area [e.g. 12-14]. The maturity of the testbed is an essential background factor when testing the usability and effectiveness of innovations in the health care field, as the maturity of the testbed might have an impact also on the findings related to the testing activities [9]. Furthermore, maturity aims to systematically increase the capabilities of the processes in the organization [15]. In other words, process maturity indicates how close a developing process is to be complete and capable of continuous improvement through quantitative measure and feedback [16].

This qualitative mapping aimed to report health care testbed activities in Finland and two other Nordic countries and describe these testbeds' maturity. The mapping aimed to find answers to the following questions: 1) What kind of testbeds exist in the health care field in Finland and other Nordic countries? 2) How does the maturity of the testbeds appear concerning maturity factors of

testbeds? The goal was to provide new knowledge related to the selected health care testbeds and their maturity, which can be used when developing testbed activities and their maturity assessment methods to ensure more valid and reliable testing of new innovations.

Material and methods

Setting and sample

The setting of this mapping was health care testbeds in university hospitals, primary care organizations and higher education institutions in Finland and other Nordic countries. The focus was on Finnish testbeds, but testbeds were also recruited from other Nordic countries for this mapping to receive more comprehensive data. The university hospitals in Finland were chosen using total sampling. The university hospitals in other Nordic countries, the primary care organizations and higher education institutions were selected using purposive sampling [17] based on previous information of their testbed activities. The aim was to choose testbeds that showed at least some level of testbed activities based on the information on their web pages.

In Finland, university hospitals belong to specialized health care, which means specialized medical care in hospital settings provided by hospital districts [18]. Primary health care instead includes, for example, home care, long-term care facilities and hospital care for patients who need nursing services [19]. The care is provided by municipal health centres. Specialized and primary health care belongs to public health care [18]. Universities of applied sciences are higher educational institutions that provide both bachelor's and master's level education based on the requirements of working and its development [20]. Universities of applied sciences educate, for example, registered nurses and engineers, and most of the degrees provided at universities of applied sciences are bachelor's level degrees. Nowadays, some universities of applied sciences in Finland are also licensed as health care providers. Health care is publicly financed in all Nordic countries [21], and the degree structures in higher education are comparable [22].

Data collection

The data were collected in April-June 2021 using semi-structured remote access interviews [17]. The structure of the interviews consisted of eight general questions about the testbed activities and eighteen maturity questions, of which were based on seven previously identified maturity factors: *resources, facilities, marketing and communications, repeatability, contract models, certification and standards compliance* and *time at the market area* [e.g. 11-13]. Examples of the questions were: "What kind of products/services can be tested at your unit? (general)", "What kind of companies/organizations have you been working with related to testbed activities? (general), "Who is involved in the testbed activities at your unit? (maturity: resources)", "What kind of facilities do you have for testbed activities? (maturity: facilities)", "How do you report your testbed activities? (maturity: marketing and communications)". All questions were open-ended questions.

The corresponding author contacted the testbed representatives and settled the interviews. Totally, 15 testbeds were contacted, of which 12 agreed to the interview. The corresponding author conducted all interviews, started each interview with the general questions, and moved to the maturity questions. The navigation between the questions was not beforehand designated; instead, the discussion was more uncontrolled and informal. The

questions could have been asked partly parallelly, meaning that some were skipped if the answer was already received when asking another question.

All interviews were conducted in spring/summer 2021 via Microsoft Teams due to the COVID-19 situation at that time and because the participants were from different countries and cities. The interviews took approximately 30 to 45 minutes each. Totally twelve organizations were interviewed. One to three persons from each participating organization participated in the interviews. The interviews were not recorded but encompassing field notes were made. The interviews were conducted in Finnish, Swedish and English.

Data analysis

The data were analyzed using deductive content analysis [17] by the corresponding author. The following seven maturity factors were used to analyze the data: resources, facilities, marketing and communications, repeatability, contract models, certification and standards compliance, time at the market area. At first, the corresponding author read and transcribed all the field notes (approx. 14 pages). After that, each interview (organization) information was gathered to a table that included the general information, activities and focus of the testbed and experiences of testbed activities, and information related to the seven maturity factors. Furthermore, similarities and differences regarding the maturity were sought from the data that was sorted and organized to present the maturity of the participating testbeds. Finally, the findings of each maturity factor were categorized as low and high-level maturity that could be used to describe the variation of the testbed maturity levels.

Results

Testbeds

Totally, twelve organizations that had testbed activities were interviewed, of which seven were university hospitals, four universities of applied sciences and one primary health care organization. Ten testbeds were in Finland, one in Sweden and one in Norway. The Finnish testbeds represented different geographical locations. Testbed activities in university hospitals were closely connected with the local university, which is why the universities were not interviewed separately.

Specialization of testbeds

The university hospitals were often specialized in a particular technology, such as medical devices or diagnostics. The universities of applied sciences also had specializations like robotics or welfare technology. Testbed activities in universities of applied sciences were part of the research, development and innovation (RDI) activities, the main task for universities in applied sciences together with teaching. In the primary health care organization, testing related to home care and rehabilitation were emphasized in their testbed activities. Close cooperation with other local health care providers and educational institutions also had a key role, as RDI operations are not the main field of activity for health care providers in Finland.

Strengths and challenges

Organizations named cooperation at the regional and national level and co-creation with companies as strengths. On the other hand, limited resources, heavy bureaucracy, the different needs between the company and the testbed organization, and the possible unpreparedness from the companies' side were named as challenges. Testbed organiza-

tions highlighted the need for more structured and coordinated processes and activities.

Maturity of the testbeds

Resources

The testbed activities in the participating organizations mainly were funded from various projects. However, testbed activities as a business activity were becoming more and more common. The testbed activities were coordinated by testbed managers, coordinators or project leaders. Other professionals, like nurses and physicians from the hospitals and teachers from the universities of applied sciences, participated in the testbed activities on occasion. Students were also often involved in the testbed operations in the universities of applied sciences and could do their practical training periods or write theses related to the testbed activities. The number of full-time permanent employees in the testbeds varied between one to six persons. However, in organizations where research had a central role in testbed activities, the number of employees was much higher as the researchers were involved in the testing activities.

Facilities

In most university hospitals, the whole hospital itself was a testbed environment, but there were also laboratories and simulation facilities for the testbed activities. In primary health care, the testbed environments were also real-life facilities, for example, patients' homes and out-patient clinics. In the universities of applied sciences, the testbed environments were mainly laboratory and simulation facilities at the campus. Still, testing in real-life facilities was also possible in many organizations cooperating with local health care providers.

Marketing and communications

Testbeds in the participating organizations were advertised using web pages, social media, networks and events. Branding and marketing plans were under development in many organizations. A regional testbed network coordinated the testbed operations in most of the organizations. The network often consisted of the hospital district and higher education institutions. National and international cooperation was also frequent.

Repeatability

Assessment of the effectiveness of the tested products or services was not regular in the participating organizations. Instead, the testing was mostly usability testing of the products and services, and the assessment mainly was conducted using qualitative evaluations and cost estimates. Therefore, transparency in reporting was seen as essential from both testbeds' and companies' perspectives.

Contract models

In most organizations, there were existing process descriptions and contract models, which could be tailored case-by-case. In some of the organizations, the testbed processes and contract models were under development. Data and information protection statements were also included in some testbeds' contracts.

Certification and standards compliance

In most organizations, the testbeds did not have certification, such as ISO 10002, nor did they have plans for acquiring certification in the future. However, some acquiring certificates were set as a specific development milestone as well as quality certifications.

Time at the market area

The testbed activities were either user or company oriented. Co-creation of the products and services between the organization and company, especially in the universities of applied sciences, was expected as it was part of their RDI operations. In addition, a continuous discussion and co-creation with companies and other stakeholders were an essential part of the testbed operations. The regional cooperation helped testbeds and companies to find the best facility for testing and co-creation.

Testbeds' low and high-level maturities

Regarding the resources, funding received from projects and staff that included only single coordinators or project leaders was considered low-level maturity. Funding based on business activity and staff that included researchers and health care professionals was considered high-level maturity. Concerning the facilities, testing and simulation labs were considered low-level maturity when real-life environments were considered high-level maturity. In marketing and communications, webpages and social media were seen as low-level maturity and events and networks as high-level maturity. In relation to the repeatability, usability testing and cost estimated were the low-level maturity and effectiveness assessment high-level maturity. Regarding the contract models, non-existing process descriptions and contract models were low-level maturities, while tailorable descriptions and contract models were high-level. In certification and standards compliance, the low-level maturity was no certifications or standards, and the high-level maturity was quality and acquiring certifications and standards. Finally, regarding the time at market area, single testing activities were the low-level maturity, and continuous co-creation was the high-level maturity. (Table 1).

Table 1. Descriptions of the identified low-level and high-level maturity of each factor.

Maturity factor	Description Low-level maturity	High-level maturity
Resources	Funding: projects	Funding: business activity
	Staff: Single coordinators or project leaders	Staff: Researchers, health care professionals
Facilities	Testing and simulation labs	Real-life environments
Marketing and Communications	Webpages, social media	Events, networks
Repeatability	Usability testing and cost estimates	Effectiveness assessments
Contract Models	No process descriptions or contract models	Tailorable descriptions and contract models
Certification and Standards Compliance	No certifications or standards	Quality and acquiring certifications and standards
Time at Market Area	Single testing activities	Continuous co-creation

Discussion

This mapping aimed to report health care testbed activities in Finland and other Nordic countries and describe the maturity of these testbeds. According to the results, testbed activities in the health care and higher education organizations are merging with the daily operations in Nordic countries. At the national level, there was also solid regional cooperation. Health care providers and universities of applied sciences operate in an increasingly dense ecosystem, the so-called one-stop service. The advantage of a centralized service is seen in particular as combining strengths and expertise and reducing bureaucracy.

In all the organizations participating in the mapping, the activities were repetitive, but especially in university hospitals, the activities were still seen as minor or fragmented. There was also some regional specialization in testbed activities, for example, in the areas of imaging, drug development and robotics. Due to regional specialization, the development of national test platform cooperation was highlighted in the interviews. Testbed operations are also increasingly evolving towards business-based operations, especially in the universities of applied sciences sector, but increasingly also among health care providers. In particular, limited resources pose challenges for the development of testbed operations.

The maturity of the testbeds varied. The diversity of testbeds can explain the variation because testbeds in health care is a relatively new concept, especially in Finland. The maturity could have also varied within the testbeds, as some factors, like facilities, were more mature than the others, as resources in certain testbeds. This, instead, could be explained with yet fragmented and unestablished testbed processes. The level of maturity was described using a dichotomous low-high maturity categorization to identify the variation in the maturity levels. Maturity categorization or scoring was also used in previous literature [23], but this mapping emphasis was different as the data were qualitative.

Participating testbed organizations named cooperation and co-creation as strengths in testbed processes. The challenges were limited resources, heavy bureaucracy, varying needs between the company and the testbed organization, and poor preparedness. Testbed organizations emphasized the importance of structured and coordinated processes and activities. Previous literature has also identified problems related to innovation development in health care as health care is a fragmented and complicated context [24].

The organization's primary tasks influenced the priorities of testbed activities in the organization, and therefore the activities may look different when comparing hospitals and universities of applied sciences. For example, in university hospitals, activities are based primarily on patient care, followed by research and education (Figure 1). However, business cooperation is also of growing importance in the public sector.

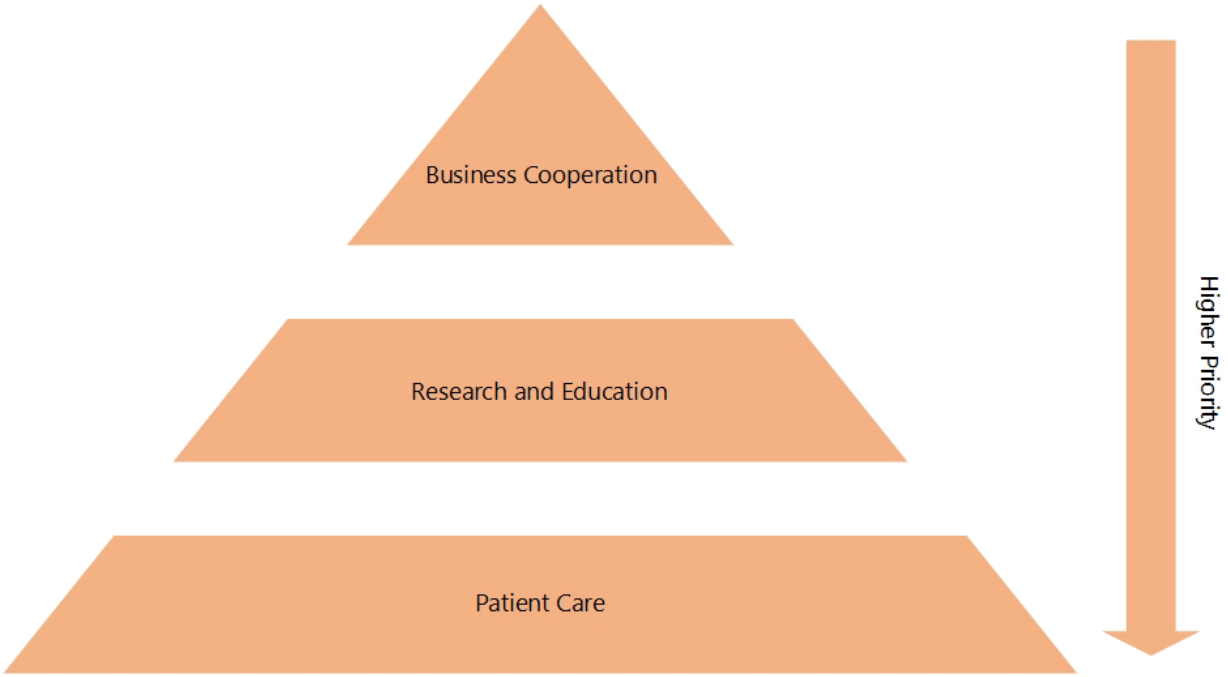

Figure 1. An example of prioritizing activities in organizations that provide health services (e.g., university hospitals).

As discussed earlier concerning brokering health care testbed activities [25], the fundamental problem behind Finnish public-private innovation partnerships in health care is related to the core functions of the provider organizations. In Finland, testbed services are commonly provided either by education institutes or health care service providers, and testbed services are rarely core functions of the organization. These are patient care, teaching or research. This "Structural Problem" [25] needs to be solved if health care testbeds are seen as a permanent element in the Finnish innovation landscape.

Solving this problem calls for structural changes. A good starting point is to investigate organizing health care testbed activities. In other words, what kind of a purchaser-provider model is the most suitable for the Finnish innovation landscape. Unless a) the testbed activities can be regarded as core activities of the provider organization, and b) the provider can benefit from the activities (i.e., make a reasonable profit), a dual model should be put in place.

In a dual model, one organization providers the testbed services. Another one buys them and sells them to the companies that are the end customers. The intermediary organization that operates between the providers and end customers should be a separate legal entity free from the profit-making restrictions on different provider organizations.

The intermediary organization's ownership should be implemented so that it benefits the actual service providers. In this, potential profits are only one part of the equation. The intermediary should take most of the burden related to providing testbed services for itself, which is a lot to bear. Advertising the testbed services, making agreements with the end-customers and the providers, taking care of the entire customer base (incl. after-

sales services, such as customer complaints), etc., rapidly grows the intermediary organization's size. One person can't "staff the stall" that does not sell apples, but health care testbed services provided by higher education institutes, cities, hospital districts, and so on.

Considering the resources needed from the intermediary organization, a viable organization that could meet the challenges of the task could be a national testbed intermediary organization, a "Testbed Finland Ltd.". This way, the intermediary organization could a) pick the best (most mature, available, etc.) services from the national testbed provider portfolio, and b) offer them to a broader audience, such as European SMEs (for example, part of test-before-invest services offered concerning the European Digital Innovation Hubs).

However, a practical challenge arises if the actual implementation of the proposed intermediary organization is considered. In the currently ongoing health and social services reform, the role of the public health service provider organizations – and testbed services provided by them – is unclear, especially from research and development activities. Who organizes these activities, and what constraints are placed on them, are all on the "drawing board".

Strengths and limitations of the study and suggestions for future action

This mapping has some limitations related to its design, data collection and data analysis. Due to the qualitative design of this mapping and the sample size of only twelve testbeds, the results cannot be generalized to a larger perspective of the topic. In addition, the majority of the testbeds were located in Finland, meaning that the results do not represent the whole Nordics. However, the organizations represented different sectors and geographical areas, increasing the study's external validity. The organizations were primarily selected using purposeful sampling, decreasing the validity and generalizability of the results. In addition, the participating organizations had a lot of collaborative testbed activities with other organizations in the same region, which might decrease the validity of the mapping as the activities were partly overlapped. The data were collected and analyzed using previously identified maturity factors. The identification of the factors was not systematic, the interviews were not recorded, and the data were collected and analyzed by only one author, which decreased the internal validity of the mapping.

The mapping was about industry collaboration and was conducted in economic science. Aspects related to patients or care were not addressed during the mapping. The interviewees were informed about the limitations and focus of the mapping at the start of the interviews, and they were allowed to refuse. As the mapping did not include any issues that could have been regarded as sensitive, there was no need for ethical clearance or specific permissions common to the field of healthcare.

As a proposal for further development, regional cooperation should be maintained, and national and international cooperation should be increased. It is also vital to clarify testbed processes and operations for companies. Co-creation between companies and end-users is essential to meet the needs of different stakeholders better. In addition, the marketing of testbeds needs to be developed so that companies can find testbed services. Finally, utilizing multi-professionalism and other competencies in testbed activities is crucial and should be further developed.

Future investigations should focus on the way testbeds are operated on the practical level. For

example, what kind of aspects of a testbed contribute to best practices; what makes a testbed more "mature" compared to others. Understanding "the good and the bad", and the everyday realities of testbeds, are of the essence when solving the typical problems of public-private innovation partnerships (PPIP) in the health care domain.

However, as Hammond et al. [26] discussed, it should be kept in mind that many of these problems are inherently political by nature. It follows from this that many of the issues call for a political solution and maturity on the decision-making level as well. If the decision-making functions – and the underlying rationale – are not mature, it is hard to take corrective measures on a practical level.

Understanding a) the nature of these “wicked” and often self-inflicted problems in decision making, and b) the effect (coupling) they have on the practical level is of the essence. More so, when the entirety of health care research and development activities is developed on a national level.

Acknowledgements

We would like to thank all the participating organizations for their valuable discussion.

Funding

This paper is part of the project Health Campus Turku 2.0 (337640), funded by the Academy of Finland.

Conflict of Interest

The authors declare no conflicts of interest.

References

[1] Seppänen K, Väisänen J, Koivuniemi J, Pesonen K. ELSA – Elinvoimaa älykkäällä sotella. Lappeenranta: ELSA-hanketiimi; 2020.

[2] Haukipuro L, Väinämö S, Torvinen H. End-user Involvement Enhancing Innovativeness in Public Procurement. Evidence from a Healthcare Procurement. J Innov Manag. 2016 4:98-121. https://doi.org/10.24840/2183-0606_004.004_0007

[3] Haukipuro L, Väinämö S, Hyrkäs P. Innovation Instruments to Co-Create Needs-Based Solutions in a Living Lab. Technol Innov Manag Rev. 2018 8(5):22-35. https://doi.org/10.22215/timreview/1156

[4] Verloo H, Lorette A, Rosselet Amoussou J, Gillès de Pélichy E, Matos Queirós A, von Gunten A, Perruchoud E. Using Living Labs to Explore Needs and Solutions for Older Adults With Dementia: Scoping Review. JMIR Aging. 2021 Aug 19;4(3):e29031. https://doi.org/10.2196/29031

[5] Swinkels ICS, Huygens MWJ, Schoenmakers TM, Oude Nijeweme-D'Hollosy W, van Velsen L, Vermeulen J, Schoone-Harmsen M, Jansen YJ, van Schayck OC, Friele R, de Witte L. Lessons Learned from a Living Lab on the Broad Adoption of eHealth in Primary Health Care. J Med Internet Res. 2018 Mar 29;20(3):e83. https://doi.org/10.2196/jmir.9110

[6] Korman M, Weiss PL, Kizony R. Living Labs: overview of ecological approaches for health promotion and rehabilitation. Disabil Rehabil. 2016;38(7):613-9. https://doi.org/10.3109/09638288.2015.1059494

[7] Frow P, McColl-Kennedy JR, Payne A. Co-creation practices: Their role in shaping a health care ecosystem. Ind Mark Manag. 2016;56:24-39. https://doi.org/10.1016/j.indmarman.2016.03.007

[8] Lubis AN, Lumbanraja P, Lubis RR, Hasibuan BK. A study of service quality, corporate social responsibility, hospital image, and hospital value creation in Medan. European Research Studies Journal. 2017;20(4B):125-133. https://doi.org/10.35808/ersj/879

[9] Kauppinen S, Kesäniemi E. Co-creation in the public sector: the CoHeWe case. In: Hirvikoski T, Erkkilä L, Fred M, Helariutta A, Kurkela I, Pöyry-Lassila P, Saastamoinen K, Salmi A, Äyväri A (eds.). Co-creating and Orchestrating Multistakeholder Innovation. Laurea Publications 143. Laurea-ammattikorkeakoulu; 2020 p. 115-122. https://urn.fi/URN:NBN:fi:amk-2020082719893.

[10] Staggers N, Rodney M. Promoting usability in organizations with a new health usability model: implications for nursing informatics. NI 2012 (2012). 2012 Jun 23;2012:396.

[11] Guo C, Ashrafian H, Ghafur S, Fontana G, Gardner C, Prime M. Challenges for the evaluation of digital health solutions—A call for innovative evidence generation approaches. NPJ Digit Med. 2020 Aug 27;3:110. https://doi.org/10.1038/s41746-020-00314-2

[12] Kielo-Viljamaa E, Collanus E, Lahtiranta J, Tuomisto A. Maturity of health care testbeds – A survey from Nordic countries. Abstract at the 26th Finnish National Conference on Telemedicine and eHealth 2021.

[13] Engels F, Wentland A, Pfotenhauer SM. Testing future societies? Developing a framework for test beds and living labs as instruments of innovation governance. Res Policy. 2019;48(9):103826. https://doi.org/10.1016/j.respol.2019.103826

[14] Santonen T, Kjellson F, Andersson K, Hirvikoski T. Developing maturity model for transnational living lab collaboration. In: Bitran I, Conn S, Gernreich C, Heber M, Huizingh KRE, Kokshagina O, Torkkeli Marko (Eds.). Proceedings of the 2020 ISPIM Innovation Conference (Virtual) Event "Innovating in Times of Crisis" held on 7 to 10 June 2020. International Society for Professional Innovation Management; 2020.

[15] Van Looy A, De Backer M, Poels G. Defining business process maturity. A journey towards excellence. Total Qual Manag Bus. 2011;22(11):1119-1137. https://doi.org/10.1080/14783363.2011.624779

[16] ISIXSIGMA. Process Maturity. Definition of Process Maturity [cited 10.1.2022]. Available from: https://www.isixsigma.com/dictionary/process-maturity/

[17] Leavy P. The Oxford Handbook of Qualitative Research. New York, New York: Oxford University Press; 2014. https://doi.org/10.1093/oxfordhb/9780199811755.001.0001

[18] Finlex. Health Care Act (1326/2010). Ministry of Social Affairs and Health, Finland; 2010 [cited 11.10.2021]. Available from: https://www.finlex.fi/en/laki/kaannokset/2010/20101326

[19] Ministry of Social Affairs and Health. Primary Health Care. Ministry of Social Affairs and Health; 2021 [cited 11.10.2021]. Available from: https://stm.fi/en/primary-health-care.

[20] Finlex. Universities of Applied Sciences Act 932/2014. Ministry of Education and Culture; 2014 [cited 11.10.2021] Available from: https://www.finlex.fi/en/laki/kaannokset/2014/en20140932

[21] Einhorn ES. Healthcare in the Nordics. Nordics.info 25 February 2019. Aarhus University; 25.2.2019 [cited 5.1.2022]. Available from: https://nordics.info/show/artikel/healthcare-in-the-nordic-region/

[22] Elken M, Hovdhaugen E, Wiers-Jenssen J. Higher Education in the Nordic Countries - Evaluation of the Nordic agreement on admission to higher education. TemaNord. 2015:526. Copenhagen: Nordic Council of Ministers; 2015. https://doi.org/10.6027/TN2015-526

[23] Milanović Glavan L. An Investigation of Business Process Maturity: Report on Croatian Companies. Business Systems Research Journal 2020;11(2):159-165. https://doi.org/10.2478/bsrj-2020-0022

[24] Hyrkäs P, Haukipuro L, Väinämö S, Iivari M, Sachinopoulou A, Majava J. Collaborative innovation in healthcare: a case study of hospitals as innovation platforms. Int J Value Chain Manag. 2020;11(1):24-41.
https://doi.org/10.1504/IJVCM.2020.105475

[25] Reunanen A, Kontio E, Lahtiranta J. Concurrent Research and Decentralized Decision Making as an Accelerator from Idea to Business – Case Turku Finland. In: "Advances in Human Factors, Business Management and Leadership: Proceedings of the AHFE 2020 Virtual Conferences on Human Factors, Business Management and Society, and Human Factors in Management and Leadership", July 16-20, 2020, USA. Vol 1209. https://doi.org/10.1007/978-3-030-50791-6_26

[26] Hammond J, Bailey S, Gore O, Checkland K, Darley S, McDonald R, Blakeman T. The Problem of Success and Failure in Public-private Innovation Partnerships. J Soc Policy. 2021 Feb 1;1-21. https://doi.org/10.1017/S0047279421000192