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Exploring the Critical Success Factors in Social and Health Care Information Systems Project Procurement

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ABSTRACT

The Finnish government is implementing a welfare reform that involves combining the social and healthcare systems. Several motivations for this change have been identified, the most significant of which are that many information systems are not interoperable, and challenges associated with data management and isolated service offerings. In the government's strategy involves digitalising to address these challenges. This paper outlines the landscape of the reform and discusses the architecture choices and critical success factors of the proposed digitalisation process. The enterprise architecture is applied to the largest county, which comprises over 1,900 social service and healthcare-related information systems. The target is to design a single joint system with a maximum of 300 supporting information systems resulting in 3 billion EUR in savings. The findings are presented as six primary empirical conclusions.

Keywords: Healthcare reform; welfare system; enterprise architecture; information systems; data driven; critical success factors.

1. INTRODUCTION

Finland's recent welfare reforms are paving the way to combine the country's social and healthcare systems. A robust and cost-effective system will need to be implemented to enable municipalities to run the service and citizens to utilize it. As in other Nordic countries, Finland's current social and healthcare system and local government services are operated under at the municipality level administration; some municipalities have very small populations. One-third of the country's 5.5 million inhabitants live in Helsinki-Uusimaa region.

The planned regional reform will create 18 larger counties instead of current 295 municipalities, which are responsible for organizing all social services and public health care in their area. The reform seeks to provide a modern, cost-effective public administration that serves all inhabitants. It will ensure key services and streamline transactions, and help to bridge a large part of the sustainability gap in general government finances. The government aims to save EUR 10 billion, of which approximately EUR 3 billion should be covered by the reforms in the branch of government of the Ministry of Social Affairs and Health [1]. However, the factors behind this positive development – improving cyclical conditions, privatization and enterprise restructuring and lower debt servicing costs, for example – are unlikely to exert the same influence going forward [2].

The authors' previous analysis of the system entity and related enterprise architecture (EA) modeling has been published in [3]. This paper extends previous research with an empirical analysis designed to identify the critical success factors in the case counties.

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Building an integrated system is a complex task, given the large amount of dependencies and number of non-integrated systems. As digitalization has progressed, a number of steps in the right direction have been made. For instance, patient data in the Finnish healthcare system is now 100% digitalized. In public hospitals, electronic patient record availability has been 100% since 2007. In public primary health care centers, this threshold was reached in 2010 and in private health service providers even earlier than that. Delivering good quality care is a complex endeavor that is highly dependent on patient information and medical knowledge [4,5,6]. Patient information created by health care service providers is transferred to the National Patient Data Repository, KANTA [7], to which all public and private healthcare providers are linked. The KANTA data archive stores and transmits providers' medical records; the central repository contained more than 600 million documents as of 12/2016. In addition, electronic prescriptions have been mandatory since the beginning of 2017. Approximately 5.35 million ePrescriptions are issued monthly, for a total of 170 million to date [8].

Several prior studies have assessed healthcare IT reform [9,10,11,12,13,14]. However, these studies have generally been qualitative and do not describe the complexity of the field in terms of concrete data regarding the systems and their connections. Our research aims to describe critical success factors for public IT system development programs and to demonstrate the complexity of social and healthcare information systems using a case study of an actual system configuration.

In this article, we focus on the information systems used in Helsinki-Uusimaa region in the areas of social service and healthcare. We examine the factors that contributed to the high rate of failure of public sector information system projects in a case county and how systems can be classified. We identify systems that have been replaced by the Epic system [15] delivered by the Apotti project, thus reducing the number of parallel systems.

2. RELATED WORK

2.1 Critical Success Factors

Several studies have examined why IT projects fail repeatedly [16,17,18,19,20]. Rosacker [21] identifies ten factors that are critical to the success of project implementation, which are listed in Table 1.

Table 1. Critical success factors in project implementation

Factor	Description
Project mission	Clear statement of goals and objectives
Top management support	Necessary resources and authority present
Client consultation	Communication, consultation and active listening to all stakeholders
Schedule/plan	Detailed specification of actions required for project implementation
Personnel	Recruitment, selection and training of necessary team personnel
Technical tasks	Availability of required technology and expertise
Client acceptance	The act of selling final projects to their ultimate intended users
Monitoring and feedback	Timely provision of an appropriate network and necessary data to all key actors
Communication	Appropriate network and necessary data to all key stakeholders in project implementation
Troubleshooting	Ability to handle unexpected crises and deviations from plan

These success factors are widely accepted, and enterprise-wide design is agreed to be the key determinant of project success. But there is also a human factor in the development process – usability – that needs to be considered.

It is not enough to make the systems work with each other; their usability and availability must also consider their internal and external end users, as well as their specific needs [22]. This is still a valid problem. An example is the design of digital services for the elderly. Public digital services are often

acquired by people who are unfamiliar with the complexity of the requirements. Even full-time professionals may find it difficult to keep up to date in this field [23].

2.2 EA – An Essential Element of Implementing the Finnish Regional Reform

Information and communications technology (ICT) reforms in support of larger public sector reform have been ineffective and unsustainable in the past, although many ICT reforms have been successful in a narrower context. EA is an important tool for reducing information management silos that successive governments have unsuccessfully tried to decrease. EA can be used as an approach to ICT governance, but it can also be applied as a more wide-ranging and strategically oriented method to serve growing organizational needs [24,25,26].

Effective communication is essential in sharing knowledge, achieving a common understanding, agreement and a shared view of the EA scope, vision, and objectives, and of the developed models and other artifacts. EA is a structured view of a functional entity that includes the relations, dependencies, principles and guidelines [27]. It forms part of an organization's strategic work, management process, and financial and operational planning. Communication is an important means of obtaining a commitment to the EA effort [28].

In Finland, the use of EA has recently been mandated by the newly passed Act on the Direction of Public IT Governance [29]. EA has been promoted as a key tool for transforming and modernizing government [30]. EA work follows the enterprise architecture method, Public Administration Recommendation JHS179 [31], which is based on the international, open and most widely used EA framework, TOGAF® [32]. JHS179 provides information management guidelines for public administration, both governmental and municipal. The JHS179 system aims to improve the interoperability of information systems and the compatibility of data within them, and to facilitate cross-sector process development and more efficiently use existing data.

Table 2 describes the classification of social and healthcare information systems [33]. Information systems that are intended to be attached directly to KANTA services are classified as category A systems. Supporting information systems used in social and healthcare are classified as category B.

Table 2. Classification of information systems

Category	Connection to KANTA	Examples
A	Directly connected	Patient data information systems, social service data systems, oral healthcare data systems
B	Not connected	Specialized hospital systems, patient classification systems, laboratory systems, X-ray archive, analytics

3. STUDY 1: EMPIRICAL STUDY

This case study is designed to determine what factors contribute to the high rate of failure of public sector information system projects in a given county. Semi-structured interviews were chosen as the primary data collection method. We interviewed ten experts in a mid-sized city in Southern Finland to find out if an important underlying problem could be identified. The interviewees were asked to identify the most important determinants of success and failure in their experience concerning public sector information systems. The interviews lasted 30–45 minutes. The data were analysed with the assumption that the interviewees are trustworthy experts and that their comments reflect their experience. The interviews were transcribed in a way that relies on the authors' interpretation. The key findings are presented as **primary empirical conclusions (PECs).**

"There is a lack of expertise in making contracts…large systems require specialized expertise that is not available enough." (**I1 – Chief Information Officer**)

"The commitment of the necessary resources for both the preparation and implementation of the procurement is important." (**I6 – Director of Nursing**)

"The overall picture and consideration of the enterprise architecture is lacking in procurements that are procured on a substance-by-substance basis." (**I5 – Director of Dental care**)

PEC1 The system must have a clear owner who is equipped with an adequate budget that includes the necessary resources. The project owner should systematically follow the project and address any shortcomings as they arise.

We found that the most important problem was the unsystematic allocation of responsibility for the product development process, which has led to problems in leadership, requirements engineering, resource allocation and communication as projects have progressed. The operational mode is tailored to a stable or minimally growing system. The municipalities are not well equipped to work in rapidly changing dynamic environment.

"Acquiring a new information system should have an evaluation system to ensure benefits and usability, this is expertise. Systematic decision making for a longer period of time. A small acquisition can be made quickly, but larger information system acquisitions must be implemented systematically." (**I3 – ICT Development manager**)

"When purchasing a new system, the criteria for evaluating the system and the benefits to be obtained should be defined in advance." (**I4 – Lawyer**)

"In acquisition, it is important to see and identify the whole, which is an almost overwhelming task today because there are so many parts. It is not necessarily important knowing the all details, but important is understanding the goal." (**I6 – Director of Nursing**)

"Procurement law is really rigid and strict; it is ill suited to information system procurement. Information technology is a rapidly changing and evolving field. There will be a lot of changes and updates to social and health care information systems. Legislation imposes requirements, including restrictions on personal data and other laws. Coordinating legislation and information systems is challenging." (**I8 – ICT Designer**)

"Because the budget is tight, only the required minimum is made." (**I9 – Client manager, vendor 1**)

PEC2 Public sector operating environment and tendering rules are very strictly regulated by the Procurement Act, which poses challenges for fast-paced information system development.

The public sector environment, such as tendering regulations and its processes, is rigid, time consuming and cumbersome to organize. Successful tendering is very challenging. Technically and economically, the best solution may not win the tender if the tender is not well defined. Tenders often lead to a complaint to the Market Court, which further delays the project.

"Municipalities are in a forced marriage with a supplier. To add a third-party system of current systems causes an awful amount of work." (**I10 – Service manager, vendor 2**)

"Being tied to one supplier and system, breaking out of it is a big and expensive project." (**I2 – ICT Development manager**)

"The overall picture and consideration of the enterprise architecture is lacking in procurements that are procured on a substance-by-substance basis." (**I5 – Director of Dental care**)

PEC3 Vendor lock-in forces municipalities to use a certain product or service, regardless of its quality, because switching away from it can be challenging, and the switching costs may be substantial.

A small number of suppliers in Finland dominate the public sector information system field. Information systems are tailored to a specific municipality, and even products from the same system supplier may not be compatible with each other but require a lot of integration. System suppliers take advantage of the rigidity of legislation and the bidding process, making it almost impossible for municipalities to switch systems without high costs and time-consuming procurement processes.

"The statistical system is very difficult to master; the trainings were completely detached from everyday reality." (**I3 – ICT Development manager**)

"The end user's view has not been taken into account in the design of the systems." (**I5 – Director of Dental care**)

"In the health care division, we work with people. Information technology is just a tool for working with people and a tool for measuring cost effectiveness." (**I10 – Service manager, vendor 2)**

PEC4 A lack of practical expertise during the planning and definition phases of information system projects affects the quality of the outcome.

The planning phase of information systems should also consider the system's usability in operational activities. Interview data show that public digital services are often designed by people who are unfamiliar with the practical operations and processes. It is important that operational experts from the field are involved and their input is taken into account in the definition stage.

4. STUDY 2: HELSINKI-UUSIMAA REGION CASE

The second study is based on an actual systems configuration evaluation. We employ a case study to demonstrate the complexity of social and healthcare information systems.

The country's largest region is Helsinki-Uusimaa. It is situated on the south coast of Finland and is home to around 1.7 million inhabitants, or about 30% of the country's total population. The social and healthcare services of 26 municipalities and specialized medical care from HUS (Hospital District of Helsinki and Uusimaa, Helsinki University Hospital) and about 55,000 employees will be transferred from the region to the new county to be formed. The Epic system delivered by the Apotti project has been selected as the social services and healthcare system supplier for a large part of the region. Apotti is an extensive Finnish change project in the social services and healthcare field. The project is building the world's first information system to integrate social and healthcare services [34].

In early 2017 the Helsinki-Uusimaa region council set up the Uusimaa2019 program [35], which contains two tracks. The first (main) track focuses on operational changes, service concept development, and ramping up social and healthcare services. The second track is an ICT project that aims to build ICT functionalities, information systems and infrastructures that are needed to run services that the region will provide. Due to a political decision-making process, the project was suspended in 2019 and put under new political preparation. New social and healthcare reform is scheduled to enter political decision-making in the fall of 2020.

A typical medium-sized municipality in Helsinki-Uusimaa region has about 100 information systems, approximately 20% of which are social and healthcare systems. Fig. 1 shows the information system map for the city of Kerava, a medium-sized municipality with 35,000 inhabitants located in the middle of the region. The system map illustrates the impact of the reform on the city's information systems portfolio. Kerava has 95 systems, 18 of which are social and healthcare systems, including 3 category A systems. Information systems are classified and visualized according to operational units, as each unit has its own budget to cover the purchase and maintenance of systems.

Classifying systems according to operational units clearly illustrates which services, related information systems and interfaces are going to Helsinki-Uusimaa region. The city of Kerava has five operational units – Social and Healthcare services, Education services, Culture and Sports, City Infrastructure, and Administration. In the upcoming reform, all social and health care services will be transferred to the region, and the systems used to produce the services will be removed from the municipal information system portfolio. Information systems are connected with various application and system interfaces. For instance, Patient Data Management Systems are a critical information system with nine interfaces to other systems. The Financial Management system has interfaces to 13 different systems. The problem is if one system is changed, it will affect a number of other systems. All municipalities have a different set of systems and integrations.

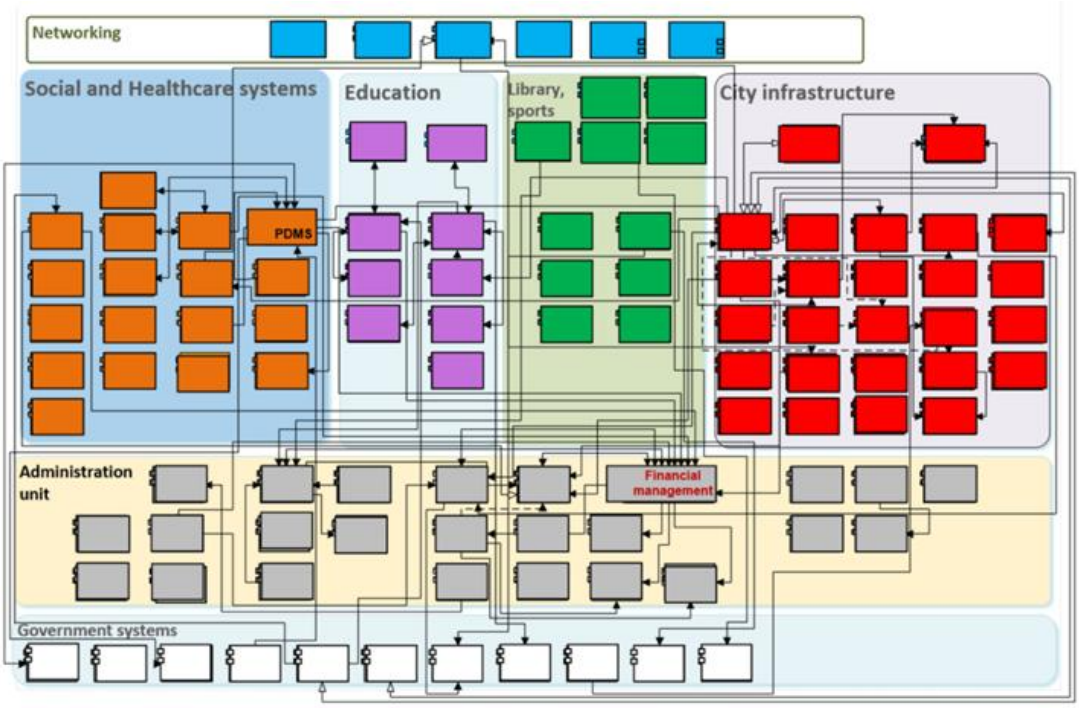

Fig. 1. Information systems map for Kerava, a typical medium-sized municipality

The ICT project started in spring 2017 with a pre-screening phase. The target of this phase was to find out what kinds of information systems municipalities are using in social and healthcare services. The survey was conducted with a questionnaire addressed to municipalities, which was used to identify which systems they use for social and healthcare services. The results of the pre-screening survey show that municipalities are currently using 1,902 different information systems, 43,000 workstations, 10,700 mobile devices (tablets, etc.), 1,250 servers and over 6,400 networking devices. There are large number of critical social service and patient data systems (category A). The problem is that the same information system has been tailored to municipality-based versions, causing uneven data structures; migration will require special attention and extra work. Category A information systems will be replaced by the Epic system delivered by the Apotti project. Epic will also replace most of the social and healthcare services supporting information systems that are not directly connected to KANTA (category B). The aim of the reform is to reduce the number of systems in use. After the reform, there will be one class A system and 100–300 general and social and health care support systems. Specialized hospital systems will mainly remain; only a small fraction of those systems can be replaced with Epic. Epic was launched in November 2018 in the city of Vantaa and is gradually being rolled out to other municipalities.

In autumn 2017 the ICT project was rolled out to sub-areas whose mission was to form detailed plans for project implementation. ICT projects followed EA guidelines and the ICT roadmap that was created was based on the JHS179 system. The ICT project is time critical. Risk management is an important element of project planning, particularly due to the scale of the project. This very comprehensive reform directly affects 55,000 people. When completed, the region will be the largest employer in Finland.

The risks will be shared to cover the operating environment, technologies, organizations, timetable, budget and system vendors. Approximately 80 detailed risks are regularly evaluated during the project. The two largest risks – legislative incompetence and the size and complexity of the project – are out of the project's control; changes will affect the entire project's structure and schedule. The project involves dozens of organizations and system vendors, as well as hundreds of different information systems that will be integrated with or replaced by Helsinki-Uusimaa region systems. Individual employees' personal IT capabilities are difficult to take into account during the risk

evaluation phase of the project. For example, the Epic system requires end users to complete an average of 2 days of certification training, which will require a total of over 110,000 training days in the Helsinki-Uusimaa region area.

Table 3. Information systems classification (2018)

Category A			Category B		General
Health care	**Oral health care**	**Social service**	**Specialised hospital systems**	**Social and healthcare supporting systems**	**HR, payroll, logistics, CRM, financial management**
6	3	5	536	476	876

PEC5: Delays in political decision-making lead to delays in social and health care reform, which further complicates the information system design due to changing priorities and goals.

The first attempt at social and health care and regional reform started in 2006. Since then, various governments have put forward their own solutions.

PEC6: The development of a unified EA for the whole region is critical to the success of the social and health care reform.

Municipalities in the area have hundreds of information systems with cross-integration and data models. The information system reform required by the change is a very challenging task; a unified EA will be key to solving the problem cost effectively.

5. CONCLUSIONS

This study and previous efforts demonstrate the important role that system design architecture plays in the technical context. Furthermore, architecture documentation serves as an elementary tool in communicating with vendors, decision-makers, users and the rest of the community including municipalities and cities.

This paper has described critical success factors and findings. Legacy information systems in the healthcare and social care fields are the key limiting factor in combining the systems as part of the country's welfare reform. Difficulties associated with integrating these systems have limited the pace and extent of the reform.

Future research could explore a scenario in which this legacy constraint is lifted when the system can be built from scratch. An interesting case study could be developing markets, for example in Africa, where the opportunity space in this respect allows more flexibility and grounds for innovation. The frugal innovation opportunity is another trend that could be examined in future work [36]. First steps in this direction have been taken by the AiRRhow alliance, which explores opportunities in Namibia together with local authorities and actors [37].

This paper discusses the critical success factors associated with a complex multiple provider domain with a considerable legacy. So far, the legacy systems have served the Finnish nation well. Understanding the limits of the new system will pave the way for developing the next level of services and innovations.

The social and healthcare system chosen will impact a large number of individuals who form part of the end-to-end process, including the professionals and users or customers. The change should improve the experience of individuals involved in all aspects of the process by exploiting the potential advantages of digitalization, which is fundamentally changing traditional mechanisms and ways of working. Part of the solution is based on customers using electronic self-service tools. The professionals would utilize new digital interfaces that would provide added value that is integrated across the domains and contains accurate, up-to-date information provided by an end-to-end EA system. The basic building blocks of the reform are Data Lake and Data Warehouse solutions that can be used to process large amounts of raw data in operational use, service optimization and for research purposes.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Regional Reform. Ministry of Social Affairs and Health; 2018. Available:http://alueuudistus.fi/en/general-information/presentations
2. Curristine T, Lonti Z, Joumard I. Improving public sector efficiency: Challenges and opportunities. OECD Journal on Budgeting. 2007;7(1):1-41.
3. Vilpponen H, Grundström M, Abrahamsson P. Combining social service and healthcare as the first country in the world: Exploring the impacts on information systems. Journal of Advances in Information Technology. 2018;9(4):84-88. DOI: 10.12720/jait.9.4.84-88
4. Bose R. Knowledge management-enabled health care management systems: Capabilities, infrastructure and decision-support. Expert Systems with Applications. 2003;24(1):59–71.
5. Rezazadeh E, Hachesu RR, Rezapoor A, Aliereza K. Evidence-based medicine: Going beyond improving care provider viewpoints, using and challenges upcoming. Journal of Evidence-Based Medicine. 2014;7(1):26-31.
6. Rexhepi H. Improving healthcare information systems: A key to evidence based medicine. Doctoral Dissertation, University of Skövde; 2015.
7. Kanta. The National Patient Data Repository; 2018. Available:http://www.kanta.fi/en/web/ammattilaisille
8. Korhonen I, Ermes M, Ahola J. Technical Research Centre of Finland. VTT T304 Strategic Research Agenda (SRA) on Finnish Innovation Hub for Artificial Intelligence for Health (AI for Health); 2017. ISBN: 978-951-3862-5.
9. Magnussen, Jon, et al. Nordic health care systems: Recent reforms and current policy challenges. McGraw-Hill Education. ProQuest Ebook Central; 2009.
10. Thorpe JH, Gray EA, Cartwright-Smith L. Show us the data: The critical role health information plays in health system transformation. The Journal of Law, Medicine & Ethics. 2016;44.
11. Helfert M. Challenges of business processes management in healthcare: Experience in the Irish healthcare sector. Business Process Management Journal. 2009;15(6):937-952.
12. Mäenpää T, Suominen T, Asikainen P, Maass M, Rostila I. The outcomes of regional healthcare information systems in health care: A review of the research literature. International Journal of Medical Informatics. 2009;78(11):757-771.
13. Jensen TB. Design principles for achieving integrated healthcare information systems. Health Information Journal. 2013;19(1):29-45. DOI: 10.1177/1460458212448890
14. Buntin MB, Jain SH, Blumenthal D. Health information technology: Laying the infrastructure for national health reform. Health Affairs. 2010;29(6). DOI: 10.1377/hlthaff.2010.0503
15. Epic Systems; 2018. Available:https://www.epic.com
16. Cooke-Davis T. The 'Real' success factors on projects. International Journal of Project Management. 2002;20:185–190.
17. Wateridge T. IT projects: A basis for success. International Journal of Project Management. 1995;13(3):169-172.
18. Heeks R. Health information systems: Failure, success and improvisation. International Journal of Medical Informatics. 2006;75(2):125-137.
19. Stacie P, DeLone W, McLean E. Measuring information systems success: Models, dimensions, measures and interrelationships. European Journal of Information Systems; 2008. DOI: 10.1057/ejis.2008.15
20. Rosacker KM, Olson DL. Public sector information system critical success factors. Transforming Government: People, Process and Policy. 2008;2(1):60-70. DOI: https://doi.org/10.1108/17506160810862955
21. Jeffries R, Desurvire H. Usability testing vs. heuristic evaluation: Was there a contest? ACM SIGCHI Bulletin. 1992;24(4):39-41.

22. Vilpponen, Human System Interaction HSI 2020, June 6-8; 2020. DOI: 10.1109/HSI49210.2020.9142655
23. Buss TF. IT and enterprise architecture in US public sector reform: Issues and recommendations. Enterprise Architecture for Connected E-Government: Practices and Innovations; 2012.
24. Hjort-Madsen K. Institutional patterns of enterprise architecture adoption in government. Transforming Government: People, Process and Policy. 2007;1(4):333-349.
25. Seppänen V. From problems to critical success factors of enterprise architecture adoption. Dissertation, Jyväskylä University, Springer-Verlag, London. 2014;368–394. ISBN: 978-951-39-5941-8.
26. Ylimäki T. Potential critical success factors for enterprise architecture. Journal of Enterprise Architecture. 2008;2(4).
27. Lemmetti J, Pekkola S. Understanding enterprise architecture: Perceptions by the Finnish public sector. In: Scholl H.J., Janssen M., Wimmer M.A., Moe C.E., Flak L.S. (Eds) Electronic Government. EGOV 2012. Lecture Notes in Computer Science, vol 7443. Springer, Berlin, Heidelberg; 2012.
28. Enterprise Architecture in Public Sector, Ministry of Finance; 2018. Available:http://vm.fi/en/enterprise-architecture-in-public-sector
29. Hjort-Madsen K, Pries-Heje J. Enterprise architecture in government: Fad or future? 42nd Hawaii International Conference on System Sciences – 2009, HICSS '09.
30. JHS179; 2018. Available:http://www.jhs-suositukset.fi/web/guest/jhs/recommendations/179
31. TOGAF; 2018. Available:https://www.opengroup.org/togaf
32. Valvira. National Supervisory Authority for Welfare and Health; 2018. Available:http://www.valvira.fi/web/en
33. Apotti Project; 2018. Available:http://www.apotti.fi/en/oy-apotti-ab-2
34. Uusimaa2019 Program; 2018. Available:https://www.uusimaa2019.fi/uusimaa2019.fi
35. Ministry of Social Affairs and Health. Press release 67, Government proposes to increase freedom of choice in health and social services; 2017. Available:http://stm.fi/en/article/-/asset_publisher/hallitus-esittaa-laajaa-valinnanvapautta-sosiaali-ja-terveyspalveluihin
36. Weyrauch T, Herstatt C. What is frugal innovation? Three defining criteria. Journal of Frugal Innovation. 2017;2:1. Available:https://doi.org/10.1186/s40669-016-0005-y
37. AiRRhow Alliance, Aviation Center of Know-how – Helicopter Emergency Medical Services. (Retrieved June 2, 2020) Available:https://www.airrhow.fi

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